Create new human - artificial agent interactions through the concept of similarity in order to enhance social competence in patients suffering from social deficits.

SEVENTH FRAMEWORK PROGRAMME

Project FP7-ICT-2011-9-600610

AlterEgo

“Enhancing Social interaction with an AlterEgo Artificial Agent”

Collaborative Project

Cognitive Systems and Robotics

Deliverable D2.2
“Report on experimental results”

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1 Deliverable description

The deliverable D2.2. "Report on experimental results" summarizes and describes the work performed in the Task 2.2, which is the experimental part of the first step of the AlterEgo project. The Task 2.2 involves UM1, CHU, DFKI and UOB/UNEXE from Month 6 to Month 12.
The goal of this first step is to create a cognitive architecture having the same (similar) physical resemblance (morphology) and the same movement characteristics (kinematic) as that of the patient. A series of key experiments (called Step #1 experiment) are performed to validate the concept of similarity by showing that when a patient is interacting with a similar avatar, his/hers social competence is enhanced.

UM1 is in charge of collecting, analyzing and interpreting the Step #1 experiment, which is composed of four "subsets/series" of separate experiments: the morphology, kinematic, facial recognition and integrated experiments. The three former experiments are made to 1) help designing the key experiment (integrated experiment) and 2) complement it.

The first experiment was dedicated to observe the effect of morphology on human coordination. Zhong Zhao, a PhD student of UM1, was in charge of this experiment. Morphology is one of the components of the similarity that has never been studied as an influential aspect of motor coordination. In other words, we were trying to understand whether the social (facial morphology) characteristic of a person we coordinate with could affect our movements. If there were no significant results we could question whether the physical resemblance (morphology of the avatar) would enhance the social competence of the patients.

The second experiment was devoted to the manipulation of kinematic on human coordination. Mathieu Gueugnon, a PhD student of UM1, was in charge of testing different types of kinematics (simple vs. complex) in different conditions of similarity (similar vs. dissimilar). The goal was to observe which combination was the most efficient to apply to a synchronization situation between two healthy participants. A secondary goal was to reveal when the highest synchronization occurs, at the beginning of the interaction of after a certain time of collaborative exposure.

The CHU also had an important concerned on how patients would recognize their own similar avatar. As an effect of pathology it could be possible that patients do not recognize their own avatar as healthy people do. For that reason a third experiment was designed to address the aspect of facial recognition in patients suffering from schizophrenia. Besides the judgment and questionnaires, an eyetracker was used to detect what visual patterns patients performed. This experiment had just started and no significant results could be reported. However predicted results could be conveyed.

The last experiment was the key of the Step #1 experiment, integrating not only the three previous experiments (morphology, kinematic, facial recognition of patients) but also the work of UOB/UNEXE, DFKI, EPFL and CHU all combined into the cognitive architecture for testing the effect of morphology and kinematics similarity on the human-to-avatar synchronization. This experiment has no result yet since the first data acquisitions have just started.

In the current deliverable 2.2 UM1 should provide a report on experimental results and start writing the results and interpretations as a draft of an abstract (poster or oral communication) submitted to a conference. Based on the completion of latter experiments, the morphology and kinematic experiments will be submitted to the 13th European Workshop on Ecological Psychology (EWEP 13) in June 2014 in Ireland, and to the special session "Modelling, analysis and control of human-machine motor coordination" in preparation for the IEEE Conference on Systems, Man and Cybernetics that will be held in San Diego (USA) 5-8 October 2014. The two abstracts are ready to be sent and are reported below. The third experiment on facial recognition is also reported as an abstract, although it is not ready to be sent as no significant results have been found yet. The last integrated experiment is not reported as an abstract in this deliverable, since the data are about to be collected. They will be reported in a subsequent WP2 deliverable. The results will be presented at the first AlterEgo review on March 4. For experiments 1&2, they are now being formatted in documents that will be submitted for publication.

1.1. Summary of WP2 experiments

Table 1. Summary and status of WP2 experiments during the first period

Experiment #	Title	Status	Number of subjects	Results/Expectations
1	Manipulating morphology	Done	34	Results showed that participants are influenced by the morphology. Their movement is more stable when the video in front of them depicted someone they liked. On the contrary they were more variable when collaborating with someone they were indifferent to or disliked.
2	Manipulating Kinematics	Done	96	Results revealed that when people were synchronized, they tended to like each other more. But after a certain time of coordination with a co-actor, dissimilar movements enhanced motor synchronization and feeling of connectedness.
3	Facial recognition	In progress	6	Preliminary results indicated that schizophrenic patients performed different visual fixation patterns and were more variable than healthy controls
4	Integrated experiment	Starting	4	Expected results should demonstrate that similarity (morphology and kinematic) enhances social interaction in healthy and patient participants. More specifically, we believe that a similar avatar moving like the patients would launch a high level of interactions (synchronization) as well as a higher score of likeliness. Conversely, a dissimilar avatar yielding dissimilar movements would be indifferent to the patients.

