Following the crowd or avoiding it? Empirical investigation of imitative behaviour in emergency escape of human crowds

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When humans escape from a threat in a crowded space, how do they choose the best wayfinding strategy for their survival? This is a decision context in which individuals are heavily exposed to the actions of others; it is thus plausible to assume that they are influenced by the social interactions. It has been suggested by some influential theoretical studies that in emergency escape situations, ‘people show a tendency towards mass behaviour, that is, to do what other people do’ (Helbing, D., Farkas, I., Vicsek, T., 2000. Simulating dynamical features of escape panic. Nature, 407, 487–490, page 487). However, the validity of this assumption has not come under scrutiny, nor has the role of context-specific factors that may strengthen or weaken the possibility of displaying the so-called herd-type (or imitative) behaviour been adequately understood in this context. Here, we report on novel wayfinding decision experiments that simulated the escape of human crowds from multi-exit spaces. Participants’ perceptions of different alternatives chosen by the crowd and the direction at which the social interactions (i.e. observing the movements of other evacuees towards different exit alternatives) impacted on individuals’ navigational choices depended significantly on the decision maker’s knowledge about the attributes of the alternatives chosen by the crowd flows. Contrary to the conventional belief, people’s dominant wayfinding strategy was not to copy the escape directions that other people (i.e. the majority) chose. In fact, in a heavily crowded space with little or no choice uncertainty, observing many people choosing a certain exit direction reduced the desirability of that escape route. The assumption of herd-like behaviour does not necessarily apply to all contexts of evacuations and it should be considered in conjunction with the moderating role of context-specific factors, particularly the level of information available to individual evacuees.

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clustering (Wagner, 2003), or aggravated financial inequalities (Muchnik et al., 2013). Previous studies have also shown that it has the potential to distort to significant degrees the beliefs and wisdom of the crowd (Lorenz, Rauhut, Schweitzer, & Helbing, 2011) in a variety of social contexts.

The phenomenon of social interaction has also received considerable attention in relation to the behaviour of foraging or migrating animals (Couzin, Krause, Franks, & Levin, 2005) as well as human groups on the move (Faria, Codling, Dyer, Trillmich, & Krause, 2009; Faria, Dyer, Tosh, Krause, 2010), particularly from the perspective of consensus decision making for decision contexts that require coordination or synchronization of individuals’ actions (Boos, Pritz, Lange, & Belz, 2014; Dyer et al., 2008; Dyer, Johansson, Helbing, Couzin, Krause, 2009). The existing evidence has strongly suggested that information about individuals with pertinent knowledge (of food, resources or spatial targets) can be transferred among moving groups based on the visual perception of the local movements of others, even without obvious signalling or active communication (Faria et al., 2010). Individuals have the ability to identify and follow those who possess accurate information in the group and thus a group of informed minority has the capacity to lead the entire group to the target (Dyer et al., 2009).

A recent study by Dyer et al. (2011) suggested that information about individuals with pertinent knowledge (of food, resources or spatial targets) can be transferred among moving groups based on the visual perception of the local movements of others, even without obvious signalling or active communication (Faria et al., 2010). Individuals have the ability to identify and follow those who possess accurate information in the group and thus a group of informed minority has the capacity to lead the entire group to the target (Dyer et al., 2009).

An emergency escape essentially does not require any coordination or synchronization of actions due to anxious reactions to a certain event (Helbing & Johansson, 2011, page 697). In contrast, an emerging body of literature has recently revisited the conventional belief of irrational and panic-type behaviour (Cocking, Drury, & Reicher, 2009; Faby, Proulx, & Aiman, 2012; Mawson, 2005; Quarantelli, 2008) in emergencies. It suggests that, rather than displaying indecision or erratic behaviour, humans do cooperate with other individuals and make reasonably predictable trade-offs to make the optimum decision in the light of the available information even in acute states of emergency (Kuligowski & Mileti, 2009; Li, Huang, Zhang, & Ni, 2016; Sherman, Peyrot, Magda, & Gershon, 2011; Still, 2014). Yet, to our knowledge, whether the state of anxiousness or fear can particularly strengthen a follow-the-majority instinct in humans has not been demonstrated.

More recently, some experimental studies in which wayfinding decisions of evacuees in crowded spaces were investigated found no evidence of herd-type behaviour. These studies, however, mainly included hypothetical decision experiments with virtual crowds (Bode & Codling, 2013; Bode, Wagoum, & Codling, 2014, 2015; Duives & Mahmassani, 2012; Haghani & Sarvi, 2016a; Haghani, Sarvi, Ejtemai, Burd, & Sobhani, 2015a; Haghani, Sarvi, & Shahhoseini, 2015b) which face the traditional question of generalizability (Chang, Lusk, & Norwood, 2009; Herbst & Mas, 2015; Levitt & List, 2007) and transferability to the context that they intend to address, also known as contextual (or hypothetical) bias (Hensher, 2010). It can be argued that since participants in these experiments do not realistically interact with other individuals as they do in actual evacuation scenarios, then their results might not perfectly represent their true behaviour.

Here, we revisit this assumption based on a large number of empirical observations extracted from the individual level analysis of a series of innovative experiments in which the emergency escape of human crowds was simulated in action. We examined the impact of social interactions on wayfinding decisions in conjunction with the physical factors of the escape environment such as spatial distances and target visibility. Individuals’ perception and evaluation of these factors were quantitatively inferred from their observed decisions using econometric choice modelling techniques. We were particularly interested in testing whether introducing ambiguity in terms of the attributes of different escape route alternatives would significantly impact on how humans perceive the decisions of others observed to have chosen those alternatives. In other words, we aimed to investigate on a
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