Deciphering the movement of pedestrians in a crowd

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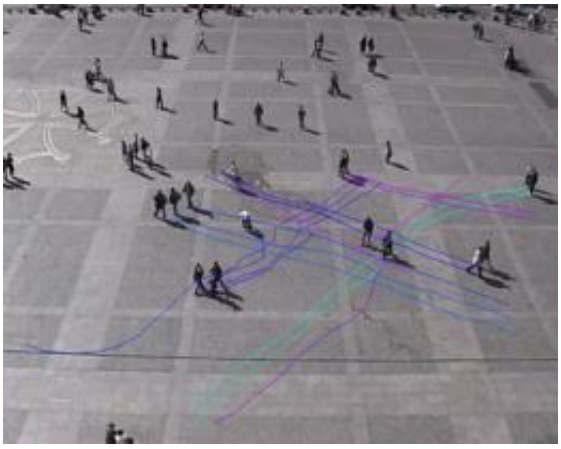

Pedestrian trajectories in the Place du Capitole in Toulouse, as they appear after video treatment.

(PhysOrg.com) -- How do pedestrians move in the street? How do they interact? French researchers from the Université Toulouse, in partnership with the Swiss Federal Institute of Technology, Zurich, have carried out a series of studies to improve understanding of the group behavior of pedestrians in urban environments. Published on April 7th in *PloS ONE*, their results establish realistic models of crowd dynamics to improve pedestrian traffic management.

The mechanisms that govern crowd motion remain largely unknown. However, this knowledge is essential for the management of pedestrian

flows (walking comfort, traffic fluidity, etc.) in urban areas. The lack of information is due in part to the difficulty of studying these phenomena experimentally and of building quantitative models able to account reliably for them.

For simplicity's sake, most current models of crowd dynamics consider that pedestrians move independently of one another, trying to reach their destination while avoiding collisions. Using video recordings made in urban areas, Guy Theraulaz's team has shown that depending on the situation, 50 to 70% of pedestrians do not walk alone but in small groups, most commonly composed of two to four members. The study of the spatial organization of pedestrians within these groups reveals that when they have enough room, group members choose to walk side by side. Conversely, when crowd density increases the group no longer has enough room to walk abreast: the pedestrians in the middle move back slightly and those at the sides move towards each other, forming a concave structure. A group of three pedestrians adopts a “V”-like pattern. In groups of four, a “U”-like formation is observed.

These configurations facilitate communication between group members, but they considerably reduce their walking speed. A concave configuration makes the group's forward motion difficult and forces individuals moving in the opposite direction to perform avoidance maneuvers. At the scale of a crowd, this significantly modifies the spatial and temporal characteristics of pedestrian flows. Numerical simulations based on these observations demonstrate that the presence of pedestrian groups reduces overall traffic efficiency by about 17% compared to a situation in which pedestrians walk in isolation.

This study shows that it is important to take into account the highly heterogeneous composition of crowds and the presence of pedestrian groups who privilege their social activities to the detriment of their walking efficiency. This new knowledge will help improve the reliability

of pedestrian traffic predictions in urban environments.

More information: The walking behaviour of pedestrian social groups and its impact on crowd dynamics, M. Moussad′d, N.Perozo, S. Garnier, D. Helbing & Guy Theraulaz, Plos One (2010)

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