Predictable object motion is extrapolated to support visual working memory for surface features

Anna Heuer & Martin Rolfs
Department of Psychology, Humboldt-Universität zu Berlin, Germany

Background and rationale
- Both space and time support VWM by providing reference frames, in which objects are incidentally represented relative to other objects. In fact, recent findings point towards a functional equivalence of space and time. For example, both spatial location and temporal position mediate the binding of surface features like colour or shape.
- So far, the functional role of temporal properties for VWM has only been studied with stationary items appearing sequentially at different locations. But natural scenes also contain moving objects, whose positions change over time, often in a predictable manner. VWM may bridge the gaps when objects temporarily move out of view.

Is predictable object motion utilised to facilitate visual working memory for surface features?
- Representations of dynamic configurations in VWM are characterized by specific spatiotemporal properties of the objects’ motion. Thus, spatiotemporal reference frames of moving objects may be updated by extrapolating their predictable motion, so that memory for surface features is enhanced when objects reappear at positions that are spatiotemporally congruent with their original motion.

Task and procedure
- At test, items reappeared...
  1. ... at the movement endpoint locations, where they disappeared.
  2. ... at positions spatiotemporally congruent with their previous motion direction and speed.
  3. ... at positions spatially congruent but with a temporal offset.
  4. ... at positions temporally congruent but with a spatial offset.

Memory performance decreased with an increasing temporal or spatial offset relative to spatiotemporally congruent positions, indicating that spatiotemporal reference frames in VWM incorporate an extrapolation of the memorised objects’ motion to facilitate retrieval.

Accordingly, temporal profiles centred on spatiotemporally congruent positions were asymmetrical - especially with unreliable motion patterns - as item positions with negative temporal offsets were closer to the endpoint locations.

Object motion can be leveraged to support VWM. This updating of spatiotemporal reference frames only occurs if the mental motion extrapolation allows for a reliable prediction of where temporarily occluded objects will reappear.

Summary and conclusions
- Memory performance decreased with an increasing temporal or spatial offset relative to spatiotemporally congruent positions, indicating that spatiotemporal reference frames in VWM incorporate an extrapolation of the memorised objects’ motion to facilitate retrieval.
- This congruency effect, however, diminished over time in a task context with unreliable motion patterns: When items were likely to reappear at spatiotemporally incongruent positions, performance instead increased at the movement endpoint locations.
- Accordingly, temporal profiles centred on spatiotemporally congruent positions were asymmetrical - especially with unreliable motion patterns - as item positions with negative temporal offsets were closer to the endpoint locations.

Object motion can be leveraged to support VWM. This updating of spatiotemporal reference frames only occurs if the mental motion extrapolation allows for a reliable prediction of where temporarily occluded objects will reappear.

References

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