PhD Theses

THE DEVELOPMENT OF THINKING STATEGIES AND POSSIBILITIES FOR THEIR FACILITATION DURING THE TRANSITION PERIOD FROM NURSERY SCHOOL TO SCHOOL

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THE PURPOSE OF THE THESIS AND AN OUTLINE OF THE RESEARCH TOPIC

The aim of the present thesis has been to look at games from a developmental, educational viewpoint, with the purpose of gaining more insight into the ways games reflect the slow maturation and restructuring of thinking in the transition period from the nursery school to the school. A further aim of the study has been to track the process by which the socio-cognitive setting created by alternating games provides multiple propping for cognitive maturational processes.

Psychological approaches focusing on the facilitating potentials of play in terms of emotions (Winnicott, 1971) or the intellect (Piaget, 2004) also pertain to issues which concern modern cognitive developmental psychology. Using the conceptual framework of modern cognitive psychology the process of play functions turning into regulatory functions (Huizinga, 1944; 1990; Grastyán; 1985) has also been analyzed both within the social framework of alternating games and within the cognitive frame of strategy games.

Focusing on the process whereby conceptual categories of representations become symbolic (Bruner, Goodnow, Austin, 1956) may provide insights into the individual characteristics of development. The thesis has also seeked to contribute to the understanding of how equivalence (Donaldson, Campbell and Young, 1976; Lover and Hornsby, 1966) and categorization (Bryant, 1975; Rosch 1975; Vygotsky 1967, 2000) account for the grounding and integrating of operational thinking as it develops in the course of rule playing. Furthermore, it was aimed to identify processes of hypothesis-making which are instrumental in the conscious use of conceptual strategies.

The research results have been interpreted within the theoretical framework of developmental modularity and modularization (Fodor, 1985, 1996; Dennett, 1987; Karmiloff-Smith, 1992; Gergely and Watson, 2001). In line with the views of natural pedagogy (Gergely and Csibra, 2007) our study has seeked to find relationships between imitation, teleological thinking, the development of mentalization, the transmission of cultural knowledge and the recent views concerning rapid learning.

Key concepts: play; games; environmental effect; transaction; model-observation; re-starting; representational development; representational redescription; modularization; narrative; natural pedagogy.

The participants of the study: I. Cross-sectional study: 5 and 6 year old nursery school children, 20-20 children; 1st, 2nd and 3rd grade elementary school children, 20-20 children, n=100. II. Longitudinal training study: a study group: 5 and 6 year old nursery school

children, 20 children, and a control group: 5 and 6 year old nursery school children, 20 children, n=40.

A case study (a problem-analysis of Gergo; 7;1, a boy about to enter school) presented in the thesis highlights the impediments or neural/functional deficits that might account for the hindered development of conceptual representations in children suffering from developmental disorders characterized by attention and communication deficits.

The games developed by us have proved to be useful in educational practice and therapy: they possess the potential of becoming tools of measurement and facilitation within the „organizing" efforts of educational facilitation and in the „building" efforts of therapeutic interventions.

The use of these games fits in well in the educational practice prompted by pedagogical-psychological approaches to learning, such as those of individual pedagogy or cooperative learning, which make use of the facilitating effect of play and offer social educational contexts for socio-cognitive games.

In its everyday educational practice the „from nursery school to school transition approach" emphasizes the regulatory and integrating functions of play which support and facilitate the maturation-development process and also the whole complex of training processes. Play is a grounding and integrating activity in early learning and also in the transition period from nursery school to school, helping intentional learning processes emerge. The development of play is the main precursor of preparedness for school.

METHODOLOGY

The research methods used earlier in studies concerning children's thinking strategies had often proved to cause special problems making measurements and their interpretation difficult. For example, the children had found the tasks too difficult, or the instructions and research tools had been unfamiliar to them. This problem in the methodology of earlier studies prompted us to elaborate new procedures for studying thinking strategies in children between the ages of five and nine years. Our methods developed for the study are as follows:

- The „Sorting" card game:

The set consists of 36 playing cards. The game starts with a sample card which refers to a concept. Six cards, all representing members of the same conceptual category have to be collected in order to create the perceptual-conceptual group. Searching assumptions, suggestions and explanations given by the child during the process are regarded as hypotheses. In this way the game can be instrumental in studying whether the child is able to articulate assumptions to be qualified as hypotheses. The assumptions made on the basis of the perceived cards could be the same as the conceptual category set up by the experimenter or they could differ from it. The child's answer therefore needs to be not only appropriate, but also has to correspond to the „concept" conjured up by the experimenter, which means that the task has not only cognitive, intellectual, but also social-emotional demands.

