ADAPT

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Artificial Development Approach to Presence Technologies

Deliverable Item 1.6
Periodic progress report

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Short Description:

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This document describes the project advancement just before the second year review meeting to be held in Munich on June 7-9th, 2004. The document has been updated to reflect the status of the project up to October 2004.

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1 Executive summary

Adapt deals with a very basic question about the sense of presence: that is, how do we represent our world and, in particular, how do we represent our world of objects? There are two basic facts about this: we can ask first what a representation* is, encompassing in the answer quite a wide range of different disciplines, and second, how this representation can be used to reproduce the sense of presence in a human being. We chose (see the Technical Annex) to study mostly the first question and, as such, we are not going to work on the construction of any virtual reality device. Conversely, we are investigating on one side how representations are built by the brain during ontogenesis and, in parallel, how a model of this process can be reproduced in a robotic artifact. The reasons being that the study of development can provide precious hints that the study of adults can not, while, following the so-called synthetic methodology†, we aim at producing a working model of a similar process allowing a robot to acquire representations through the interaction with the environment.

Since the concept of representation is a quite troublesome one we tried to formulate a consistent explanation of what it means “to be representing something”. This is described in deliverable 2.1 “a theory of intentionality”. As a consequence we are not only asking what a representation is but also how the brain might be building it. This problem is, primarily, investigated on human infants starting from newborns to children of 12/18 months of age. We aim at uncovering some important missing pieces in the comprehension of our capacity of forming representations. In particular, since experiments need to be more narrowly focused than the general theory presented in D2.1, we are investigating how the multisensory representation of objects is acquired in early infancy. The experiments conducted so far are described in deliverable 4.1 and 4.2.

The role of embodiment, that is how the structure of the sensory and motor system influences this process, is also considered in Adapt (deliverable 3.2). In particular, we are considering how embodiment influences the information processing capacities of our artificial agents.

When considering embodied agents (natural or artificial) we need naturally to extend our representations to take into account motor information. Recent results of neurophysiology strongly support this view where various sensory modalities are intermingled with motoric and bodily information (similar to the ecological psychology and the concept of affordances proposed by Gibson).

Our big feat continues to be that of trying to embed these fragments of understanding in a fully functional robotic system and in doing so producing a functional model of presence. The platform we are developing is described in deliverable 3.1. The control architecture is described in deliverable 5.1, 5.2, and 5.3.

In summary, the central core of Adapt is that of representation, and for explaining it our investigation ranges from developmental psychology to philosophy of mind and to robotics.

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* Representation: not to be confused with the classical view of classical AI (representation and symbol manipulation).

† Synthetic methodology: it has been proposed that building robotic artifacts might be a useful endeavor to understand the extent and conditions of validity of models of the physiology (the functioning) of biological agents.

Our rationale as mentioned in deliverable 1.4 is the following:

1. Since we believe that representations are unified and created by means of action,
2. and the best example of action is manipulation,
3. we decided to investigate how the multisensory representation of objects develops in children and in artificial systems possessing opportune structures.

During the reporting period the Adapt team was also responsible of the organization of the Fourth International Workshop on Epigenetic Robotics dealing with development and robotics thus covering and overlapping with the scope of the project. It was organized in Genoa on August 25-27th, 2004.

2 Work progress overview

2.1 Specific objectives for the reporting period

Most of the Adapt effort during the reporting period has been devoted to the preparation of the experiments and consolidation of the experimental scenarios. We acknowledge the project has accumulated some delay but this was not incidental. On the other hand we have overcome one of the most challenging aspects of the project, namely, the creation of a common background and language between developmental psychology, robotics, artificial intelligence and philosophy.

Our goals for the past year have been to:

- Recover from the delay;
- Finalize the preparation of the robotic setups;
- Start new developmental psychology experiments.

We believe all these goals are now accomplished and the experiments are on their way. The actual activity is very close to the planned one.

2.2 Overview of the progress

At the moment of writing various aspects of Adapt are getting to a more definite form.

In particular considering **workpackage 2**, the consortium produced a document (D2.1) where the basic elements of a theory of intentionality have been defined. This effort is the minimum core from which Presence-related specifics will be derived during the prosecution of the project. Also, the validation of the theory[‡] or at least a certain degree of congruence is expected between the developmental experiments (WP4) and the theory. One of the goals of WP2 is that of gaining support and evidence for the general theory of intentionality from the results of experiments on young infants on one side, and from experiments on computational modeling (the artificial developmental architecture) on the other. According to our schedule, further prosecution of WP2 is only due towards the end of the project (last 6 months or so).