1.2. Illustrations of the four experiments

1) Morphology experiment

Participants played a dual-task game (reaction time & motor coordination) with 4 different-looking agents (who can be moving or static) shown in a video on a Wacom tablet (Figure 1). These agents were: Unpreferred agent, Preferred agent, point light display of the Preferred agent, and gray background. The reaction time task required participants to react as fast as possible when the center of the red dot (on the agent's face) turned black. At the same time, subjects were instructed to perform in/anti-phase coordination with the agent at either the preferred or 1.5 times of the preferred frequency of the subject. Participants were convinced that they were coordinating with the pre-recorded movement of the agent. A questionnaire was provided to the participants to measure their preferences to each agent, based on which the agent was categorized as Preferred or Unpreferred agent.

Figure 1. Experimental situation of the morphology experiment. Illustration of a participant interacting with the Unpreferred agent displayed on the video screen

2) Kinematic experiment

92 participants were split into 4 groups of 12 pairs each (similar/complex movements, similar/simple movements, dissimilar/complex movements, dissimilar/simple movements). Participants were instructed to perform the collaborative task the consortium chose: the horizontal movement 1-D (Mirror game used in the Noy et al., 2010 study, see Figure 2). Five steps composed the experiment. The steps two and four were the Exposure Conditions in which participants were instructed to perform a specific movement (according to the group of which they belonged) in an unintentional coordination task (similarity/dissimilarity and simple/complex movements). The steps one, three and five were the Test Conditions in which participants were asked to "create interesting, complex and various movements and be the more coordinated" in three different situations (as leader, follower or in a joint improvisation). Before and after the five steps, we asked participants to rate each other in terms of mutual connectedness.

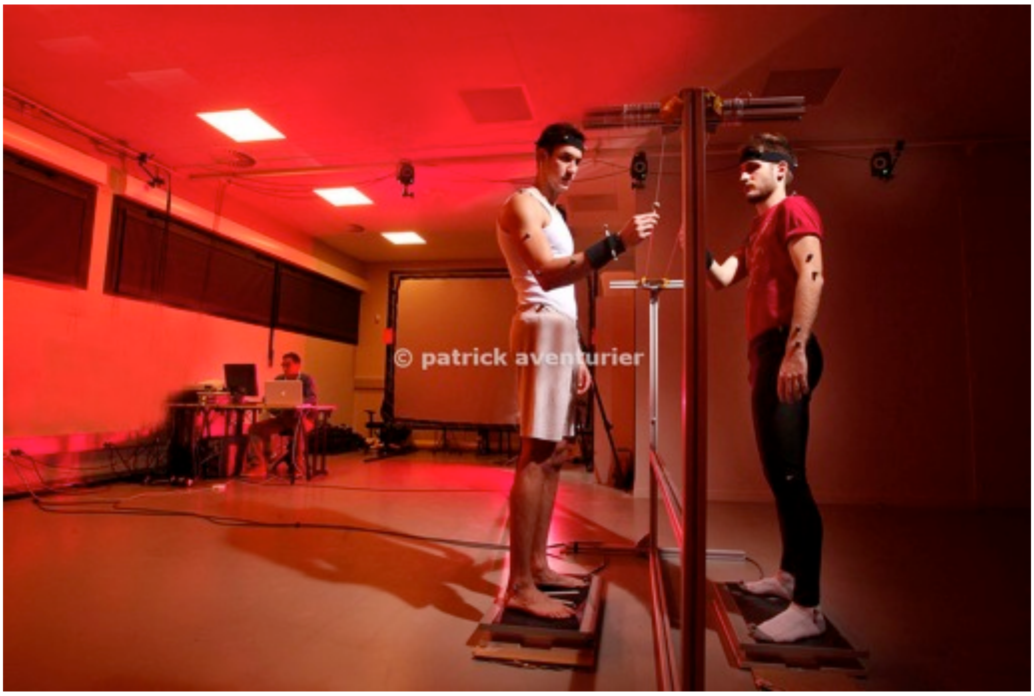

Figure 2. Experimental situation of the kinematic experiment. Example of two participants performing the similar/simple condition in the follower situation

