

# The Effectiveness of a Motivational Signage as a Natural Experiment in Promoting Physical Activity in a University Setting: Program Evaluation using a Logic Model

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**Abstract:** Physical inactivity is an emerging problem which is prominent in university settings. A program which promotes stair climbing could help to reduce the problem of physical inactivity in a university. A recent systematic review suggested the usefulness of motivational signage for promoting stair climbing. While the randomized and controlled trial is difficult to conduct for evaluating the implementation of motivational signage, natural experiment using a logic model was conducted to evaluate the effectiveness of a motivational signage program in a university building. **Methods:** A logic model was developed to conduct program evaluation. A questionnaire was developed based on the logic model. A survey using the questionnaire was conducted to examine visibility of the signage, readability of the signage, the influence of the signage on the choice of stair use, awareness of the benefits of using the stairs, encouragement to use the stairs, and opinion about the importance of the motivational signage. Descriptive statistics and calculation of the odd-ratio were conducted to report the data. **Results:** Most of the research respondents were female (56%), students (76%), and current stair users (74%). The motivational signage in this study resulted in excellent visibility and readability, 71% and 72% respectively. However, most of the visitors who had ever seen the signage still felt that it did not influence their choice (71%). Students were 10 times less likely to see the signage and 3 times less likely to read the signage than staffs. The readability of the signage was also associated with the influence of the signage on the choice of using the stairs (Odd ratio 2.78 95% Confidence interval 1.13 to 6.82). **Discussion:** Motivational signage could influence the stair use behavior in a university building. There were several suggestions to improve the effectiveness of motivational signage in promoting physical activity in a university setting. Future program evaluation should have a more rigorous design by measuring the baseline data and observing an identical building as a control.

## 1 INTRODUCTION

Physical inactivity is an emerging global problem. It is the fourth leading risk factor of mortality worldwide (World Health Organization, 2009). While 27.5% of adults were physically inactive (World Health Organization, 2018), the problem of physical inactivity was more prominent in university settings. In a UK university, 42% of employees did not engage in a recommended amount of physical activity (PA) (Cooper & Barton, 2015). Moreover, more than 60% of employees in an Indonesia university had a low cardio respiratory fitness level, which represented a lack of physical activity (Wibowo, Wasityastuti, & Sofro, 2019). Similar

problems were found among university students. A recent systematic review found that almost half of the university students were physically inactive (Keating et al., 2005). Investing in physical activity promotion in a university setting could result in beneficial effects for both employees and students. British Universities & Colleges Sport (2018) found that the promotion of regular physical activity among university students could improve personal wellbeing, mental wellbeing, academic attainment, perceived social inclusion, and perceptions of employability. A Cochrane Systematic Review conducted by Freak-Poli et al., (2013) also found that workplace physical activity intervention improved employees' health parameter, quality of life, and worksite injury. Therefore, a program for

promoting physical activity in a university setting could be a beneficial investment. A program which promotes stair climbing could help people reach the recommended amount of physical activity. Since stair climbing is classified as a vigorous-intensity physical activity (Ainsworth et al., 2011), the amount of that kind of PA needed to reach the guideline is lower than moderate-intensity PA, such as walking. Recent systematic reviews suggested that motivational signage could increase stair climbing in worksite settings, including university settings (Bauman et al., 2017; Bellicha et al., 2015; Jennings et al., 2017; Soler et al., 2010). Thus, several universities implemented motivational signage program to promote stair climbing. While the randomized controlled trial is considered the gold standard for evaluating the effectiveness of interventions, this type of studies is difficult to conduct in human behavioral research, especially in policy or built environment evaluation. Ramanathan et al. (2008) suggested that natural experiments could be conducted to evaluate changes in policy or built environment. In natural experiments, policy or program are often delivered before baseline data are collected. To evaluate the program, a logic model could be developed to demonstrate how the program will contribute to the outcome. This study aims

to provide an evaluation of a motivational signage program in a university building. A logic model was developed to evaluate the effectiveness of motivational signage in promoting stair use, and to identify elements of the motivational signage program which will contribute to the increase of stair use.

## 2 METHODS

This study has been approved by the Moray House School of Education Ethics Committee on 21 March 2019.

### 2.1 Development of the Logic Model

The logic model was developed to evaluate the effectiveness of the motivational signage in a reverse approach. This development was started by answering the question “What must happen in order to achieve the outcome?” Then, it was continued by answering this question, which adapted in each stage until a chain connected the program and the outcome (Figure 1).



Figure 1: Logic Model of the Motivational Signage for Promoting Stair Use.

