Learning about Humans During the First 6 Minutes of Life

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Abstract— There is strong experimental evidence that new-born infants orient towards human faces [1]. While opinions are divided as to whether this preference reflects domain specific knowledge about the appearance of human beings, or general preferences for stimuli that happen to occur in humans [2] most views agree that the face-preference phenomenon is innate and not learned. Here we explore another hypothesis, *the Rapid Learning Hypothesis* which in the past was rejected as being computationally implausible.

We built a robot with the appearance of a human baby and endowed it with an algorithm that detects contingencies in the auditory domain [3]. Members of our laboratory were then encouraged to sporadically interact with the baby robot.

We also endowed the robot with a new machine learning algorithm for discovering visual concepts [4]. The input to the system were the images collected by the baby robot's camera at 30 frames per second. In addition each image was automatically labeled by the auditory contingency detector to indicate whether or not auditory contingencies were present at the time the video frame was captured. 30% of the images captured while auditory contingencies were detected, did not contain people. 5% of the images captured while auditory contingencies were not detected, contained people. In addition, people could appear anywhere on the image plane, sometimes showing their face, sometimes other parts of their body.

In less than 6 minutes of interaction with the world the robot learned to locate people in novel images. In addition, it developed a preference for drawings of human faces over drawings of non-faces, even though it had never been exposed to such schematic face drawings before. During learning, the baby robot was never told whether or not people were present in the images, or whether people were of any particular relevance at all. It simply discovered that to make sense of the images and sounds it received, it was a good idea to use feature detectors that happened to discriminate the presence or absence of people.

While in our experiment we used auditory contingency as a training signal for a visual concept learner, other training signals could also have been used. All that is required is for the signal to provide higher than chance information about the presence or absence of people. For example, if a baby or robot is being touched or moved, these could likely serve also as a training signal.

The results illustrate that visual preferences of the type typically investigated in human neonates can be acquired very quickly, in a matter of minutes. Previous studies that were thought to provide evidence for innate cognitive modules may actually be evidence for rapid learning mechanisms in a neonate brain exquisitely tuned to detect the statistical structure of the world.

Index Terms— Infomax Control, Autonomous Learning, Object Categories, Face Detection, Developmental Robotics, Social Robotics, Internal Labels, Rapid Learning Hypothesis.

REFERENCES

[1] John Morton and Mark H. Johnson. Conspec and conlern: A two-process theory of infant face recognition. *Psychological Review*, 98(2):164–181, 1991.

[2] K. A. Kleiner and M. S. Banks. Stimulus energy does not account for 2-month-old preferences. *Journal of Experimental Psychology: Human Perception and Performance*, 13:594–600, 1987.

[3] Javier R. Movellan. Infomax control as a model of real time behavior: Theory and application to the detection of social contingency. Technical Report 1, Machine Perception Laboratory, 2005.

[4] Ian R. Fasel and Javier R. Movellan. Weakly-supervised robust, real-time object detection and localization. In *NIPS Workshop on Automatic Discovery of Object Categories*, December 2005.