In the domain of spatial navigation, the neuroscience literature largely converges with the developmental literature, and, in the domain of geometry-based navigation, pushes beyond behavioral data.

This convergence happens on two fronts. First, and most generally, the behavioral and neuroscience literature converge on the fact that certain aspects of spatial navigation are privileged in development. Behavioral work in young children and animals suggests that basic navigation is early-developing or even core: young humans, rates, and birds all show successful orienting based on geometric properties of a room, such as wall length (e.g. Chiandetti et al 2009; see Lee & Spelke, 2010, and Vallortigara et al, 2009, for a review). Similarly, early work in neuroscience found a specific region in vertebrates, including humans, uniquely involved in spatial processing, memory, and navigation: the hippocampus. This region contains neurons that are specifically tuned for various aspects of spatial navigation, and which are functionally-specified from very early on, at least in rats (Willis et al, 2010; Langston et al, 2010).

Second, the developmental literature, combining human child and controlled rearing experiments, makes a strong argument that this early, privileged system of navigation relies primarily on geometric cues, as opposed to feature-based or object-based navigation. For example, young children will orient based on room shape (short and long walls), and structural features of a room (e.g. alcoves), but not always to feature-based cues, (e.g. objects offset from the wall, or colored walls; see much work by Spelke and colleagues). This (surprising) result is supported by the neuroscience literature: both human and animal studies suggest distinct neural circuits for spatial versus feature-based navigation. For example, Doeller et al. 2007 found using fMRI that human adults show hippocampal activation when making navigation decisions based on spatial boundaries, but dorsal striatal activity when making decisions based on landmarks. (It is, however, important to note the interpretation of this neuroscience literature is informed by the developmental literature: many of the texture and color cue versus boundary experiments were run precisely because of the developmental results.) This dissociation seems supported by patient literature as well: while certain lesion sites lead to specific failure to encode or use landmarks (e.g. Takahashi et al 1997), others lead to difficulty in path integration (Habin & Sirigu, 1987). Recently Iaria et al (2009, 2010) discovered a set of individuals who experienced severe impairment in navigation, despite a preserved ability to recognize familiar places and environmental landmarks, and Lakusta et al (2009) reported that some individuals with Williams syndrome show an ability to navigate using feature-based cues (colored wall), but not geometric cues (room shape); exactly the opposite profile of children.

Finally, in the domain of geometry-based navigation, the neuroscience literature goes beyond purely behavioral measures. The discovery of at least three different profiles of activity in hippocampus -- place, direction, and grid cells -- suggests ways of getting traction for more precise characterizations of "geometry-based" navigation. As well as having distinct functional profiles, the development of these neurons in rats suggests that, while geometric navigation as a whole comes very early, the sub-components come online and become refined at slightly different rates (Willis et al, 2010; Langston et al, 2010). Understanding these profiles and how they interact will hopefully inform further questions about navigation: what are the computations and representations, what makes something in the world a geometric cue vs a landmark, and what does a model of navigation that makes use of place, direction, and interval location (grids) look like?

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