Modeling the Impact of Visual Access and Crowd Flow on Human Indoor Emergency Wayfinding: from Empirical Investigations to Simulations

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ABSTRACT

Various types of emergencies can occur in buildings, exposing human safety to great danger. During building emergencies, it is of paramount importance for people to reach safe destinations quickly, for which wayfinding behavior is a critical determinant. In this study, the impact of visual access and crowd flow on emergency wayfinding was examined using simulations, in which human behavior was modeled based on empirical investigations. To do so, evacuation experiments were conducted in a virtual metro station. A total of 317 participants were involved in the experiment and each participant experienced two or three decision points during the evacuation process. Using the experimental data, a mixed logit model was employed to investigate the relationship among participants' wayfinding choices, visual access, and crowd flow. The results showed that both visual access and crowd flow significantly affected participants' wayfinding choices. Crowd simulation was further developed according to the estimated mixed logit model, and multiple building designs with varying levels of visual access were evaluated with regard to the impact on evacuation performance and exit choice. The results suggested that increasing visual access of a shorter evacuation route could result in more agents choosing that route and improve the evacuation performance. The main contribution of this study is that instead of using predefined rules for crowd simulation, we established an approach to developing crowd simulation from empirical data to improve the fidelity of agents' behavior. We also quantitatively assessed the impact of visual access and crowd flow on human indoor emergency wayfinding.