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Prompts to Increase Physical Activity at Points-of-Choice Between Stairs and Escalators: What About Escalator Climbers?

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The findings reported have not been published elsewhere and this manuscript is not being simultaneously submitted. The authors have full control of the primary data and agree to allow the journal to review the data if requested.

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ABSTRACT

Background: Since 1980, many studies have evaluated whether stair-use prompts increased physical activity by quantifying changes in stair use.

Purpose: To more completely evaluate changes in physical activity, this study addressed the often-overlooked assessment of climbing up escalators by evaluating the degree to which stair-use sign prompts increased *active ascent*—defined as stair use or escalator climbing.

Methods: Over five months, at an airport stairs/escalator point of choice, we video-recorded passersby (N=13,544) who ascended either stairs or escalators, on 10 days with signs and 10 days without signs. Ascenders using the stairs, standing on the escalator, and climbing the escalator were compared on days with vs. without signs using multivariable logistic regression.

Results: The percent of ascenders on days with vs. without signs was: stair use, 6.9% vs. 3.6%; escalator standing, 75.2% vs. 76.0%; escalator climbing, 18.5% vs. 20.4%. Signs more than doubled the odds of stair use (vs. escalator use; OR=2.25; 95% CI=1.90-2.68; p<.001). Signs decreased the odds of escalator climbing (vs. escalator standing or stair use); OR= 0.90; 95% CI= 0.82 -0.99; p=.028). Signs increased the odds of active ascent vs. escalator standing by 15% (OR=1.15; 95% CI=1.05-1.25; p=.002).

Conclusions: Though stair-use prompts increased *stair use* more than two-fold (125%), they increased *active ascent* by only 15%, partly because escalator climbing—a behavior not targeted by the intervention—decreased. While our results corroborated the established consensus that point-of-choice prompts increase stair use, future studies should test interventions designed to increase active ascent.

Key words: Stairs, escalator, active ascent, physical activity, point-of-choice prompts, built environment

INTRODUCTION

Since 1980, investigators have evaluated the effects of stair-use prompts on increasing physical activity by encouraging pedestrians to use stairs [1]. Two articles published in 2010 systematically reviewed the findings from trials using point-of-choice prompt interventions to increase stair use [2, 3]. The most recent review included 60 stair-use interventions [4], the majority of which employed point-of-choice prompts, and found such interventions were effective in increasing stair climbing in public settings. Collectively, the reviewed studies provide convincing evidence that point-of-choice prompts effectively promote the use of stairs, especially in settings where escalators are the alternative method of ascent.

One point-of-choice prompt intervention examined the effects of stair use prompts on changes in both stair use and walking up escalators. In that study, Andersen et al. observed stair and escalator use at the lobby of the convention center used for the American College of Sports Medicine annual meeting in 2001 [5]. Using an analytical model adjusted for age, sex, race, and time of day, the authors found that a point-of-choice prompt ("Be a role model. . . Use the stairs!") increased both stair use and escalator climbing. This finding suggested that escalator climbing, a behavior not targeted by prompts, might be worthy of assessment.

Point-of-choice prompt interventions are recommended in the Centers for Disease Control and Prevention's (CDCs) Community Guide [6] as evidence-based tools for increasing *physical activity*, but to date have focused almost-entirely on stair use and not *active ascent*—defined as stair use or escalator climbing. This study evaluated the extent to which our stair-use

intervention changed active ascent by distinguishing ascenders who merely stood and rode up the escalator from those who ascended actively, either by using the stairs or by climbing the escalator.

METHODS

Sample

The sample consisted of all passersby who ascended the stairs or escalators to the Terminal 1 sky bridge at the San Diego International Airport. All persons were eligible for participation, including airport patrons, airline and airport security and staff, and children. Using a hidden camera, we video recorded 13,544 ascenders over 20 non-consecutive days—10 days with signs and 10 days without signs—during January to May 2006. The study was conducted between 12 PM and 3:30 PM. According to airport authorities, that was the most heavily trafficked time of day at the San Diego International Airport. Days for conducting the study were selected largely to accommodate schedules of student research personnel. Video recording occurred only during the hours of observational data collection. The San Diego State University Institutional Review Board and airport authorities approved all study procedures.