3) Facial recognition experiment

Two groups of participants (patients suffering from schizophrenia and healthy controls) had to observe a picture of their own face, an unknown face and a famous face in two different conditions: active task and passive task. Photographs were morphed with each other (self-famous; self-unknown; famous-unknown; see Figure 3) in steps of 20% using the Fantamorph software. A total of 15 photographs were presented. An eyetracker was used to record visual scan paths and two questionnaires were used, the Self-Face Recognition Questionnaire (Larøi et al., 2007) and the Positive And Negative Syndromes Scale (PANSS; Kay et al., 1987). Participants were first requested to look at each face in any way they wanted. The same photographs were presented a second time and participants were asked to identify if the face was similar to their own face, an unknown face or a famous face. Stimuli disappeared when participants provided manual response, which was recorded by the experimenter.

Figure 3. Experimental situation of the facial recognition experiment. Illustration of faced morphing in three steps from their own face into an unknown face. An eyetracker was used to record visual scan paths

4) Integrated experiment

1 group of 30 patients suffering from schizophrenia and 1 group of 30 controls matched in terms of age, level of education and gender shall participate in the experiment. After designing the morphology and the kinematic of each participant, all participants will be involved in four different conditions 1) similar morphology + similar kinematic; 2) dissimilar morphology + dissimilar kinematic; 3) similar morphology + dissimilar kinematic; 4) dissimilar morphology + similar kinematic (see Figure 4). Participants will perform a succession of tests with these 4 conditions using the leader model intertwine with 5 minute periods of exposures of each of the fourth condition using the follower model.

Figure 4. Experimental situation of the integrated experiment. Representation of a participant performing the follower task with a dissimilar agent.

2 Results

As the results of this deliverable 2.2 on reporting experimental results, three abstracts out of four are provided. Two are ready to be sent to an international conference (EWEP 13) and one still needs to be buffed up with more data before being submitting. The fourth experiment (integrated experiment) cannot be delivered since not enough data are available to be considered as being reported.

2.1. Report on the morphology experiment

Different-looking individuals influence interpersonal coordination stability

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BACKGROUND AND OBJECTIVE

The Gibsonian approach to social perception proposed that individuals inherently use perception of others' faces (morphology) to guide their social behavior and reaction (Zebrowitz et al., 1997). Morphology was found to affect preference and interaction between parents and children (Wiersma, 1936) and between supervisor and students (Ensher et al., 1997). The present study aimed at investigating whether motor coordination differed with different-looking agents.

METHODS

34 participants (age=22±3.2 years, 16 males) played a dual-task game (reaction time & motor coordination) with 4 different-looking agents (who were moving or static) on a Wacom tablet (Figure 1). These agents were: Unpreferred agent, Preferred agent, point light display (Control_PL) of Preferred agent, and gray background (Figure 2). The reaction time task required participants to react as fast as possible when the center of the red dot turned black. Meanwhile, subjects were instructed to perform in/anti-phase coordination with the agent at either the preferred or 1.5 times of the preferred frequency of the subject. Subjects were convinced that they were coordinating with the pre-recorded movement of the agent.

