On the Perceptual and Neural Basis of Event Understanding

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How do we represent what is happening around us? In particular, how do observers perceive and understand the temporal organization of everyday, goal-directed activities? From making coffee to performing a tonsillectomy, people seem to talk about continuous activity in terms of discrete parts that are hierarchically organized. Evidence from four sources indicates that such talk is no accident; rather, people integrate bottom-up perceptual cues with top-down information about intentions to understand events.

First, studies of perception indicate that everyday events such as making the bed or doing the dishes are encoded in terms of hierarchical part-subpart relations: When observers are asked to segment movies of these activities into parts at coarse and fine temporal grains, they spontaneously do so in terms of hierarchical relationships between parts and sub-parts. This perceptual structure appears to be preserved in memory. Recent data strengthen the view that motion cues play a key role in identifying event segment boundaries.

Second, neuroimaging studies suggest that event segmentation is an ongoing component of perception, subserved by specialized neural substrates. In one study, participants passively viewed movies of everyday activities during functional MRI scanning and later segmented the same movies into meaningful coarse and fine units. A network of regions including posterior extrastriate cortex and precentral cortex showed transient increases at those moments later identified as perceptual event boundaries. Notable in the posterior regions was the MT complex, a region known to be specialized for processing motion information. Throughout the network, increases were larger for coarse boundaries than fine boundaries, and increased when participants deliberately segmented the activity.

Third, psycholinguistic production data suggest that information about event structure is spontaneously encoded into language. Descriptions of coarse-grained and fine-grained event parts differ systematically in their syntax: Coarse-grained descriptions pick out objects more precisely, whereas fine-grained descriptions are more precise regarding actions. Within descriptions of fine-grained units, those that occur near coarse boundaries take on some of the syntactic properties of coarse-grained descriptions. Thus, speakers implicitly convey information about hierarchical event structure within running descriptions of fine-grained events.

Finally, studies of narrative understanding demonstrate that event boundaries can guide working memory updating. Narrative time shifts such as “an hour later” serve as cues to readers that an event boundary has been encountered. After such phrases, anaphors to information presented before the event boundary are processed more slowly, and recognition memory for nouns presented before the boundary is less accurate.

Together, these results support the view that we automatically and actively encode events in terms of structured representations that capture recurring features of activity such as goals, roles and causal influence. The human perceptual system appears to include specialized routines for processing such information, possibly implemented by specialized neural systems, leading to active structuring of the perceptual information. This perceptual structure appears to guide downstream processing, including linguistic production and narrative understanding.

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Related Papers

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