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C2

Curious visual representation learning in children and machines


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Motivation

- Vision is an active process. We decide several times a second which information we sample next.
- What guides this selection of information in young visual learners like infants and children? Curiosity can serve as a guiding principle, but how are children curious?

Preliminary work:

- Deep learning for active vision[1,2]
- Limits to infants' label-based categorization and generalization of novel perceptually overlapping objects (Fig. 1)[3]

Fig. 1. Young infants struggle to extend novel labels to novel category members in the presence of perceptually overlapping non-category members

Objectives

- Study active vision during development under realistic and natural conditions
- Find out what guides information selection in young visual human infants and nonhuman primates

➢ We use a normative approach using active learning in computer vision models to answer the question **How are we curious?**

➢ In analysing the consequences of curiosity on learning, this project will speak to the question **Why are we curious?**

?

Can curiosity serve as a guiding principle for active information selection in young visual learners?

Methods

- Use artificial vision systems as **normative models**
- Train artificial vision systems in an **active vision** setting using different unsupervised and supervised objectives
- Active sampling at the level of **images** and **image regions**
- Measure **eye movements** of children viewing natural scenes

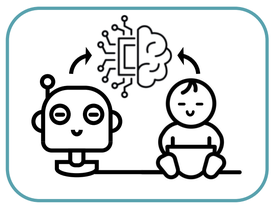
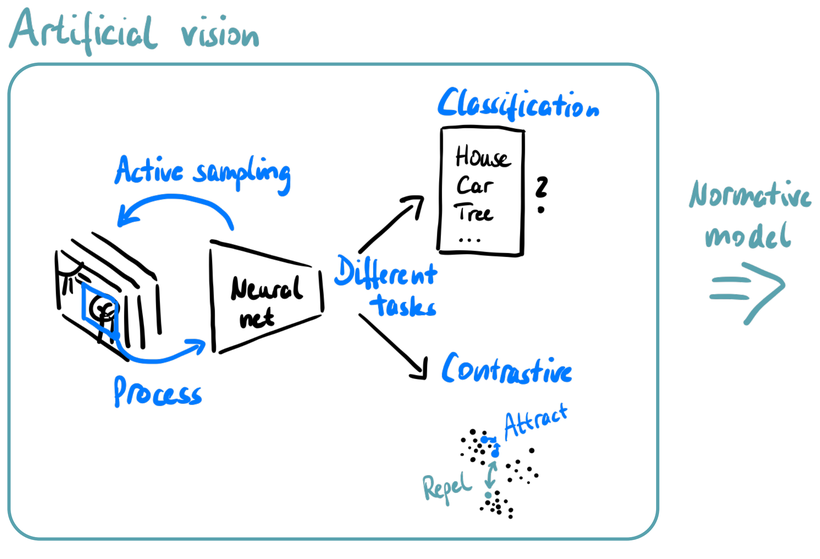


Fig. 2: Head-mounted eye-tracking in children exploring a visual scene



Hypotheses:

- Infants will rely more on typicality and population density than older children
- With the advent of language and metacognition, children will rely more on uncertainty and linguistic category membership
- Children will be curious about objects that improve their knowledge of object categories

Cross-project collaborations

- Work closely with **A2** and **B4** on curiosity-driven learning in nonhuman primates and children together with **C3** and **C5**
- Focus on **ecologically valid settings** in experimental designs with **A1**, **A3**, **B2**, **B3, B4**

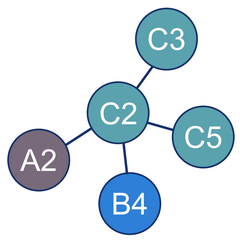


Fig. 1. Some key collaboration partners of doctoral researcher working on Project C2

Potential PhD projects

1. How do active learning strategies predict which objects children are curious about?
2. Which learning objectives explain what object features children attend to?
3. Modelling changes in children's curiosity over development

References

1. Weis, M.A. (2018). Class-agnostic instance segmentation with foveated image sampling. *Master thesis (Universität Tübingen)*
2. Weis, M.A., Chitta, K., Sharma, Y., Brendel, W., Bethge, M., Geiger, A. & **Ecker, A. S.** (2021). Benchmarking unsupervised object representations for video sequences. *The Journal of Machine Learning Research*, 22(1), 8253-8313.
3. Taxitari, L., Twomey, K. E., Westermann, G., & **Mani, N.** (2020). The limits of infants' early word learning. *Language Learning and Development,* 16(1), 1-21.