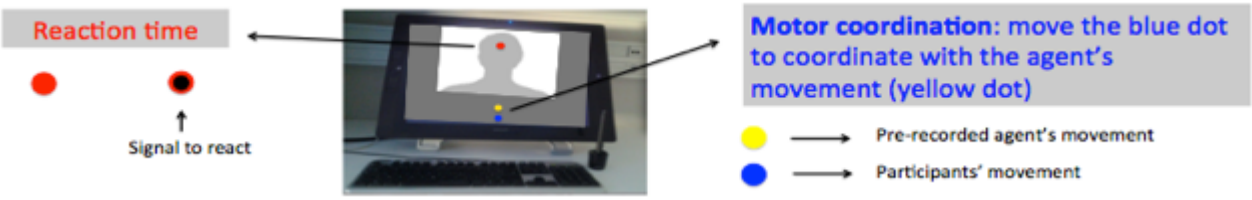

Figure 1. Experimental setup

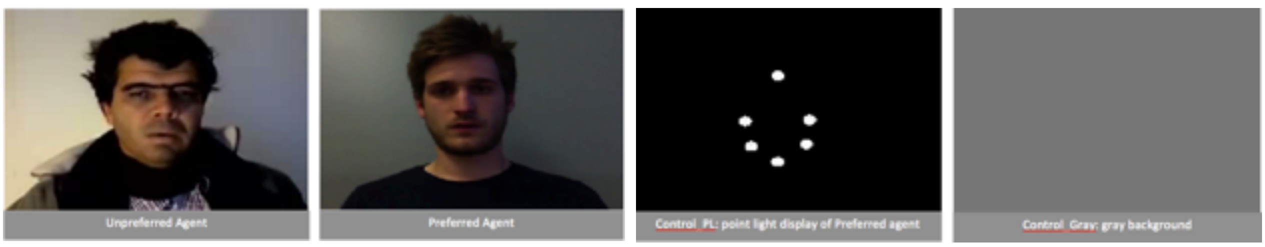

Figure 2. Morphology of agents. A 7-point scale was used to measure participants' preference to each agent, based on which Unpreferred (M=3.9) and Preferred (M=4.5) agent were categorized.

RESULTS

Repeated measures ANOVA and Fisher LSD post-hoc tests were performed. The mean relative phase was significantly lower with Unpreferred moving vs. Unpreferred static agent. The SD of relative phase was significantly lower with Preferred vs. Unpreferred agent when the agent was moving, and with Preferred moving vs. Preferred static agent (Figure 3). Moving agent was shown to have significantly longer reaction time than static one.

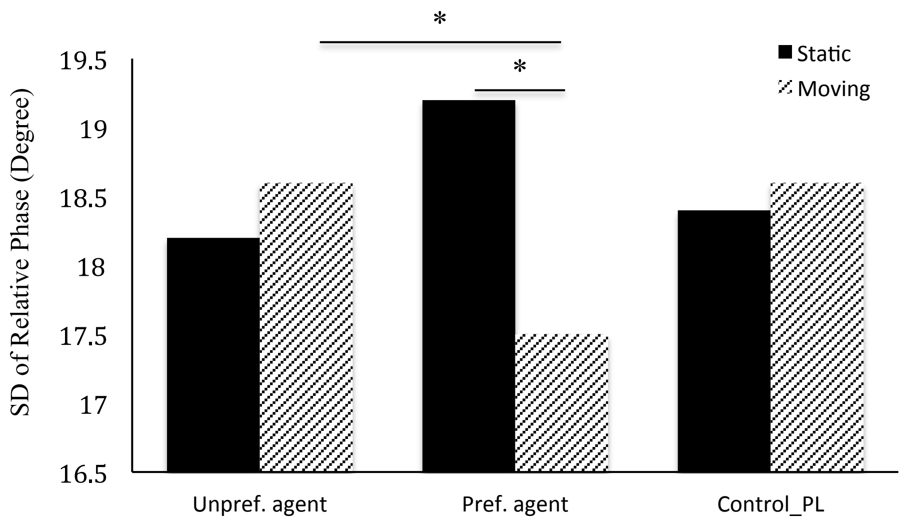

*Figure 3. Stability of motor coordination: interaction effect of Agent * Agent state ($F(2,66)=5.9$, $p<.01$). Post-hoc tests showed that SD of relative phase was significantly lower with Preferred vs. Unpreferred agent ($p<.05$) when the agent is moving, and with Preferred moving vs. Preferred static agent ($p<.05$).*

CONCLUSION

Preferred morphology leads to stable motor coordination. The reason may be that preference of someone may affect mental connectedness with the person, which causes difference in motor coordination (Schmidt et al., 2008). The moving agent results in more accurate and stable coordination. This may be because interaction with a moving agent makes people feel like playing with a real human being and they pay more attention to coordination.

AKNOWLEDGMENT

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2.2. Report on the kinematic experiment

Effect of similarity exposure on socio-motor competences

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The aim of this study was to investigate the learning process of socio-motor competences, hallmark of human species. Most of researches used simple and predictable movements to observe interpersonal coordination (Schmidt et al., 2008). However, Noy et al. (2011) recently utilized more ecological and complex movements showing the effect of expertise (learning). Nevertheless, mechanisms underlying this learning remain unknown. Moreover, Chartrand & Bargh (1999) demonstrated the concept of “chameleon effect”, namely natural tendency to mimic others behavior during social interaction. This behavioral similarity increased feeling of connectivity (van Baaren et al., 2004), indicating that social competence was associated with better motor synchronization. Thus, we expected behavioral similarity to affect acquisition and improvement of socio-motor competences.

