The Effects of Interactive Stairways on User Behavior and Safety

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International Conference on Universal Design
June 16, 2014
Lund, Sweden
Background

- People of all ages fall on stairways
- Stairway use is involved in 1,900 deaths and 1.3 million hospital emergency room visits per year in the U.S. (NSC 2011; Pauls 2011)
- Most stairway accidents are related to the design and construction of stairways (Archea et al. 1979; Templer 1992)
- A study found that people perceived using stairways as the most problematic activity in the built environment (Danford et al. 2009)
Health and Wellness

- Stair climbing can improve weight control, cholesterol levels, lower-limb strength, and cardiovascular fitness (Lee et al. 2012; Lewis and Eves 2001)

- Stairways should be highly visible, easy to access, and attractive to encourage use (Active Design Guidelines 2010)
Interactive Stairways

- Changes the purpose of stairways by allowing users to engage in stair climbing tasks while feeling as though they are having an influence on the built environment (Swenson and Siegel 2013)

- Have shown a higher impact on stair use (Swenson and Siegel 2013) and thus greater promise for increasing physical activity levels

- “Piano Stairs” in Stockholm reported a 66% increase in stair use
Issues to consider

- A higher frequency of stair use increases the exposure to risks of falling
- Interactivity may affect the user’s visual attention
- Interactive stairways motivate people to use the stairs in unconventional ways (e.g. running, jumping, dancing)
Research Aims

- To build the knowledge base for stair safety

- Objectives:
  - Assess interactive stairways
  - Compare the user’s behavior and the incidence of unsafe stair use on the interactive stairways compared with a conventional stairway

- Hypothesis:
  - On the interactive stairways, there will be more user gaze to the stairway itself, less diverted gaze to the surroundings, and more handrail use
Methods

1. Developed a checklist for observing and recording stair use

2. Conducted observations in two museums with interactive stairways and in a university building with a conventional stairway using a video recorder
   - Collected 2-hour observation periods
   - Observed stair users only in descent

3. Documented and compared behaviors and stair incidents
### Stair use observation checklist

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Child (ages 1-14)</td>
<td></td>
</tr>
<tr>
<td>Young Adult (ages 15-24)</td>
<td></td>
</tr>
<tr>
<td>Middle-Aged Adult (ages 25-64)</td>
<td></td>
</tr>
<tr>
<td>Older Adult (ages 65+)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Male</td>
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#### Key Behaviors
- Frequent tread gaze (3 or more glances at the treads)
- Infrequent tread gaze (2 or less glances at the treads)
- Diverted gaze
- Handrail use

#### Typical Behaviors
- Talking
- Using electronic devices
- Carrying things

#### Noticeable incidents
- Hesitation
- Loss of balance
- Misstep

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**Example of an observation setup**

Observer and video recorder
Findings

Cross-site comparison of key behaviors

- Tread Gaze
- Diverted Gaze
- Handrail use

Children's Museum (CM)  Science Museum (SM)  Student Union (SU)
N = 92              N = 502              N = 453

* Percentages are the percent of the total sample of each stairway.
** Stair users exhibited more than one behavior.
Findings

- Cross-site comparison of the incidence of unsafe stair use:

<table>
<thead>
<tr>
<th></th>
<th>Children's Museum (CM) (N = 92)</th>
<th>Science Museum (SM) (N = 502)</th>
<th>Student Union (SU) (N = 453)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hesitation</td>
<td>1.08% (1)</td>
<td>0.39% (2)</td>
<td>1.54% (7)</td>
</tr>
<tr>
<td>Misstep</td>
<td>0.0% (0)</td>
<td>0.39% (2)</td>
<td>0.22% (1)</td>
</tr>
<tr>
<td>Loss of balance</td>
<td>1.08% (1)</td>
<td>1.19% (6)</td>
<td>0.88% (4)</td>
</tr>
<tr>
<td>Fall</td>
<td>0.0% (0)</td>
<td>0.19% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Total</td>
<td>2.17% (2)</td>
<td>2.19% (11)</td>
<td>2.64% (12)</td>
</tr>
</tbody>
</table>
Discussion

Unreachable and ungraspable handrails

Adequate handrails for children
Discussion

People using the left-side descending path to interact with the stairway
Discussion

LED color displays on stair risers

A stairway painted as an art piece
Conclusion

- Interactive stairways can be as safe as any other stairway but they do alter stair use behavior.

- The research suggests that interactivity can improve stair safety if used appropriately.
Limitations and Future Research

- Stairways with different characteristics were compared
- Two hour observation periods resulted in reasonable sample sizes
- Video recording is an inexpensive and easy to implement method for assessing stairways in public places
- Laboratory studies would increase our knowledge about the issues related to interactive stairways
  - Useful in testing other design concepts before they are implemented in public places and used widely
- Devise strategies to improve professional education on safe stairway design
References


Pauls J. Injury Epidemiology. International Conference on Stairway Usability and Safety; 2011 June 9-10; Toronto; Canada.