This chain is influenced by the current stair use behavior, occupation, and gender since it was hypothesized that these factors could interfere with the process and the outcome. Then, a questionnaire was developed based on this logic model to investigate the current stair use behavior, and to explore the visitors’ perception of motivational signage, including their perception on the visibility and readability of the signage, influence of the signage on their awareness of the benefits of stair use, encouragement to use the stairs, and their decision to use the stairs. Finally, the visitors’ opinion about the importance of the motivational signage was also assessed.

### 2.2 Participants and Measurements

A survey was conducted using a questionnaire in a printed or digital version on a working day at a

University building. All visitors were included to the building except those who were pregnant or carried bulky goods. Then, their baseline characteristics were collected, including gender, occupation, and current stair use behavior. A single question was employed to examine each measurement. Thus, there were six questions related to the visitors’ perception.

1) **Visibility of the motivational signage:** The visibility of the signage was assessed by asking the visitors if they see the signage (“Did you see the signage?”, anchored with “Yes” or “No”). If they did not see the signage, the readability of the signage was not asked to them. However, the question went directly on their perception of the influence of the signage on their choice to use the stairs.

2) **Readability of the motivational signage:** To the visitors who saw the signage, the readability of the signage was asked by the question “Did you ever read the signage?” anchored with “No,” “Not

really,” “Not sure,” “Yes briefly,” and “Yes in detail.”

3) **Perceived influence of the motivational signage on the awareness of the benefits of using the stairs:** The visitors’ perceived influence of the motivational signage on the awareness of the benefits of stair use was examined using a question “Did this make you aware of the benefits of using the stairs?” This question scored using Likert Scale from 1=“Not at all” to 5=“very aware.”

4) **Perceived influence of the motivational signage on the encouragement to use the stairs:** The visitors’ perceived influence of the motivational signage on the encouragement to use the stairs was assessed using a question “To what extent, does the signage encourage you to use the stairs?” (on a scale from 1=“not at all” to 5=“strongly encouraged.”)

5) **Perceived influence of the motivational signage on visitors’ choice in using the stairs:** A question “Do the signage influence your choice of stairs or lift?” was used to assess the visitors’ perceived influence of the motivational signage on their choice in using the stairs. This question was anchored with “not at all,” “not really,” “not sure,” “yes a bit,” and “yes very much.”

6) **Visitors’ opinion about the importance of the motivational signage:** This item was assessed by asking the visitors if they thought that the signage was important (Was the signage important?) on a scale from 1=“not at all” to 5=“very important.”

### 2.3 Analysis

The participants’ gender, occupation, current stair use behavior, visibility of the signage, readability of the signage, influence of the signage on the choice of stair use, awareness of the benefits of using the stairs, encouragement to use the stairs, and opinion about the importance of the motivational signage were descriptively analyzed using frequency counts.

Odds ratios were calculated to examine how much the possibilities of the motivational signage could differ between students and staffs, as well as between genders and current stair use behavior, and how much the possibilities of the influence of the signage on visitors’ choice in using the stairs could differ between students and staffs, as well as between genders and current stair use behavior. The impacts of the signage visibility and readability on the influence of the signage on visitors’ choice in using the stair were also examined using the odds ratio. Categorical data of the readability of the signage were transformed into a dichotomous variable (“No,” “Not really,” “Not sure” were

transformed into “No,” and “Yes briefly,” “Yes in detail” were transformed into “Yes”) to allow odds ratio calculation. The influence of the signage on the choice of stair use was also re-categorized into a dichotomous variable (“Not at all,” “Not really,” “Not sure” were transformed into “No” and “Yes a bit,” “Yes very much” were transformed into “Yes”).

## 3 RESULTS

The data from 221 respondents were collected. It was found out that most of the respondents were female (56%), students (76%), and current stair users (74%). Seventy-one percent of visitors to the building had ever seen the motivational signage before the survey was conducted. Almost all of the staffs had ever seen the signage (94.3%), but there were only a few students (63.7%) who had ever seen the signage (Figure 2).

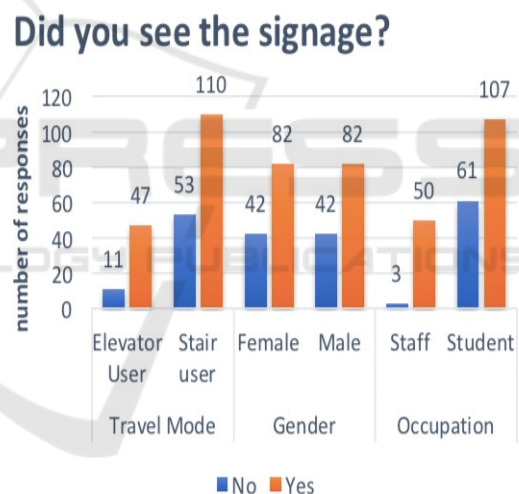


Figure 2: Visibility of the motivational signage.