[‡] Perhaps a much wider validation effort should be envisaged. Clearly a single set of experiments could not possibly validate completely the theory given its broad and far looking scope.

We dedicated some more effort from WP1 to try to harmonize these different strains (development, theory, and robotics) into a more coherent multidisciplinary view. More importantly, part of this effort will go into a clearer assessment and evaluation procedure of the results of the project. Additional documentation on this matter will be produced toward the end of year 2.

The first stage of **workpackage 3** came to a conclusion after the first 12 months of the project. We have made a number of major and somewhat minor improvements to the two existing robotic setups: the Babybot in Genoa, and the active vision system and industrial robotic arm located in Zurich.

The most natural and major upgrade of our robotic platform was the realization of a five-finger robotic hand. As described in D3.1 the robot hand fits nicely to the existing humanoid setup in Genoa. We completed a full testing of the hand electronics and mechanics. Sensors include tactile elements (FSR at the moment of writing) and Hall-effect sensors to measure the position of all joints. The setup in now completed. Along the way, a major revision of the (software) control architecture of the robot has been carried out. Some elements of the motor behaviors are not yet integrated back into the system but things are proceeding at a reasonable pace. This preparatory activity merged naturally into some early experiments on manipulation of objects.

In parallel, the group in Zurich designed a new robotic head to address the limitations of their current active vision system. The plan is to duplicate to a certain extent (functionally) the setup in Genoa so that experiments could be performed independently or jointly on both sites. The head, which already features 6 degrees of freedom and stereo vision, is soon to be extended with audition and a gyroscope. Furthermore, the design of an anthropomorphic torso-shoulder-arm-hand combination has been commenced. Four people are working on the computer interface for the robot. The design of the robot as well as the interface is done with flexibility and modularity in mind, so as to allow for later replacement of physical and logical parts, as required for morphology research.

After completion of the arm design, our focus for the prosecution of WP3 will be the study of the morphology of the haptic modality. We have completed initial studies on FSR sensors but we are now looking at an improved method employing the same technology at a higher density. Furthermore, we are going to investigate strain gauges and a combination of those with FSR sensors. Finally, we are strengthening the cooperation with Zurich's AMOUSE team, which is exploring whiskers as a sensory modality. Our goal is to be able to detect both, pressure and texture. Part of this investigation shall be concerned with the material used for the fingers, which has to be suitable for gripping as well as the integration of appropriate haptic sensors. We expect additional experiments on morphology further down the road. Deliverable 3.2 describes the experimental setup that will be used for conducting the experiments on morphology.

Clearly, given the overall time scale and effort devoted to this last activity we do not expect to fully integrate the new sensors into the existing robotic experimentation plan. For instance, it is not realistic to expect the integration of the strain gauge based tactile sensors into the robotic hand in Genoa. Instead, we believe that these results can potentially shed some new light on the relationship between morphology and manipulation (and possibly be used in some future implementation).

Workpackage 4 is devoted to the study of the developmental time course underlying the acquisition of the multimodal representation of objects. Research of WP4 is aimed at testing two hypotheses: the hypothesis of a primitive unity of senses at birth and the understanding of the "rules" of cross-modal transfer, and the hypothesis of a later access to a general intersensory integration through perception-action coupling, and in particular through experiencing the specific properties that objects afford to action. In-line with the project plan, we are now involved in testing further the first hypothesis. This is the starting point of development (time zero) and it is clearly required in defining the initial state of any developmental model.

As detailed also in deliverable 1.4, the first experiment of WP4 was carried out on 12 newborn infants. After visual habituation to an object (prism or cylinder), infants received in their right hand the familiar shape and the novel shape. A longer holding time for the novel shape than the familiar shape was expected. Results did not show transfer from vision to touch. The conclusion is that the characteristics of the shape of the object do not transfer bi-directionally: i.e. we observed transfer from touch to vision but not from vision to touch.

