

# Quantifying Recursive Mentalizing Depth for Social Navigation

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## Abstract

Effective social navigation requires individuals to infer others' intentions and adjust their movements accordingly to avoid collisions. A key aspect of this process is recursive reasoning, where individuals anticipate that others are also inferring their intentions. In this study, we quantitatively measured whether humans exhibit spontaneous mentalizing during navigation and developed a computational model to demonstrate the basic principle. Then, we introduced a novel framework for quantifying the recursive depth of human mentalizing during social navigation. Using a Doors-choosing task within a VR environment, participants navigated between two doors while avoiding a virtual human. Analyzing choice patterns, confidence levels and walking trajectories, we found that participants engaged in one or two levels of recursion, with respective probabilities of 80% and 20%. This study provides a quantitative estimation of the recursive depth of mentalizing in navigation and establishes a foundation for integrating human recursive reasoning into socially intelligent agents.