

Modeling Infant's Attention to Investigate Parental Scaffolding for Imitation

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The ability to imitate is a cornerstone for social development. Infants acquire new skills by imitating actions presented by others. An open question is how infants know “what to imitate” (Carpenter and Call, 2007), i.e., whether to reproduce the goal state by adopting any action or to copy the means action. For instance, in a stacking-cups task (see Fig. 1 (a)) achieving the goal is more important than reproducing the exact trajectory of the cup-movement, whereas in a sprinkling-salt task (see Fig. 1 (b)) the movement of the salt dispenser must be replicated to fulfill the goal.

Our hypothesis is that parental actions assist infants in detecting the information concerning what to imitate. Parents are known to significantly alter their infant-directed action compared to adult-directed one (Brand et al., 2002; Rohlfing et al., 2006). They, for example, exaggerate their movement and put more pauses between movements. In order to reveal how the parental action properly guides infants' attention to teach the important aspect of the action, we have been analyzing the parental action using a primal visual attention model. The biologically inspired model (Itti et al., 1998) can detect salient locations in a scene, where the saliency is defined as the outstandingness from the surroundings in terms of primitive features, e.g., color, orientation, and motion. Fig. 2 shows a sample scene from our experiment, where a father is demonstrating the stacking-cups task to his infant. His face and hands as well as the cups are detected as salient due to the conspicuous color against the blue background, the rich edge features, and/or the movement. Comparing the saliency for each location, the model finally directs its attention to the most salient, i.e., the green cup and the father's right hand, seeming to be important in the scene. Of particular note is that the model can simulate infants' attention (Schlesinger et al., 2007). Because infants are supposed to have little semantic knowledge about the task and thus rely more on the bottom-up information, the saliency model could explain where infants look and what they learn from parental actions.

Our analysis comparing the infant-directed action with the adult-directed revealed that the goal of the stacking-cups task was highlighted by the suppression of the parents' body movement whereas it was not in the case of the sprinkling-salt task. When demonstrating the stacking-cups task to infants, parents made a pause before starting and after fulfilling the task, which relatively increased the saliency for the static cups. They seemed to underline the initial and final states of the cups to teach the importance of the goal to the infants. In the sprinkling-salt task, by contrast, the parents added movement to the salt dispenser. They picked up it and then shook it to draw the infants' attention, which resulted in making the state invisible. They might focus on the means rather than the goal. Our findings are discussed regarding the uniqueness of the parental action depending on the demonstrated task as well as the commonality across the tasks.

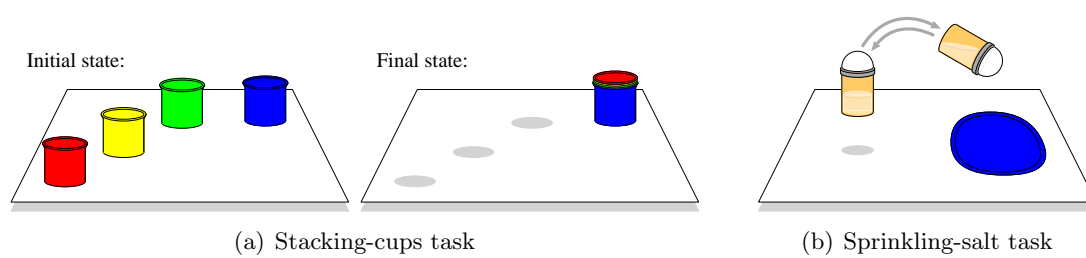


Fig. 1: What is important in the task, the goal (a) or the means (b)?

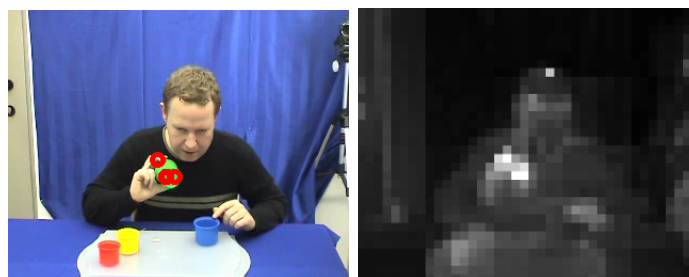


Fig. 2: Attention of saliency model (left) and corresponding saliency map (right)