Texture is also an amodal property and in adults it is well processed by touch. Moreover, texture does not need (to our knowledge) a different mechanism of processing whether it is either visually or haptically perceived. We tested rough vs. smooth objects. A group of 16 newborns participated to the experiment on cross-modal transfer from vision to touch and 16 newborns participated to the experiment on cross-modal transfer from touch to vision. The procedure was the same as in the previous experiment. There were two phases: the habituation phase in one modality and the test phase in the other modality. In this case the general results show that texture shows bi-directional transfer: i.e. the object is recognized both visually and haptically irrespective of the habituation situation. The overall experimentation plan is shown also in section 2.8. Intermodal transfer is being tested in different situations: in newborns within the context of recognition of sequences of events, and in 20-month-olds in the context of categorization.

The detection of social contingency implies building relationships between ones' own behavior as perceived via proprioceptive information and the behavior of others perceived through vision, sound, etc. It requires establishing relationships between what we perceive the other person doing and what we might feel if we had been doing the same action/behavior (cross-modal transfer between perception and proprioception). We have been testing these relationships as described in D4.1 and D4.2.

Fifteen two-month-olds reacted to non-contingent episodes by a decrease of gazing to mother, disappearance of smile, and a dramatic increase of frowning, thus replicating Nadel's previous results. In a new experiment, exploring which parameters account for such a precocious detection of non-contingency, we found that the infants did not imitate during a non-contingent episode, whilst numerous imitations were observed during contingent episodes. We interpret this results as providing evidence that non-contingent behavior is an obstacle for addressing the infant’s own perception of certain behaviors (i.e. experiencing other’s agency in their mirroring of one’s own behavior), which in turn is an obstacle to experience one’s own agency in mirroring the other’s behavior.

Newborns turn their head toward a sound. It is seen as the first example of an intersensory integration. However, an unexpected phenomenon is the temporary disappearance of visual orientation toward auditory sources around 1 to 2 months of age and its reappearance around 3 to 4 months. This phenomenon remains largely unexplained. A way to study further the early aspects of intersensory integration is to present to the infants social stimuli that violate the normal intermodal matching between visual and auditory channels. An experiment is in progress following this idea.

Workpackage 5 is devoted to the realization of the architecture for the robotic implementation of the developmental model. The architecture is described in D3.1 and D5.1. D5.2 and D5.3 describe the details of the implementation and initial experiments of learning of multi-modal features. In particular we are considering the role of motoric information in the selection of visual features through unsupervised learning mechanisms.
The results are still pretty much “work in progress” although early testing and partial results have been collected into D5.1, D5.2, and D5.3. We expect, now that also the experimental setups are fully available, to quickly further the implementation.

To improve the design of common experiments we have implemented an interface between Matlab and our robotic architecture that will allow quickly developing learning algorithms and importing existing code to the robotic platform. We started working on the neural network algorithm for learning coherent multi-modal representations. There has been some progress and the theory and initial implementation of the model are now in place (D5.3 for the latest results). We still haven't done experiments with the actual robot data.

On the pure robotic side, we have implemented a number of behaviors that now allow precise reaching (required for manipulating objects) and started an experiment on manipulation (although a simple one). We are now evaluating a simple set of data according to the neural network model proposed in D5.1/D5.2. We expect the first real experiment on the acquisition (unsupervised) of multi-modal object features to be ready by the end of the year 2004.

2.3 Deliverables

Deliverable status and reached milestones are detailed below.

Number	Title	Type	Due month	Expected
D1.1	Project presentation	Docs + web site	3	N.A.
D1.2	Dissemination and use plan	Document	6	12
D1.3	Management report	Document	6	6 (rev1) 12 (rev2)
D1.4	Periodic progress report Y1	Document	12	12
D1.5	Management report	Document	18	20
D1.6	Periodic progress report Y2	Document	24	25

D2.1	A tentative theory of intentionality and the sense of being there	Document	7	12
D3.1	Definition and implementation of a human-like robotic setup	Document	12	12
D3.2	Hardware and software in place to run experiments on changing morphologies (e.g. changing resolution and motor precision)	Prototype	15	20
D4.1	Definition of experimental paradigm	Document	12	13
D4.2	Definition and implementation of setup for the investigation on child development	Prototype	12	13
D5.1	System's architecture specifications and design	Document	6	14
D5.2	Basic unit design and implementation	Prototype	9	14
D5.3	Initial implementation of the integration model	Prototype	12	20
D5.4	Initial experiments with multiple sensory modalities integrations (DELAYED)	Document	18	27-28
Additional document	Plan of experiments	Document	-	N.A.