Design

The setting was an outdoor staircase/escalator ascending from the parking lot to the sky bridge, a location providing a clear point of choice between escalators and an adjacent staircase in a high traffic area. The staircase consisted of 34 steps, with a small landing at the midway point, ascending 18.7 vertical feet to the sky bridge. From the first to last step, ascent by escalator standing took 28 seconds. We camouflaged the camera by placing it on a luggage cart at some distance from the base of the stairs/escalator and covering it with a coat and bags.

To investigate the effect of exposure vs. non-exposure to sign prompts on stair and escalator ascent, we used a quasi-experimental design, systematically introducing and removing the exposure of interest—signs bearing one of five messages prompting stair use.

Intervention

On A-1 size (84x60 cm) poster board, determined to be the most effective size for poster prompts [7], five different prompts were printed: 'Please reserve the Escalator for those who need it'; 'Don't Lose Time, Lose Weight, Use the Stairs'; 'Don't waste Time, Trim your Waistline, Use the Stairs'; 'You'll get more Stares if you Use the Stairs'; and 'If you want to feel younger, Act Younger, Step it Up! Use the stairs'.

On intervention days, one of the five messages prompting stair use was exhibited on eye-level easels in four strategic locations around the staircase/escalators, to make signs clearly visible to people approaching from any direction. Two signs were placed some distance from the stairs/escalator, facing the parking lot at different angles; a third sign some distance away, facing the bus/taxi passenger drop-off area opposite the parking lot; and a fourth sign near the bottom of the stairs/escalators.

Measures

Research assistants (RAs) reviewed the videos for a number of factors hypothesized to influence stair use. They coded each factor using operational definitions developed in a previously published study [8] (see Figure 1). Coders were not blind to conditions, as the camera's field of view included the signs posted at the base of the stairs/escalator. Data were coded by two or more RAs for a subset of participants and 10% of the overall sample were used to compute interrater reliability. Cohen's kappa coefficients (κ) were: age, κ =.53; gender, κ

=.93; ethnicity, κ =.46; body shape, κ =.33; shoes, κ =.39; luggage, κ =.84; number of bags, κ =.70; and speed, κ =.81. Data were double entered in databases by two independent data entry personnel and discrepancies were adjudicated by a third RA.

Pedestrian traffic volume was measured based on the time at which each participant first stepped onto the stairs or escalator [9]. For each minute during a video recording period, a count of participants whose time stamp occurred within that interval was computed. We then divided traffic volume (participants/minute) into tertiles: low (0-5), medium (6-8), and high (>8). Mean(SD) for tertiles are, respectively: 3.55(1.24), 6.98(0.82), 11.43(2.73).

Outcome and exposure variables

Of particular interest for this study, RAs coded whether participants walked, ran, or stood on the escalator and there was excellent interrater reliability for this measure (κ =.81). Escalator ascenders that walked or ran up at least half the length of the escalator were categorized as escalator climbers; otherwise they were categorized as escalator standers.

Our main exposure variable was sign prompts, coded “1” on days when signs were present and “0” on days when signs were absent.

Analysis

Logistic regression was used to estimate the effect of signs on: a) stair use (coded “1”) vs. escalator use (coded “0”); b) climbing the escalator (coded “1”) vs. standing on the escalator or using the stairs (coded “0”); and c) active ascent (coded “1”) vs. passive ascent (coded “0”) where active ascent was using the stairs or climbing the escalator, and passive ascent was standing on the escalator. All logistic models were adjusted by entering factors that were significantly different (based on chi-square tests) between sign and no-sign conditions—age,

sex, ethnicity, body shape, shoe type, luggage, and traffic volume—as covariates in the models. All statistical tests were two-tailed with $p<0.05$ considered significant. Data analyses were conducted using R (R Foundation for Statistical Computing; Vienna, Austria).