Among the visitors who had ever seen the signage, more than half read the signage (50.5% read briefly, and 15% read in details). The proportion of visitors who did not read the signage was almost similar between groups (occupation, gender, current stair use behavior) (Figure 3). Most of the visitors who had ever seen the signage felt that the signage did not influence their choice of using the stairs (71%) (Figure 4).

### Did you read the signage?

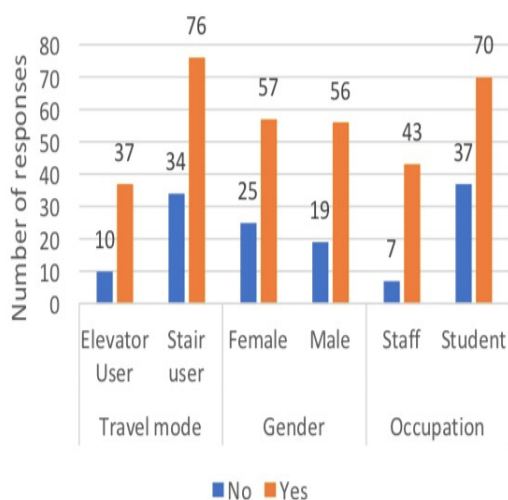


Figure 3: Readability of the motivational signage.

influence of the signage on the choice of using the stairs (Yes vs. No OR 2.78 95% Confidence Interval 1.13-6.82) (Table 2).

Table 1: Odds of seeing and reading the signage between students and staffs.

	Number of visitors (%)	Odds Ratio (95% Confidence Interval)	
Outcome	Students	Staffs	
Saw the signage	107(63,7%)	50 (94.3%)	0.1 (0.03 to 0.35)
Read the signage	70 (65.4%)	43 (86%)	0.3 (0.12 to 0.75)

### DO THE SIGNAGE INFLUENCE YOUR CHOICE OF STAIRS OR LIFT?

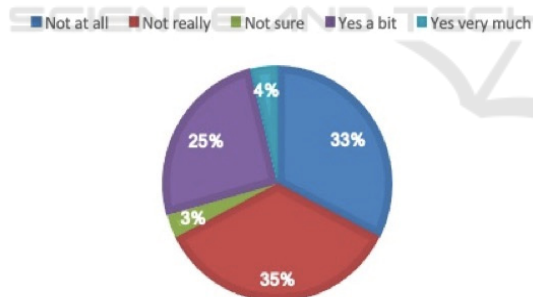


Figure 4: Influence of the motivational signage on visitors' choice.

Table 2: Odds of influenced by the signage.

	Number of visitors (%)	Odds Ratio (95% Confidence Interval)	
Outcome	Read the signage	Did not read the signage	
Influenced by the signage	39 (34.5%)	7 (15.9%)	2.78 (1.13 – 6.82)

Based on the odds ratio calculation, gender and current stair use behavior were not associated with different visibility of the signage, but the occupation was associated with different visibility (students vs. staffs OR 0.1 95% CI 0.03-0.35) (Table 1). Gender and current stair use behavior were also not associated with the readability of the signage, but visitors' occupation was associated with that parameter (students vs. staffs OR 0.3 95% Confidence Interval 0.12 - 0.75) (Table 1). The readability of the signage was associated with the

All visitors were asked about their opinion on the motivational signage. Only minority of the visitors felt that the motivational signage raised their awareness of the benefits of stair use behavior (37%) and encouraged them to use the stairs (21%). However, almost half of the visitors thought that the motivational signage is important (41%) (Figure 5).