Submitted [yellow]. This document [cyan]. To be delivered [white].

2.4 Comparison between planned and actual work

Deliverable 5.4 has been delayed since the experiments are not yet completed and in particular we have not finished the integration between the part of the architecture developed in Zurich and the robot in Genoa. We estimated a delay of about 4 to 5 months. We do not see this delay as seriously impeding the continuation and completion of our research program since a lot more of necessary activities have been carried out on the robotic setup during the reported period. Some of the foreseen robotic experiments have been started (although in slightly more limited form) and they will be extended and finalized in the next few months.

The progression of the project is in substantial agreement with the Technical Annex apart from the delay of D5.4 mentioned above. A few details of the experiments might be changed as the work progresses to allow focusing the effort onto the most promising experimental routes. For instance the experiment with conflicting haptic/visual properties might not be performed and rather we prefer to concentrate on the analysis of the development of affordant use of objects.

2.5 Milestones

Number	Title	Delivery date (month)
M1	Tentative Theory formulation	7
M2	Validated theory and common vocabulary	36
M3	Different robotic setups to test the effect of morphology	12
M4	Formal analyses and first setup of conclusions	30
M5	Final evaluation of morphology changing experiments	30
M6	Human like robotic setup	15
M7	Experimental setup and paradigm	12
M8	Result of behavioral experiments	30
M9	Modeling of coherent representations	33
M10	Basic units design and implementation	12
M11	Multi sensory modalities integrations	21
M12	Artificial intentional architecture	33

[yellow] reached.

2.6 State of the art update

There is nothing specific to Adapt to be mentioned in terms of technology or development, apart from two trends:

- The ever bigger involvement of industries in the humanoid robotics market (still at its very beginning but getting significant now: see Honda, Toyota, Sony, etc.). The involvement is still mainly Japanese.
- A trend of going “open-source” for many projects. It was probably recognized by the research community that there is much to be shared across various projects.

It is also striking though obvious that while industrial research projects are very much proprietary and closed, universities and EU projects are very much in favor of an open policy.

2.7 Actions taken after Y1 review

Following the review report a certain number of actions have been undertaken:

1. The project web site (http://www.liralab.it/adapt) has been updated and extended. It now provides information on all the deliverables, description of the experimental setup, and we expect to keep posting experimental results as soon as they’re available. A page showing the status of advancement of the project has been added.

2. The delay noted by the reviewers at the beginning of the project has been partially corrected. It is justified to some extent by the preparation of the experimental setup (especially for the infant experiments).
3. A better synergy between the different lines of work is possibly starting to emerge now (around month 20). Note though, that the preparation of the robotic setups (according to the Technical Annex plan) has been completed at month 15 (i.e. only a few months ago). The plan of the experiments includes:
    a. Joint work between the UNIZH and DIST on the learning architecture (see deliverable 5.1).
    b. A common similar experiment on learning of affordances between DIST and CNRS.
    c. Exchange of data between CNRS and UNIZH for the analysis of multi-modal (video and audio) sequences.

   This activities will coalesce into a set of three lines of experiments how outlined in the plan for the next year.
4. Reporting has been improved according to the reviewers' suggestions. Deliverable 1.3 has been resubmitted. The delayed deliverables have been all submitted. As noted earlier there is at the moment of writing only one delayed deliverable which is expected to be ready by next August 2004.
5. On the matter of cross-project activities within Presence, Adapt is participating to all the activities of Omnipres, namely, with two contributions to the Handbook of Presence, with regular reporting to Omnipres (three-monthly as planned), and with Omnipres meeting attendance. Soon Adapt will be in the position of possibly finding synergies or interacting with other projects of the PR cluster.

