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Goal Inferencing And Error Detection In Joint Action

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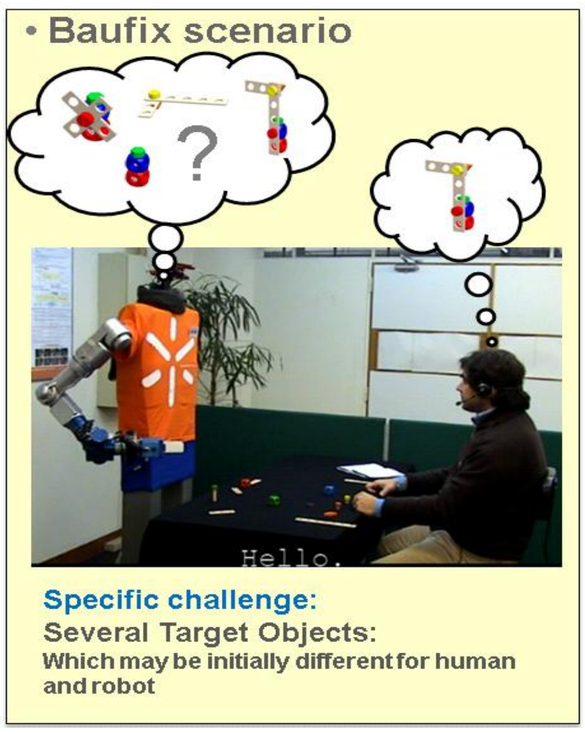
Humans are remarkably efficient in cooperating with their fellow human beings. Two crucial ingredients of this social capacity are intention understanding and error monitoring. We studied these processes by asking human dyads to perform a construction task with predefined, immediate and final goal conflicts (IGC and FGC). We analyzed how smoothly the conflicts were solved. Subsequently, one of the dyad members was asked to perform the task again but this time with the JAST robot system that was endowed with intention understanding and error detection capabilities.

A User-Evaluation Study Of The JAST Robot System

Joint Action

Recent studies of the neurocognitive basis of cooperative task performance show that understanding the actions and intentions of the behaviour of one's partner largely contributes to the social competence that is typical of humans [1-4].

A second defining characteristic of fluent cooperation is the capacity to detect whether or not the actions performed by self or partner are deflecting in any way from the inferred intentions and, if so, repair, or formulate suggestions how to repair, such errors.



Goal Inferencing and Error Detection

We designed a task in which two participants needed to cooperate and inserted two types of errors in the instruction sequences of one of the subjects: immediate goal conflicts (IGC) and final goal conflicts (FGC).

We analyzed how the participants communicated their goals and how quickly they solved conflicts.

Subsequently, one subject from the human-human pairs was asked to conduct the same experiment with the JAST robot partner endowed with intention understanding and error monitoring capabilities.

Results

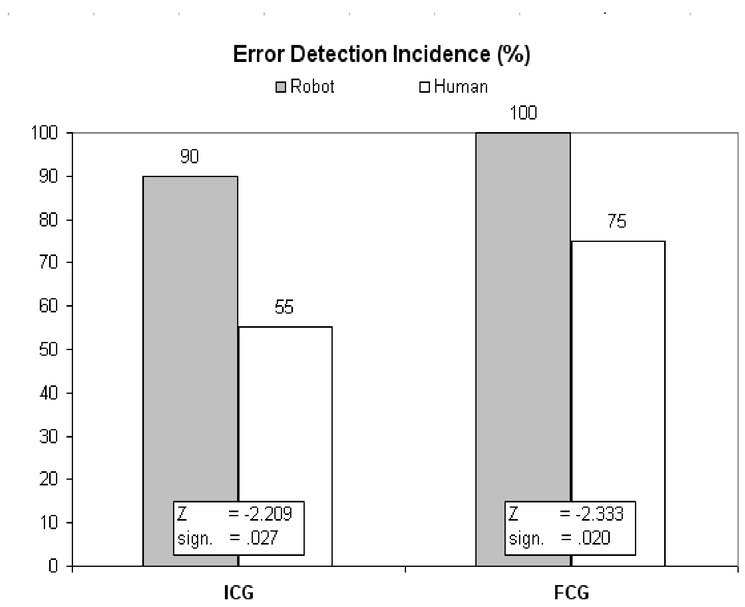


Fig. 1. Mean percentages of conflicts (IGC and FGC) detected.

