

# It's a Child's Game: Investigating Cognitive Development with Playing Robots

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## INTRODUCTION

To study and simulate cognitive development, it is useful to find a natural domain where many cognitive functions are needed and, but where the complexity of the environment and task is reasonable. We suggest that childrens games constitutes a suitable domain. The ability to play is a very fundamental part of childrens daily life and it is crucial for the future development of our behaviors [5].

In the individual domain, the coordination of the body is an important feature of play. When a child plays, it refines its motor and sensory skills and develop more advanced movement patterns e.g. in running or cycling. When playing among other individuals cognitive functions for social interactions and coordination and emotional control are also used.

Play can also be found in other species such as birds and mammals. A difference between animal development and humans is that animals develop their motor skills faster than humans, while cognitive functions are developed slower than for humans [1].

During play, a large amount is learned about relationships in the worlds, like how our own body works and the laws of physics. A grasp of these relationships is needed for higher cognitive functions, which perhaps are the functions that gain the most from childrens games. Cognitive function like exploring, problem solving, task switching, attention, anticipation etc. are used constantly during children's game.

## AN EXAMPLE: HIDE-AND-SEEK

Despite its simplicity, a game like hide and seek requires a surprising number of cognitive functions including: (1) search and navigation to find suitable hiding places, (2) context sensitive control of attention depending on the phase of the game, (3) sequentiation of behaviors in relation to the structure of the game, (4) coordination with the other players, (5) emotional control and control of emotional reaction, (6) anticipation of the behaviors of others, and (7) verbal and non-verbal communication.

Hide and seek contains at least three different phases, each of which demands different behaviors. In the first phase, a decision is made about the one who is going to search and which ones are going to hide. This requires coordination between the individuals and shared attention. In the hiding phase, perspective taking ability is required when deciding

on the most suitable hiding place. This decision could be influenced by the limited time as well as previous memories of good hiding places. The final search phase also requires a number of cognitive functions, in particular for the child searching, but also for the other participants that have to refrain from giving up their hiding spot by inhibiting their behavior.

It is also interesting that emotions play different roles in the different phases of the game. In the first phase, there may be happiness for being chosen and expectation of the game etc. The hiding phase contains aspects of hope and excitement. Finally in the search phase, there is a controlled and limited fear of being found.

## PLAYING ROBOTS

Trafton et al. [7] programmed a robot to model a 3-4 year old child playing hide and seek. The robot moves around in their laboratory and tries to hide behind different objects and learn which hiding places what are good ones. Building on our previous modeling of the development of attentional processes [2,3,6] and context sensitive behavior [4], we are currently designing robots that autonomously develop game playing abilities based on different learning mechanisms. We are using games like hide and seek, tag and other popular childrens games. By bringing the best developmental and learning models together, we hope to find out more about the mechanisms of cognitive development.

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This work was supported by the EU project MindRaces, FP6-511931.