2.8 Planned work and status of experiments

Theoretical umbrella of the theory of intentionality/development (WP2)			
Age (mo)	**Developmental experiments WP4**	**Robotic experiments WP5**	**WP3**
Birth	The very initial step of the development of the representation (newborns <3 days of age). We would like to answer to the question of what is the significance of the intermodal transfer (visuo-haptic) observed in newborns. The instability of such transfer at later age: e.g. it changes from haptic to visual (at birth) into visual to haptic by about 5 months of age.	Investigating the initial formation of the representation by haptic exploration of generic shapes. What is the language of touch for the robot made of? How does the sense of touch correlates with motor action? What is the meaning of having an initial transfer of information from haptic to vision? What does it buy us? Learn multimodal representation.	Clarification of the role of morphology in building a multisensory representation. Study and experimentation of various types of tactile sensors. Evaluation of the morphologies with information theoretical tools.
		Investigating the role of self-supervised learning in the acquisition of sensorimotor coordination. These are clearly prerequisites for the interaction with object and manipulation (e.g. eye-head coordination, reaching/transport phase).	
	Q: To what extent the intermodal transfer is selective to certain cues. Previously, testing has been carried out only with respect to the shape of objects. This experiment uses the same	What features can possibly be embedded into the robot representation? Experiments with unsupervised learning techniques. We are designing algorithms to extract invariant features	

	protocol of habituation to test texture rather than shape. Ongoing activity includes the study of cross-modal transfer between other sensory modalities (auditory/visual) and the categorization abilities in cross-modal transfer tasks.	from sensory and motor data streams.	
6-9-12	Consistency of intermodal integration: Ambiguous objects (transfer of information). What action is elicited when an object with ambiguous visual/haptic features is presented?	Experimentation includes learning (discovering) affordances of objects. An important aspect is the strategy of exploration of the environment and objects.	
	Non-affordant use of objects (embedding of motor information into the unified representation). What would an infant imitate when shown a non-affordant use of object?	How does the motor information contribute to the construction of the representation? What happens if we embed motor information into the representation of objects? See previous experiment.	
2-6	Early detection of social contingency: presentation of non-contingent situations by for example delaying speech vs. video.	Clarify what is the role of the detection of contingency into the architecture. What happens if we change the delays of different sensory cues? Analysis of sequences of multi-modal data.	

[yellow] Experiments either in progress or completed.

2.9 Future work

The future experimental activity for the remainder of the second year will mainly see the completion the ongoing experiments. In particular, we would like to complete the tests of the unsupervised learning model on the robotic setup and to finish the experiments on conflicting cues with infants and intermodal matching as outlined earlier in section 2.8.

Concerning the third year we have planned a set of three experimental lines aimed at:

1. Continuing the investigation on the structure of cross-modal transfer in infants.
2. Starting the experiment on the affordant vs. non-affordant use of objects.
3. Starting a parallel robotic experiment on the acquisition of affordances of objects.

2.9.1 Investigation on cross-modal transfer

Many studies provide evidence that 6-month-old infants discriminate large numerosities that differ by a ratio of 2.0, but fail with a ratio of 1.5, when presented with arrays of visual forms or sequences of sounds (the work of Xu & Spelke, 2000; Lipton & Spelke, 2003). Ongoing experiments investigate newborn infants' ability to discriminate large numbers of events in an auditory-visual intermodal task. In each experiment, 16 infants are first familiarized with sequences of Consonant-Vowel syllables emitted by two loudspeakers. Each sequence presents a single syllable for a specified number of repetitions; across sequences, syllables varied in pitch and duration. Equal numbers of infants are familiarized with sequences of 4 vs. 8 sounds (Experiment 1) or 4 vs. 6 sounds (Experiment 2). After familiarization, sequences of flashes emitted by a red light bulb are shown to the infants. Our preliminary results provide evidence that newborn infants successfully discriminate between 4 and 8 repetitions but fail to discriminate between 4 and 6. These results extend previous findings on large number discrimination and provide the first evidence of a system of number knowledge that is independent of postnatal experience. Most important, the experiments provide evidence that infants' initial number representations are sufficiently abstract to permit transfer across auditory and visual modes. This first experiment has to be replicated because results are very new and we have to make methodological controls. We plan also to experiment in almost the same condition but with smaller numbers (2 vs 3).

