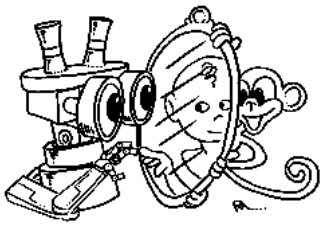

MIRROR

IST–2000-28159

Mirror Neurons based Object Recognition

Deliverable Item 4.2

Protocol for the Behavior Development Experiments

Delivery Date: April 30, 2002

Classification: Internal

Responsible Person: Prof. Claes von Hofsten – University of Uppsala

Partners Contributed: Kerstin Rosander (UU)

Short Description: This deliverable item describes the experimental procedure and the experimental protocols that will be adopted during the behavioral experiments aimed at investigating the developmental timeframe of the mirror system.

Project funded by the European Community under the "Information Society Technologies" Programme (1998-2002)

Content list

1. **Introduction**

During the initial months of the project two kinds of experiments aimed at studying the early development of mastering the adjustments of hand orientation in manual tasks have been designed: "the rotating rod experiment" and "the rod-hole experiment". In both cases the aim of the experiment is to investigate the onset and development of the goal-driven ability to control hand orientation. This ability is supposed to be a first step toward the ability to pre-shape the hand during the transport phase of grasping. The experiments are proceeding as expected. 28 infants have been tested in "the rotating rod experiment" and 15 in the "the rod-hole experiment". Calculations are underway.

2. The *Rotating Rod* Experiment

The aim of this experiment is to investigate when and how infants start to control hand posture in relation to the shape of the object to be grasped. This ability is shown very clearly in adults by the “pre-shaping” of the hand during the transport phase of grasps. What pre-shaping does is, in fact, to prepare the hand to the “best” contact with the object to be grasped before the object is touched. Therefore it has, at least, two important components: one is based on the physical shape of the object determining which type of grasp is best, the other is related to dynamics of the grasping action and the need to anticipate the position and orientation of the object at the time of contact. For practical reasons it is very hard to precisely measure the posture of the hand of infants during grasping (e.g. no “data-glove” is available for infant-hand size) and therefore it is experimentally difficult to investigate the onset of pre-shaping abilities. For this reason it was decided to simplify the measure by assuming that the orientation of the hand with respect to a rod-like object can be studied as an example of pre-shaping ability.

More specifically the following questions were asked: How well do infants adjust the orientation of the hand to the orientation of the rod at different ages? Do infants anticipate future orientations of the rod in order to optimize the grasping of it? Do they rotate the hand with the rod to ensure a smooth encounter with it? Three groups of subjects are tested: adults, 10-month-olds, and 6-month-olds. The adults are presented with a rod that is either stationary (vertical or horizontal) or move with 0.1, 0.2, 0.3 rotations/s. The infants are not presented with the 0.3 rot./s condition because piloting demonstrated that this condition was too difficult for them. Each of these conditions condition is run with the rod rotation clockwise as well as counter-clockwise. The reaches are registered with a position measuring system (Qualisys) using passive markers at significant landmark on the hand and the object. The markers on the hand are positioned at the radial and ulnar side enabling analysis of hand rotation and the markers on the rod are positioned at its endpoints. The reaches are measured at 240 Hz.

In the following figures the set-up experiment is shown as well as the picture of an infant during the experiment.

	
Experimental Set-up with recording equipmets	Close-up of infant performing the reaching/grasping action

3. The *Rod-hole* Experiment

The following questions were asked. At what ages can the child make the correct manual action to insert a certain rod into the corresponding hole after having looked at the cross-section of the rod and the hole? What kind of adjustments do they make? What adjustments seem easily mastered and what seem difficult? Infants from 1 year to 2 years of age are tested. Their task is to insert rods with different cross-sections (round, square, rectangular, triangular) into holes of the same form. This is a very motivating task and infants try hard at inserting the rods into the holes. The experimental situation is monitored by two video cameras positioned in such a way that all maneuvers are visible from at least one of the cameras. The analysis is mainly qualitative and aims at finding out how much of the adjustments are planned in advance and what kinds of corrections are made.