Slow Change: The Visual Context for Real World Learning

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Introduction

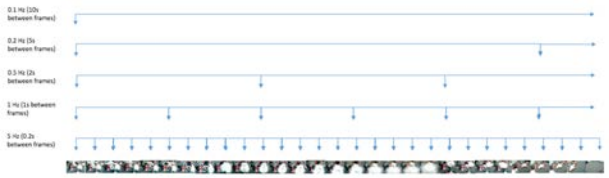
- Infant sustained attention to a single object during object play is correlated with later cognitive development, including the rate of vocabulary acquisition. [1]
- Measures of infant sustained attention to an object – before and after naming – show that longer bouts of visual attention to the object supports learning of the object name. [2]
- However, stabilized attention requires a reasonably stable visual world.
  - The rate of change of object information in the world changes as a function of physical changes in the world, moving objects and people.

How stable are the scenes that children create when they play with objects?

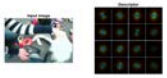
Procedure

- 12-month-olds (N = 8) and 30-month-olds (N= 8) play with their parents for 10 minutes with an assortment of 30+ toys, dumped on the floor, to create a highly cluttered naturalistic play area.
- Head-mounted first-person scene cameras recorded the infants' approximate field of view.

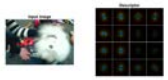
- Images were sampled from the videos at 5Hz (5 frames per second).
- Various computational measures of scene change were calculated between adjacent scenes at different timescales.

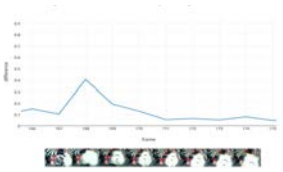


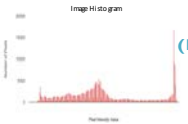
Global Measures of Scene Change



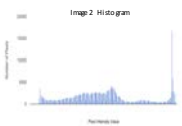
1. GIST (Spatial Envelope Model[3])

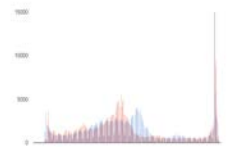






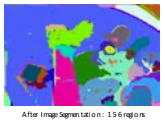
2. Pixel-to-Pixel Similarity (Image Histogram Intersections)





These two images have 66391 pixels (19% of image) **outside** the intersection of their histograms.

3. Number of Objects/Clutter (Image Segmentation[4])



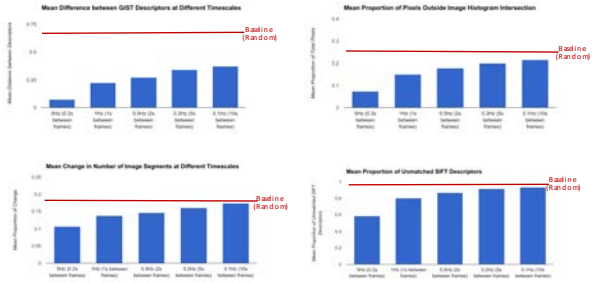
Local Measure of Scene Change

Matching Local Features (Scale-Invariant Feature Transform[5])

SIFT key points (distinct edges) are generated and mapped onto the images.

Overlay of the two images on top of each other (one in blue and other in red) the matching SIFT feature points are marked out and pinned together with a line.

Results



Discussion

- **The visual world during object play changes continuously, but the global structure of scenes changes in slow and incremental steps, even across increasingly larger timescales.**

- The importance of Sustained Attention in infant learning (especially about the visual objects and their names) may reflect the time scale of natural learning environments or scenes.
- Inferences from laboratory experiments which have rapid changes – rapid offsets and onsets of objects – may not indicate either infants' competencies in visual learning about objects or the processes through which they learn about objects.
- Slow Change, as documented here, fits a number of computational models of visual learning, animal studies[6], and some recent advances about the timescales of high level cortical processes[7].

References

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