Cross-modal transfer tasks involve a categorization process (same or different when subjects compare tactual and visual objects). The infant's ability to form object categories on visual information are now known. An experiment is planned to investigate the possible link between the categorization process in a cross-modal transfer task and lexical development. 32 20-month-old children will participate to this experiment. 16 children will receive a cross-modal transfer task from touch to vision without denomination. We adopt the preferential looking procedure: i.e. after a short tactual familiarization with an unknown odd object (20sec) without visual control, children will receive a visual test with the familiar object and another unknown odd object. We record the time of visual fixation on each object. The second group of 16 children will receive the same task, with the unknown odd object in the tactual familiarization phase but then each object will receive a label, a meaningless syllable, for example ZAP or DOUK, etc. Then, they will go through the same visual test. Our hypothesis is that cross-modal recognition should be more effective when children "know" the name of object.

2.9.2 Experiment on the affordant vs. non-affordant use of objects

The experiment will be conducted on infants aged 6 to 12 months. In a parallel experiment, the robot has to find a relationship between visual information about an object and proprioceptive anticipation of the grasping to operate (see next section). Our aim is to follow the development of perception action-coupling leading to pre-reaching strategies that generate an affordant grasping to different objects. It is expected that showing a non-affordant model to 12-month-old infants will lead to a conflict between perception of the model and pre-reaching strategies (i.e. the infant would imitate the non-affordant grasp) while no imitation is expected in 6 month olds (following Von Hofsten's data with 6 month-olds in similar experimental conditions). The experiment will be conducted on 15 full-term infants of 6 and 15 infants of 12 months.

The infant is sitting on her/his mother's lap in front of a table. The object is placed in the centre at such a distance with respect to the infant's hands that she/he has to reach the object first in order to grasp it. The experiment consists of two short episodes: 1) spontaneous grasping, and 2) grasping after a model (a demonstration).

Pre-reaching

Reaching

Grasping

Figure 1: the set of object used in experimenting with affordances.

2.9.3 Experiment on the robot

We plan to run a similar experiment to 2.9.2 on our robotic architecture. We had already tested some simple classification of object shape based on proprioceptive information.

The first set of experiments will be aimed at showing understanding of observed actions directed toward certain objects (i.e. exploitation of the representation of objects) based on the previous experience with the same objects. In practice we would like to show that:

1. The robot can learn autonomously (self-supervised learning) the motor skills required to grasp an object.
2. The robot can acquire autonomously (by exploration) a suitable sensorimotor representation of objects.
3. The robot can extract autonomously (unsupervised learning) the sensory features required for the construction of such representations.
4. The robot can imitate an observed action by querying the same affordance-based representation of objects.

The set of objects we plan to use for this experiment is shown in Figure 2 and Figure 3 presents examples of robotic grasping.

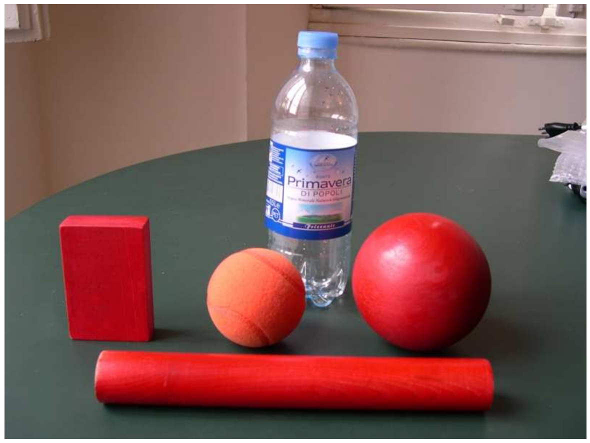

Figure 2: the set of objects used in the robotic experiments.

A more detailed set of experiments will focus on the acquisition of multi-modal features. This will fully test our "unsupervised" model for the extraction of features from unlabeled data sets described in D5.1. The goal of the experiments is to verify that interaction with the world can guide the development of a coherent representation that supports this interaction. Predictive-grasping task has been planned to be the main task of the robotic experiments. In this task, manipulating and grasping objects give proprioceptive information that, by hypothesis, guide the development of visual processing such that suitable information about the form of the grasped object can be extracted. The quality of this information can be verified by observing the accuracy of grasp-type prediction/imitation. Experiments about grasp-type prediction have been planned with infants and robots.

