PSI plays „island“: Comparison of the PSI-theory with human behavior

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During the last two decades amazing progress has been made in cognitive science and related fields in explaining and predicting human behavior (especially in cognitive modeling). Best known and most elaborated are probably the two "cognitive architectures" that "put it all together" as "unified theories of cognition": ACT (Anderson & Lebiere, 1998) and Soar (Newell, 1990; Rosenbloom, Laird & Newell, 1993). But though the term "cognition" should not be understood too narrowly (Newell, 1990), their architectural conception does not cover too many psychological phenomena beside cognitive ones (Cooper & Shallice, 1995; Detje, 1999). A theory that explicitly tries to cover more psychological relevant phenomena such as emotional and motivational processes is the PSI-theory of action regulation (Dörner & Wearing, 1995).

Intention Regulation

Central to the PSI-theory is the concept of intentions. Every state of deprivation will lead to a need as soon as internal regulation cannot reach equilibrium. But intentions are more than merely the goal to satisfy the needs, they also include a number of elements that contain context information. The memory contains of three network-like hierarchies, a sensory network, a motor network and a motivational network as an internal sensor for needs. A lot of processes work on these data structures to show action and intention regulating behavior and to perform in complex problem-solving tasks (see Dörner & Wearing, 1985). The PSI theory and its precursers were tested in several environments and compared with human behavior. The results showed sufficient similarities (e.g. Dörner & Wearing, 1995).

„Insel“ [„island“]: A short description

„Insel“ consists of a number of localities that are linked by paths. Each locality consists of objects that can be manipulated. These manipulations can have effects on the manipulating agent and / or the environment. Human subjects are asked to control a robot on a distant island. Their task is to use the robot in order to look for "nucleotides" (that are fictional lumps of fuel) and to collect as many as possible. At the same time they need to satisfy the robot's existential needs for food and water. They also have to prevent the robot from damage. When PSI plays "island" it is the autonomous agent "James", it "is" the robot, by means of the needs it has.

Results of the comparison

In an experiment 29 subjects participated in the "island" setting (1 hour) and 19 simulation runs for PSI were completed (300 cycles). We find that PSI and subjects do not differ much (see table 1) with respect to the main achievement indicators a) the number of locations visited (degree of exploration of the island; 45 existing) and b) the number of nucleotides collected (subjects were paid according to this amount; 80 nucleotides existing). Even the number of objects approached is quite similar. But if we take a look at other behavioral data we see that the PSI-simulation and the subjects differ in their tactical means or strategies. PSI shows in general much more changes of locations but much less manipulations of objects than the subjects show.

Table 1: Results for achievement indicators.

Achievement indicator	Mean (sd)
Locations visited (PSI)	29.37 (5.92)
Locations visited (subjects)	31.07 (7.28)
Nucleotides collected (PSI)	41.76 (17.70)
Nucleotides (subjects)	39.00 (9.98)
Objects approached (PSI)	150.00 (44.27)
Objects (humans)	161.24 (28.87)

Conclusion

First comparisons show that PSI is already able to deal with the "island"-game with the same success as human beings do. The island is neither explored completely nor are all nucleotides found by both groups. Still both groups deal with the simulation quite successfully. But they do it in different ways. PSI is more willing to change locations than to explore a given location in greater detail. Humans are more willing to explore what they already see than to figure out what they do not yet see.

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