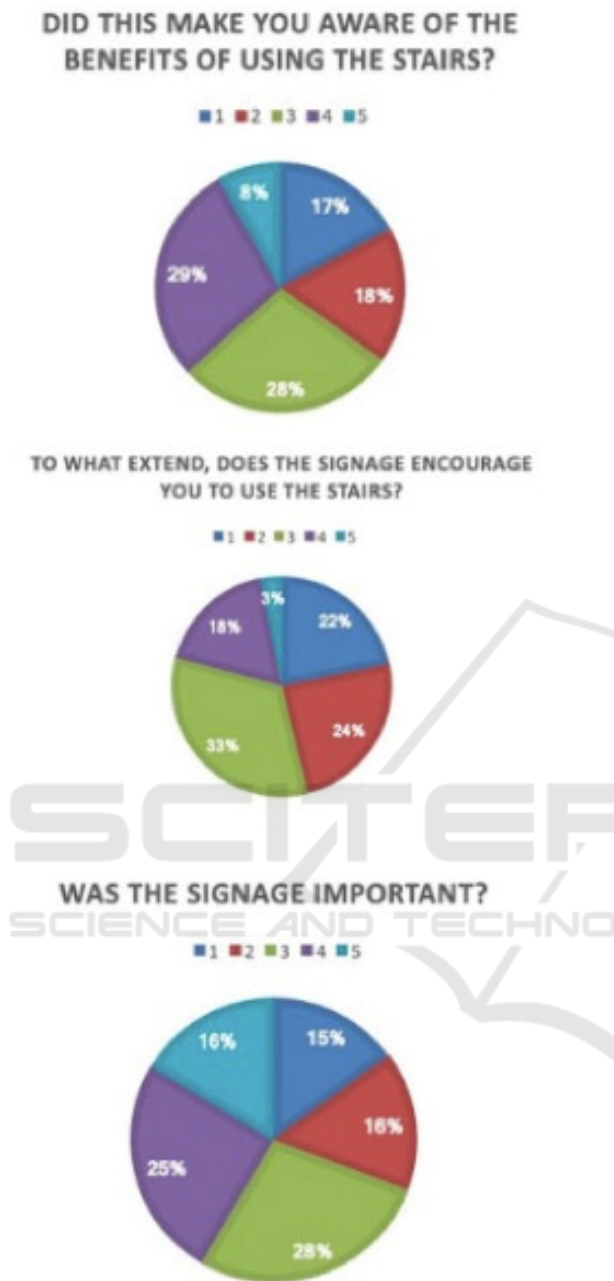


Figure 5: Visitors' opinion.

## 4 DISCUSSION

From the data analysis, it was found that currently, 74% of visitors to the building were stairs users. This percentage of stair use in the building was higher than other buildings on previously published

studies. Several studies found that the percentage of stairs users after motivational signage intervention was only below 60% (Bauman et al., 2017; Bellicha et al., 2015; Crozier, 2019; Jennings et al., 2017; Soler et al., 2010). In this natural experiment, the effect size of motivational signage intervention could not be calculated and analyzed since the baseline data were not available.

The visibility and the readability of the signage were good, 71% and 65.5% respectively. However, only a small percentage (29.3%) of visitors who had ever seen the signage felt that the signage influenced their choice in using the stairs. While only 15% of visitors who had ever seen the signage read in details and the readability was associated with the influence of the signage on visitors' choice, it could be suggested that improving signage readability could improve the signage influence on visitors' stair use behavior.

Typography, word length, and word arrangement could influence the readability of signage. Berger (2004) suggested that a serif type font and a combination of upper-case and lower-case could improve the readability of the signage. Although the motivational signage in this study had already used a serif type font, it was written in upper-case only. Eddington & Philips (2017) suggested that signage should follow the 3x5 rule and contained no more than 250 characters. The 3x5 rule said that signage should be written in only three lines with five words or five lines with three words to keep it easily readable. They also suggested that the signage contains a clear and concise message which can be read in seven seconds or less. While already contains 142 characters message, the signage in this study did not follow the 3x5 rule since it was written in eleven lines.

This study found that the signage got less attention from students. Students were 10 times less likely to see the signage and 3 times less likely to read the signage than staffs. These findings are in accordance with previous studies. Several authors found that static motivational signage was less effective in promoting stair use in young adults than older adults (Anderson et al., 1998; Yoon et al., 2018). Several studies suggested that the addition of interactive elements such as interactive painting, interactive map, piano stairs, or gamification using smart phone application could improve the effectiveness of the lift signage among students (Engelen et al., 2017; Yoon et al., 2018).

Beyond improving the readability and visibility of the signage, there were several suggestions to improve the effectiveness of motivational signage

intervention. Signage containing a specific message (e.g., Taking up the stairs burns five times more calories than taking an elevator) could have better effectiveness in promoting the stair use than a general message (e.g., Burn calories, Get Healthy) (Eckhardt, Kerr, & Taylor, 2015). A systematic review also suggested that the addition of a directional sign could improve the effectiveness of motivational signage intervention (Soler et al., 2010).

To best of our knowledge, this is the first study evaluating motivational signage effectiveness using a logic model. It showed the usefulness of a logic model for evaluating a change in policy or built environment. However, it has a few limitations. As mentioned earlier, it is not the gold standard for evaluating the effectiveness of an intervention. Based on our findings, it is recommended that future studies should be conducted with rigorous design by measuring baseline data and observing the stair use in an identical building as a control.

## 5 CONCLUSION

By using a logic model, this study showed that motivational signage influenced the stair use behavior in a university setting. The readability and the visibility of the signage could impact the effectiveness of the signage in influencing the stair use behavior. In addition, motivational signage resulted differently between students and staffs.

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