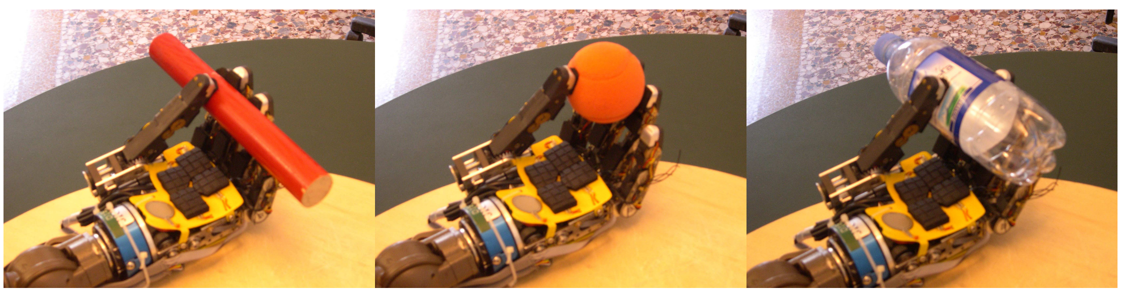

Figure 3: examples of robotic grasping.

Additionally, we plan to apply the feature extraction model to videos of mother-infant interaction. We will see whether we can use auditory data to guide the extraction of related visual features related and vice versa. We expect that phonetic information is more apparent in auditory data and expressions (i.e. mood) in visual data.

3 Project management and coordination

The major part of the management effort in Adapt has been directed to the harmonization of the different experimental plans coming from such a diverse range of disciplines. This has been carried out mostly by email and through telephone calls. The project consortium met several times during the last twelve months:

- Project meeting in Zurich on April 16-17th, 2004. Meeting minutes and more details are already on D1.5 (Management Report).
- Review meeting in Munich on June 7-9th, 2004. The Consortium held an informal meeting after the review.
- At Epigenetic Robotics in Genoa on August 25-27th, 2004. A good representation of the Consortium participated to the workshop.
- For other reasons we had people traveling either to Genoa or Zurich and thus meeting and discussing on the project.

Also, we started sharing experimental data directly. For example data acquired from the robot in Genoa were used in the development of the cognitive architecture in Zurich.

4 Cost breakdown

For additional information and cost in Euro, please see the cost statement submitted synchronous to this Progress Report.

Participant Code	One person-month corresponds to N hours
C1 – DIST	141
P2 – UNIZH	179
P3 – CNRS P4 –UPMC	135

Work-Package ID	Title		Reporting period
WP1	Project management		1.10.2003 – 30.05.2004
Participant Code	Spent (person-months)	Planned (person-months) Total	Start date / End date Month 1 / Month 36
C1 – DIST	1.0	3	
P2 – UNIZH[1]	0.2	1 (1)	
P3/P4 – CNRS/ UPMC	0.3	1.2	

Work-Package ID	Title		Reporting period
WP 2	Theory of intentionality and the sense of being-there		1.10.2003 – 30.05.2004
Participants Code	Spent (person-months)	Planned (person-months) Total	Start date / End date Month 1 / Month 36
C1 – DIST	4.3	12	
P2 – UNIZH[1]	3.8	10 (5)	
P3/P4 – CNRS/ UPMC	2.0	4	

Work-Package ID	Title		Reporting period
WP 3	Embodiment and body morphology		1.10.2003 – 30.05.2004
Participants Code	Spent (person-months)	Planned (person-months) Total	Start date / End date Month 1 / Month 30
C1 – DIST	3.7	12	
P2 – UNIZH[1]	8.0	24 (10)	
P3/P4 – CNRS/ UPMC	4.3	12	

Work-Package ID	Title		Reporting period
WP 4	Development of Coherent Representations		1.10.2003 – 30.05.2004
Participants Code	Spent (person-months)	Planned (person-months) Total	Start date / End date Month 1 / Month 31
C1 – DIST	4.7	14	
P2 – UNIZH[1]	8.0	25 (10)	
P3/P4 – CNRS/ UPMC	9.2	26	

Work-Package ID	Title		Reporting period
WP5	System's architecture		1.10.2003 – 30.05.2004
Participants Code	Spent (person-months)	Planned (person-months) Total	Start date / End date Month 1 / Month 33
C1 – DIST	4.0	12	
P2 – UNIZH[1]	4.0	12 (3)	
P3/P4 – CNRS/ UPMC	1.2	4	

The number between brackets report the persons/month spent by permanent staff at UNIZH and not charged to the project.

