Emergence of behavioral repertoires in entrance situations: Interplay between physical, collective and inter-personal factors

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Short Abstract. Within moving crowds, patterns of pedestrian behavior occur. Examples include walking, running or even racing, queuing, huddling. The transitions between these ways of behaving occur fluently, typically without overt gesturing, and sometimes rapidly. The question is: how do these patterns emerge and propagate? Our approach emphasizes the interplay between physical, collective and inter-personal factors.

Movement repertoires in pedestrian behavior

Our prior research has closely analyzed a wide variety of behavior in crowd experiments from a social psychological perspective (1). Based on past behavioral observation work (2,3) we developed a method which focuses on observable forms of behavior that are socially meaningful. We have called these *behavioral repertoires*. Being socially meaningful means that repertoires are cultural and embodied understandings of such movements. This means that actors understand not just how others and self are supposed to move, but also other aspects of the social setting: what social norms apply, what atmosphere and emotions are fitting. Some repertoires are specific for individuals (standing aside), some for small interactive subgroups (chatting) and some for larger subgroups (queueing).

To explain the emergence and propagation of repertoires (e.g., everyone suddenly racing), a classic explanation is contagion. But contagion is a problematic term - there are many different ways in which humans can influence each other and co-ordinate that are nothing like biological contagion (4). Indeed, recent studies of "contagion" in protest activities point to other mechanisms (including social identification). But whilst this research is informative, it is not directly relevant for pedestrian behavior and our questions, because it focuses on macro level characteristics (e.g., protest issues). Accordingly, in the current paper we use micro-level (experimental) data to infer how patterns emerge.

Current research: Cataloguing the emergence and propagation of pedestrian behavior

Our analysis is based on close observation of an experimental dataset (5) containing 8 videos of large groups (80-100) of participants walking towards a gate, waiting in front of the gate and moving through the gate (see Fig. 1). We coded behavioral repertoires first and then analyzed how collective and individual behavior was enacted. Additionally, we conducted a series of exploratory experiments in which different forms of coordinating movement were tried out.

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We observed that three interplaying factors are relevant for the organization of behavior. Firstly, *physical factors* can lead people to act the same way. The body itself limits what behaviors are possible and attractive. Spatial characteristics can also encourage particular forms of sociality, as when lanes encourage people to form queue-like shapes. And finally, in crowds the physical presence of other bodies is a major determinant of what actions are possible.

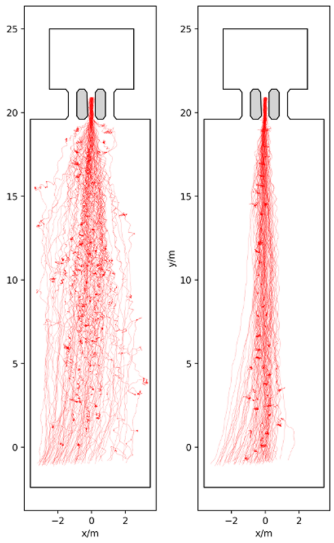

Fig. 1: Experimental structure with gate at the top and 20 m long corridor in front of the gate. Individual trajectories are in red. Both runs are from the same experimental condition, yet different behavioral repertoires are enacted. While during the run on the right hand side participants formed a queue, the run on the left hand side showed more diverse repertoires. Here also a queue was formed, but some participants ignored it and overtook.

A second factor that leads people to behave the same is the activation of *common knowledge and understandings*. Many behaviors are guided by social scripts, norms and expectations - the queue is a prime example (6). This can be achieved through social influence, e.g. communication. One example of such a process is that in the crowd a shared social identity can become salient which then structures subsequent pedestrian behavior (7). Another effective process is initiated by a leader who directly communicates norms and scripts. There are some situations where common knowledge exerts a very strong influence. Because of its top-down and predictable nature, we also refer to this as a *mechanical* form of social influence.

But in many crowd settings the meaning of the situation is more diffuse. Therefore, the third factor is organic in nature: it involves the emergence of structure through *dynamical social interactions* within the crowd. People seek to understand the situation by observing the behavior of others and making inferences about them. So far in our research we have discerned two ways in which this third factor operates. First, people use those cues from others to induce what social scripts are appropriate. The second way is empirically rarer in the data we have so far studied. It occurs when people attempt to innovate and introduce new or different ways of moving.

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