46 dyads of healthy subjects were randomly attributed to a Similar or Dissimilar movements group. Three steps of intentional interpersonal coordination (Pre / Intermediary / Post) were alternated with unintentional interpersonal coordination (steps 2 & 4) where similarity of movement was engaged. Before and after the five steps, participants were asked to rate the feeling of connectedness of their co-actor.

We analyzed accuracy and stability of the coordination and the connectedness. In Similar conditions results revealed an increase of the performance, i.e. a better synchronization ($F(1,42)=5.856$, $p=.02$) indicating that the dyad became more accurate associated with a destabilization ($F(1,42)=11.781$, $p=.001$) suggesting that the dyad movements became more complex. Additionally, dissimilar conditions exhibited a significantly higher synchronization during the fifth step. These results also correlated with the judgment of the connectedness: the more people were synchronized, the more they liked each other; the more they challenged each other, decreasing paradoxically the stability of the coordination.

To conclude, our experiment indicated that socio-motor competences could be acquired in two phases: 1) performing a similar task to promote feeling of affiliation, 2) followed by a dissimilar task to improve synchronization and connectedness between both participants.

This study was funded by the European AlterEgo Project (Grant#600610 / FP7).

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van Baaren, R.B., Holland, R.W., Kawakami, K., & van Knippenberg, A. (2004). Mimicry and pro-social behavior. Psychol. Sci , 15 , 71–74.

2.3. Report on the facial recognition experiment

Title: Self-similarity recognition in schizophrenia: face exploration using eye tracking.

Among the deficits found in schizophrenia patients this work focus on self-recognition deficits and atypical scanpaths, which have never been investigated together. Therefore, we aimed to explore differences and similarities between schizophrenia patients and healthy controls in terms of which facial features drove their attention when recognizing their own face, an unknown face and a famous face in two different conditions: active task and passive task. Photographs were morphed with each other (self-famous; self-unknown; famous-unknown) in steps of 20% using the Fantamorph software. All pictures were edited in the Adobe Photoshop to match pictures for luminance. Hair and clothing were removed. A total of 15 photographs were presented using E-Prime 2.2. The Mobile Eye XG was used to record visual scan paths based on a pupil eye tracking system. The occurrence of saccades and fixations was computed using a Matlab toolbox called IMap (Caldara & Miellet, 2011). Two questionnaires were used, the Self-Face Recognition Questionnaire (Larøi et al., 2007) and the Positive And Negative Syndromes Scale (PANSS; Kay et al., 1987). Participants were first requested to look at each face in any way they wanted. The same photographs were presented a second time where participants were asked to identify if the face was similar to their own face, an unknown face or a famous face. Stimuli disappeared when participants provided manual response, which was recorded by the experimenter. The order of photographs was randomized. Based on preliminary results and previous studies we expected to find differences first, between schizophrenia patients and healthy controls, second, differences in terms of visual fixation patterns and eye movement variability for the three different photographs when each fixation was analyzed individually in healthy controls but no in schizophrenia patients who present abnormal scanpaths regardless of the stimulus.

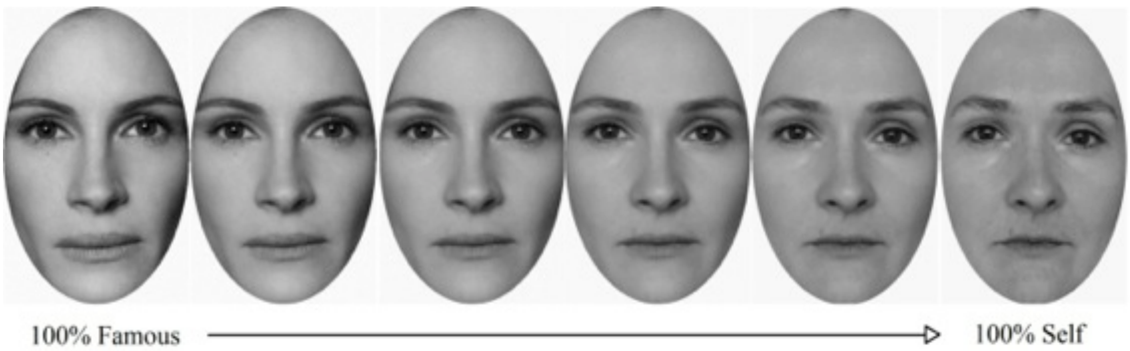

Figure 1. Morphing between famous face and self-face.

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