Title				Reporting period		
Cumulative effort				1.10.2003 – 30.09.2004		
Participants Code	SPENT HOURS	Spent (person-months)	Planned hours 2nd year	Planned person-months 2nd year	Planned hours (TOTAL)	Planned person-months (TOTAL)
C1 – DIST	2496	17.7	2496	17.7	7488	53
P2 – UNIZH	4296	24	4296	24	12888	72 (29)
P3/P4 – CNRS/UPMC	2199	16.3	2124	15.8	6372	47.2

5 Information dissemination and exploitation of results

About six months before the end of the project also the effort on WP2 will be reinstated. The goal will be to capitalize on the whole set of experiments (robotic and psychology) to support the theory of intentionality presented in D2.1. The results of this last activity should provide a common view of the various approaches. Important to this end is also the contribution to the Handbook of Presence where Adapt plans to contribute with two chapters.

Since the project has a more scientific rather than applicative focus, project dissemination is mainly carried out in terms of publications of results. For the same reason there is not any result to exploit yet.

On the aspect of dissemination, it is worth mentioning that Adapt has participated to the organization of the Fourth International Workshop on Epigenetic Robotics co-sponsored by the LIRA-Lab (DIST) and NICT (National Institute of Information and Communications Technology), Japan. The FET Presence Initiative was officially acknowledged, see:
http://www.epigenetic-robotics.org/2004/index.html

5.1 Publications

J. Nadel. *Contingency or agency: where is the mindreading pointer?* Invited address given at the European Conference of Developmental Psychology, Milano, August 2003.

J. Nadel. *Imitate and be imitated in the development of agency.* ICIS, Chicago, Illinois, May 5-8th, 2004.

J. Nadel. *Imitation as a basis for perception-action coupling and the development of agency.* European Psychologist (invited paper) to appear in 2005.

M. Lungarella, G. Metta, R. Pfeifer, G. Sandini. *Developmental Robotics: A Survey.* Connection Science. 15(**4**), pp. 151-190. 2003.

G.Metta, G.Sandini, L.Natale, R.Manzotti. *Artificial Development Approach to Presence.* In proceedings of Presence 2003, Aalborg, Denmark. October 6-8, 2003 (abstract submission).

L. Natale, G. Metta and G. Sandini. *Learning haptic representation of objects.* International Conference on Intelligent Manipulation and Grasping. Genoa - Italy July 1-2, 2004.

H. Valpola and J. Särelä. *Accurate, fast and stable denoising source separation algorithms.* In Proceedings of the 5th International Conference on Independent Component Analysis and Blind Signal Separation, ICA 2004, Granada, Spain. (2004) In press.

J. Särelä, H. Valpola. *Denoising source separation.* (2004).
On: http://cogprints.ecs.soton.ac.uk/archive/00003493/

H. Valpola. *Behaviourally meaningful representations from normalisation and context-guided denoising* (2004) Technical Report, Artificial Intelligence Laboratory, University of Zurich.
On: http://cogprints.ecs.soton.ac.uk/archive/00003633/

G. Gómez, and P. Eggenberger Hotz. *Investigations on the robustness of an evolved learning mechanism for a robot arm.* In Groen, F., Amato, N., Bonarini, A., Yoshida, E., and Kröse, B., editors (IAS 8): Proceedings of the 8th International Conference on Intelligent Autonomous Systems, Amsterdam, The Netherlands, pp. 818-827. (2004).

G. Tarapore, M. Lungarella, and G. Gómez. *Fingerprinting Agent-Environment Interaction Via Information Theory*. In Groen, F., Amato, N., Bonarini, A., Yoshida, E., and Kröse, B., editors (IAS 8): Proceedings of the 8th International Conference on Intelligent Autonomous Systems, Amsterdam, The Netherlands, pp. 512-520. (2004).

G. Gómez, and P. Eggenberger Hotz. *An Evolved Learning Mechanism for Teaching a Robot to Foveate.* In Sugisaka Masanori and Tanaka Hiroshi, editors (AROB 9): Proceedings of the 9th Int. Symp. on Artificial Life and Robotics, Beppu, Oita, Japan. pp. 655-658. (2004).

A. Streri. *Discrimination of large numbers.* Presented at the 14th biannual International Conference on infant Studies (ICIS), Chicago, Illinois. May 5-8th, 2004.