RESULTS

A total of 13,544 people were video recorded ascending either by escalator or by stairs during the 20 days of data collection. Most ascenders were adults (83%), 14% were coded as older adults (seniors) and 3% youth. Ascenders were predominantly male (63%), white (81%; vs. 4% black and 15% "Other") and coded as normal weight (82%). The percent of ascenders on days with vs. without signs was: stair use, 6.9% vs. 3.6%; escalator standing, 75.2% vs. 76.0%; escalator climbing, 18.5% vs. 20.4%. See the online Supplementary Material for full output from each regression model, including the odds ratio, 95% CI, and p-value for all covariates.

Stair use vs. escalator use

Figure 2 compares stair use to escalator use across sign conditions, the method of comparison used in nearly all other stair-use interventions. The odds of ascending the stairs more than doubled on days with signs compared to days without signs (OR=2.25; 95% CI=1.90-2.68; p<.001; Figure 2, Panel b).

Escalator climbing vs. escalator standing or stair use

Figure 3 compares escalator climbing against the other two methods of ascent. On days with signs (vs. days without signs), odds of climbing the escalator (vs. standing on the escalator or using the stairs) decreased 10% (OR=0.90; 95% CI=0.82-.99; p=.028; Figure 3, Panel b).

Active ascent (stair use or escalator climbing) vs. passive ascent (escalator standing)

Figure 4 compares the two active ascent methods combined (using the stairs or climbing the escalator) with passive ascent (standing on the escalator). There was a small (15%), statistically significant, increase in the odds of active ascent attributed to signs prompting stair use (OR=1.15; 95% CI = 1.05-1.25; p=.002; Figure 4, Panel b). Conversely, these results also indicate that there was a small (13%), statistically significant, decrease in the odds of passive ascent, i.e., escalator standing (OR=0.87; 95% CI = 0.80-0.95; p=.002). These figures are computed by inverting the odds for active ascent.

DISCUSSION

Increasing physical activity has been a core public health objective for nearly four decades [10]. One method recommended by the CDC's Community Preventive Services Task Force is to introduce stair-use prompts at points of choice between stairs and escalators/elevators ". . . on the basis of strong evidence of its effectiveness in moderately increasing levels of *physical activity*, as measured by an increase in the percentage of people choosing to take the stairs rather than an elevator or escalator" [emphasis added] [11].

In our study, when stair use was compared to escalator use, point-of-choice prompts increased stair use by 115%, confirming previous findings [4], including our own [12], that prompts are an effective means of changing *stair-use* behavior. However, to more accurately assess the impact on *physical activity*, we also compared active ascent (stair use or escalator climbing) with passive ascent (escalator standing), and found prompts increased active ascent by only 15%.

Considering the three ascent methods separately, our results indicated that stair use increased on days with point-of-choice prompts, while both escalator climbing and escalator

standing decreased. One interpretation is that, upon seeing the sign prompts, some of those who were already disposed to climb the escalator were prompted to make an even greater effort, and used the stairs. If the interpretation is correct and our findings are replicated in other populations and settings, then the effect estimates based on comparing stair use vs. escalator use reported by many previous studies may represent *over*-estimates of the increase in physical activity resulting from stair-use prompts.

