Decision-Making in Human Crowds: Nonlinear Competition Dynamics

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When a crowd splits into two groups walking in different directions, how does an individual decide which group to follow? We previously found (VSS 2019) that participants average the heading directions of all neighbors in the field of view up to an angular difference of 40° between groups, consistent with Rio, Dachner & Warren's (*PRSB* 2018) neighborhood model. Here we investigate what rules govern individual decisions with larger angular differences (≥80˚). Participants (N=10) were instructed to "walk with" a virtual crowd (8 or 16 virtual humans) while wearing a Samsung Odyssey HMD (110º FOV). After 2-3s, one group made a small turn (20° left or right) and the other group made a large turn (60°, 100°, 140°, or 180°) in the other direction. We manipulated the percentage of the crowd making the large turn (0%, 25%, 50%, 75%, 100%), and measured the participant's walking direction. The results show a strong attraction to follow the majority ($p<0.001$), with no influence of total crowd size ($p=0.27$, contrary to a quorum). However, this effect trades off with an attraction to the smaller (20°) turn: as the magnitude of the large turn increased, participants were more likely to follow a minority making the smaller, less effortful turn ($p<0.001$). Interestingly, there were individual differences: while most participants followed this trade-off, a few always preferred either the majority or the small turn. To model this data, we introduced nonlinear competition dynamics into our neighborhood model, such that an individual decision is driven by the relative weight of the crowd proportion and the angular difference between groups. We fit the competition parameters to each participant, and simulated heading in all experimental trials. The new model accounted for 86% of the individual decisions in the data set.

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