



Supplementary Figure 2. Cube-mapping and image rendering. **(a-b)** Schematic of the image-warping transformation of the rat's perspective view of the virtual environment to the projection on the arena. The image warping algorithm involves three steps: **(a)** The virtual world (consisting, in this example, of four colored 3D objects) is rendered 360 degrees about the rat's head position on the faces of the cube using a cube-mapping algorithm, **(b)** each wall's relative position to the rat is mapped to this 3D virtual world, and **(c)** all arena surfaces (walls and floor) are then warped from the perspective of a video projector mounted above the arena. This process is repeated every frame, maintaining the VR-rodent-arena despite movement of virtual objects, the rat, or the arena itself. **(d)** 3D lighting algorithms employed by ratCAVE to increase spatial visual cues and visual richness of the virtual environment. Improvements are successively applied to the object, from left to right. First, diffuse reflections increase object brightness on parts of the object facing the light. Second, high-resolution objects are used, with smoothed surfaces, to further increase object detail. Third, specular reflections are added to provide subject-object-light triangulation cues. Finally, shadows are added to provide inter-object distance cues.