In contrast to our results, Andersen et al. found that prompts designed to increase stair use increased both types of active ascent [5], with larger increases observed for escalator climbing than for stair use. If Andersen et al.'s results are replicated in other populations and settings, then previously reported stair-use prompt effect estimates based on comparing stair use vs. escalator use could represent *under*-estimates of the increase in overall physical activity resulting from stair-use prompts. There are notable differences between Andersen et al.'s study and ours that could account for the contrasting results. First, the Andersen et al. study was conducted at the Baltimore Convention Center among attendees of a scientific conference on physical activity; our sample was drawn from the general population of San Diego International Airport users. Second, Andersen et al. coded participants as "walked up the escalator" only if they walked all the way up the escalator. We tailored our measure for an airport setting considering sometimes high pedestrian traffic and the presence of luggage that could prevent uninterrupted escalator climbing. Therefore, ascenders were coded as "escalator climbers" if they walked or ran at least half the length of the escalator. Finally, Andersen et al. relied on research assistants at the venue to observe, count, and code characteristics of stair and escalator ascenders in-person. Observers are less readily concealed than cameras, and thus

more likely to influence behavior. Also, accurate real-time observation and recording can be difficult during periods of high pedestrian traffic. The present study used concealed cameras to make video recordings that were subsequently coded by trained research assistants who could view recordings at a slow speed and as often as needed.

By itself, walking or even running up a single flight of stairs does not constitute a substantial amount of physical activity, and walking up an escalator constitutes even less. But the goal of prompting incidental physical activities like stair use or escalator walking is to promote behavior change in all aspects of life, to encourage the public to take advantage of multiple opportunities for activity that together may contribute to their overall health. To that end, stair studies play an important part in efforts to promote active living [13] and change the built environment [14], all with the aim of providing greater opportunities for physical activity during the course of everyday life. The ultimate goal of this line of investigation is to help understand how to develop a variety of strategies across a number of settings that can each make a small contribution to a large cumulative improvement in public health.

There are limitations to take into account when interpreting our results. First, the target behavior of the intervention was stair use (not active ascent). Ideally, we would have tested the effects of stair use prompts alone, escalator climbing prompts alone, and the two types of prompts combined. Second, our analysis of active vs. passive ascent treated those individuals who climbed (walked or ran up) the escalators as equivalent to those who used the stairs, for the purpose of contrasting with participants who merely stood on the escalator. However, because escalators are moving while ascenders climb, the overall energy expended by climbing escalators is less than the energy expended by climbing stairs, for a given speed, making the

two methods of ascent similar, but not equivalent. Third, our study was conducted in an airport setting during a busy time of the day. Congested escalators and/or passengers carrying luggage and/or traveling with small children could make active ascent prohibitively difficult. This last limitation raises the issue of confounding. Because our study design was quasi-experimental, it was not possible to randomly assign participants to experimental conditions (days with versus days without signs), which would have increased the likelihood that measured and unmeasured factors were balanced across conditions. We addressed the issue in part by reviewing the video recordings to measure factors that might have differed between conditions, and adjusting for these in statistical models—including factors that could inhibit active ascent, such as luggage usage and pedestrian traffic volume. However, residual confounding from measurement error and unmeasured variables may still exist. Our study design was not capable of providing the degree of confidence in findings that would have resulted from a fully controlled trial.

While the literature contains strong evidence that stair-use prompts can increase *stair use* in a range of settings and populations, the results from our study and those of Andersen et al. highlight the importance of measuring (and possibly intervening on) *escalator climbing,* a behavior which, like stair use, requires greater energy expenditure than needed for standing. Since the two studies found contrary effects of stair-use prompts on increasing escalator climbing, more research is warranted to evaluate whether point-of-choice prompts can increase escalator climbing, and future studies should test prompts specifically designed to increase both stair climbing and escalator climbing. Investigators should proceed with caution, however, because little is known about the risks associated with climbing escalators. Escalator use has been associated with injurious falls in airports and other settings, primarily among

elderly and young children [15, 16], although it is unknown whether the risk exceeds that associated with using stairs. Any studies promoting active ascent should take steps to prevent injuries. Finally, we recommend that all future stair-use studies evaluate escalator climbing along with stair use so that changes in physical activity can be more accurately assessed.

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