Neural decoding of viewpoint-tolerant object representations in 6-month-old infants and adults

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Humans have a remarkable ability to recognise objects quickly and accurately, even in the face of vastly different retinal projections caused by changes in an object's position relative to the observer. This capacity for invariant object recognition is a hallmark of adult object recognition and is presumably acquired during early development. Here, we examined whether very young infants (6-7 months, N = 25) already show evidence of viewpoint-tolerant object representations. We compared these representations with those evoked by the same stimuli in adults (N = 20). We used 3D models of 14 different grayscale objects (7 animate, 7 inanimate) to generate 8 distinct viewpoints consistently spaced along the front-facing half of each object. We recorded electroencephalography while infant and adult observers viewed the objects in rapid, randomised 4 Hz streams. Multivariate Pattern Analysis applied to the adult data revealed that the evoked neural signals contained reliable information about object identity that generalised across changes in viewpoint from around 70-600ms post stimulus onset. This suggests that in adults, neural responses evoked by the same object presented in different viewpoints were reliably more similar to each other than to responses evoked by other objects. In contrast, evidence for viewpoint-invariant object representations in infants was relatively weak at the group level, with substantial inter-individual variability. Inspection of individual-level data revealed a subset of infants who exhibited reliable viewpoint-tolerant object representations, whose magnitude and timing representations varied across individuals. These results provide preliminary evidence that the neural mechanisms underlying invariant object representations can already emerge as early as 6 months. These mechanisms vary considerably across individuals, continuing to refine throughout development.