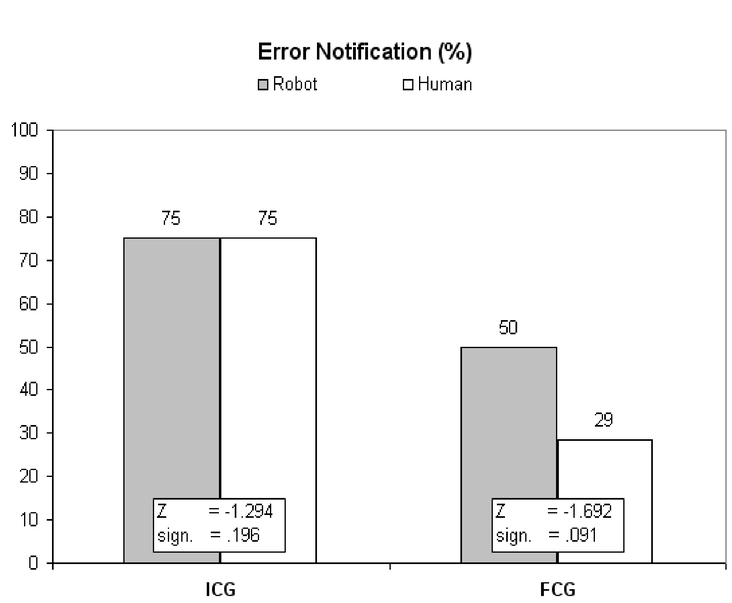


Fig. 2. Mean percentages of conflicts (IGC and FGC) notified to the participant.

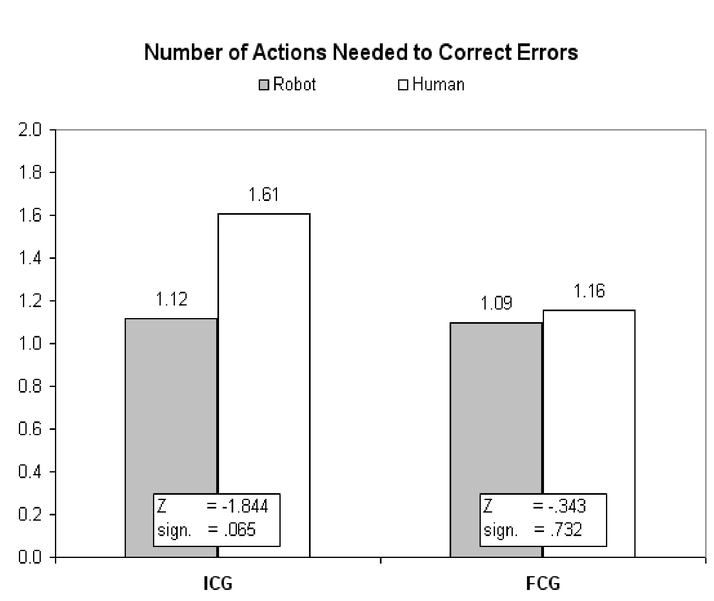


Fig. 3. Mean number of actions to correct errors following conflicts.

Conclusion

The JAST robot and human succesfully completed the construction tasks in all trials. The robot could adapt to immediate and final goal conflicts (Fig. 1), sometimes even without asking.

The robot showed anticipatory behaviour by offering or instructing what the human partner needed next (Fig. 2-3).

Results from the questionnaire showed that participants rated anticipatory behaviour higher for the robot than for the human partner. Moreover, the collaborating robot was judged favourably.

Action and intention understanding are critical social capacities which make autonomous agents sociable robots that can outperform human beings.

Questionnaire

Results of Questionnaire (0 = totally disagree and 100=totally agree)

	Partner		Wilcoxon Signed Ranks Test	
	Robot mean (SD)	Human mean (SD)	Z	sig. (2-tailed)
CAPABILITY RATINGS				
My partner seemed to be well-informed regarding the tasks	88 (17)	65 (32)	-2.411	<.05
IMMEDIATE-GOAL LEVEL				
When I performed the prescribed errors, my partner was able to detect it	95 (14)	67 (40)	-2.341	<.05
When I performed the prescribed errors, my partner was able to correct me	92 (15)	56 (41)	-2.556	<05
When I picked up a wrong piece my partner was able to correct me	82 (19)	64 (35)	-1.758	<.10
When my partner picked up pieces, it seemed to make sense	90 (12)	77 (22)	-2.103	<.05
FINAL-GOAL LEVEL				
When we were working on different objects, my partner was able to adapt to the object that I was assigned to build	80 (29)	80 (22)	-.105	ns
My partner seemed to be able to predict what piece was needed next	89 (13)	67 (32)	-1.846	<.10
My partner was able to give me pieces before I requested it	91 (19)	58 (42)	-2.229	<.05

References

References

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