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Humans do not always act selfishly: social identity and helping in emergency evacuation simulation

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Abstract

To monitor and predict the behaviour of a crowd, it is imperative that the technology used is based on an accurate understanding of crowd psychology. However, most simulations of evacuation scenarios rely on outdated assumptions about the way people behave or only consider the locomotion of pedestrian movement. We present a social model for pedestrian simulation based on self-categorisation processes during an emergency evacuation. We demonstrate the impact of this new model on the behaviour of pedestrians and on evacuation times. In addition to the Optimal Steps Model for locomotion, we add a realistic social model of collective behaviour.

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1. Introduction

An abundance of research has been conducted on pedestrian dynamics for safety and event planning of crowds, including simulations of pedestrian evacuation during fires (Ran et al. (2014); Wagner and Agrawal (2014)), the movement of pedestrians through buildings (Kamkarian and Hexmoor (2013); Sagun et al. (2011)), simulations of realistic pedestrian movement (Chraibi et al. (2010); Moussaïd et al. (2011); Seitz and Köster (2012); Davidich and Köster (2013)), and the monitoring of pedestrian flow at public events (Zhang et al. (2013)). Although this work is crucial for safety management and organisation, a recent systematic review by Templeton et al. (in preparation) found that previous simulations of crowd behaviour have treated crowds as either mindless masses – wherein the crowd is merely an unthinking mass of numerous individuals with no connection to one another – or as consisting of smaller groups within a crowd. Specifically, it was found that some modellers are basing these approaches on outdated theories of crowd psychology which have been recently superseded in the social science literature by accounts which can explain mass behavior without positing mindlessness. For example, in some simulations of emergency crowd

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behaviour, crowd members act as individuals with no group affiliation (Yan et al. (2012); Shao et al. (2013)), or merely panic (Helbing et al. (2000); Franca et al. (2009)). Further, models that suggest that small groups of affiliates stick together in emergencies (e.g. Shao et al. (2013); Zheng et al. (2014)) are correct for crowds in which there are groups of families and friends (Sime (1980)). However, they do not apply to those crowds where people are amongst strangers and yet still behave socially (e.g. crowds of commuters). As yet, no model of crowd behaviour has been developed which has sufficiently accounted for large scale collective crowd behaviour where strangers in a crowd act together in a spontaneous and yet coordinated way.

There are numerous examples of crowds acting together in a coordinated manner, for example in urban riots (Reicher (1984)), religious mass gatherings (Alnabulsi and Drury (2014)), and music festivals (Neville and Reicher (2011)). Crucially, research has also found numerous instances of crowd members coordinating in emergency situations (Drury et al. (2009a)). For example, Drury et al. (2009a) analysed accounts of survivors from numerous disasters, such as fires, crushings in football stadiums, and the sinking of two cruise ships. In the accounts, rather than the irrational panic or small group behaviour that has been suggested in previous simulations of crowd behaviour, survivors often described people forming orderly queues, acting calmly despite the emergency situation, and gave descriptions of "camaraderie" and "pulling together as opposed to pulling apart" (p. 495).

Over recent years an increasing number of crowd modellers have acknowledged that the inclusion of theory and research from contemporary crowd psychology is necessary in order to create an adequate simulation of crowd behaviour (for examples, see Langston et al. (2006); Smith et al. (2009); Aguirre et al. (2011); Köster et al. (2011)). However, as yet, most of these examples have modelled small group phenomena, and no model has simulated collective behaviour across an entire crowd without falling back into the mindless mass approach. In order to develop a more realistic simulation of crowd behaviour where a crowd can act as one cohesive unit, modellers can benefit from incorporating the most up to date research findings of psychologists on collective behaviour. One prominent theory of crowd behaviour which is grounded in empirical research and can explain a range of collective behaviour is self-categorisation theory (Turner (1985); Turner et al. (1987)), which is part of the social identity approach (Tajfel and Turner (1979)).

2. The social identity approach and self-categorisation theory

The social identity approach originated to foreground the social world as an explanation for human behaviour, focusing on how social structures impact upon cognition. According to the social identity approach, as well as personal identities, we each have numerous social identities, based on social categories and groups. We act in accordance with the social identity that is salient at a particular time (Tajfel and Turner (1979); Turner et al. (1987)). Self-categorisation theory is that part of the social identity approach that accounts for people's perception of their own group membership and the group membership of others. The theory suggests that it is this categorisation of group membership which makes collective behaviour possible, including how people can come together psychologically within a crowd regardless of prior interpersonal relationships or interactions. Through this process, the individual shifts from their personal identity to their social identity, where their commonality with others becomes salient (Turner et al. (1987)). Through a process of self-stereotyping, individuals conform to the features of the group. Since these features are shared, this explains how people can spontaneously act as one. Thus, it is this process which opens up the possibility for a crowd of strangers to come together as a group.

2.1. Collective behaviour and collective self-organising in emergency evacuations

Self-categorisation theory has been shown to explain behaviour in emergency situations, as well as other collective phenomena such as crowd conflict (Reicher (2001)) and mutual support among group members (Haslam et al. (2005)). For example, by using a virtual reality paradigm, Drury et al. (2009c) placed participants in a scenario where they had to escape from a burning underground rail station. It was found that the more that the participants identified as being part of the crowd, the more helping behaviour they exhibited to others and the less likely they were to push them aside in their attempt to escape. The common finding that crowds can come together and help one another in an emergency has implications for how computer modellers should be approaching crowd behaviour. Indeed, Drury et al. (2009a) argue that the crowd should stop being seen as an inherent problem; adaptive behaviour by crowd members *as* crowd members can actually enhance collective changes of survival and therefore should be conceptualised as a