- „Invicta" logic set:

The set consists of 60 plastic forms. In the first „modeling game" the adult is searching the plastic form chosen by the child from the 60 plastic items of the set by asking questions. The adult discards the „wrong" items to get closer to the solution. A change of roles follows. Six games are played with three taking turns.

- The „Clowns" set of cards

The set contains 32 cards all based on the same drawing of a clown's face as a starting point. Except for the starting card each face is added a new feature to make it individual and the cards get more complex in a hierarchical manner. As a result there are no cards displaying the same combination of features. The cards are spread out on the table with their faces up. In a similar fashion to the „Invicta" logic set and other role-taking games the player asks questions to constrain the categories of characteristics by sorting cards following her/his questions. This game also begins with a starting game to provide a model and facilitate the child's learning process.

	„Sorting" card game"	**„Invicta" logic set**	**„Clowns" card game**
Material	Cards of blackboard	Plastic-forms	Cards of blackboard
Number of items	36 pieces	60 pieces	32 pieces
Perceptual attributes	Visual-perceptual (different cards)	Tactile, spatial, visual (different plastic items)	Visual-perceptual (identical form with varying attributes)
Logical structure	6 x 6 conceptual matrix	10 x 6 forms matrix	A combination of 5 altering attributes matrix
Type of strategy	Matching extending strategy	Constraining constraining strategy	Constraining and matching constraining and extending strategy
Goal of the search	Group	Individual item	Individual item and group
Main goal	Concept searching	Concept searching	Concept searching
Application	Speech thinking facilitation tool	Speech-thinking facilitation tool	Speech-thinking facilitation tool
Level of difficulty	Conceptual prototypes	Forms of different degrees of complexity	Identical forms with different attributes
Number of turns and games	3 turns 1 – 1 game	10 turns (spread over 10 weeks) 3 models + 3 games by the child	10 turns 3 models +3 games by the child
When were they used			
1st Study.	**For follow-up testing**	-	-
2nd study.	**For follow-up testing** The"Sorting" game is to be used in follow-up testing only!	**As a tool for facilitation** nursery groups	**As a tool for facilitation** the case study of Gergo

Table 1. The games used in the study

In research the games are used in face to face situations with each child, however, in family or nursery school settings they can be applied during group playing or free play sessions both within a child - child or an adult - child setting.

RESEARCH DESIGN AND RESEARCH PARAMETERS

I. Cross-sectional study: A cross-sectional study was carried out with 100 children between the ages of 5 and 9 years (5 and 6 year old nursery school children and 1st, 2nd and 3rd grade elementary school children, respectively) with twenty children in each age group. The „Sorting" card game was used in order to assess the age characteristics of children in face to face setting in the following parameters:

– *Levels of concept formation:* abstract concept formation; functional-egocentric response; functional response; perceptual response; affective response;
– *Complexes:* multiple grouping; chain complex, associative complex; key-ring complex; collection complex;
– *Thematic response*: story;
– *Levels of sub-equivalence, guesses*:
  1.) preference-based choosing of pictures with labeling (only labels);
  2.) sorting pictures in succession on the basis preference, without making any comments;
  3.) sorting pictures successively, mechanically guessing without making any comments;

II. A longitudinal training study involving 20 five year old and 20 six year old nursery school children, with 10 children in the training condition and 10 in the control group, the „Invicta" logic set was used as a facilitation and measurement tool; over a one year period involving ten sessions Each session consisted of six games by experimenter and child respectively, with three taking turns

Testing:
The follow-up measures of process analyses used during the training process:

- *errors in instruction*: a lack of ability to change viewpoints;
- *guessing and asking direct questions*: a lack of constraining questioning;
- *inadequate questions*: a question involving systematic errors;
- *falters:* for proceeding help is needed;
- *mistakes*: a mistake in sorting and grouping;
- *explanations*: giving reasons for actions and mental steps aloud

Post-testing (**An outcome study):**
An outcome study was carried out with the children using the „Sorting" set of cards.

Case study (Gergo's case):
A longitudinal facilitation was carried out with the same arrangement as descibed above, with the exception that the tool for measurement and facilitation consisted of the „Clowns" card game.

For **post-testing** the „Sorting" set of cards was employed.

HYPOTHESES OF THE TWO STUDIES

A.

I. Hypotheses concerning the cross-sectional study

As to the development of thinking strategies during the transition period it was hypothesized that

1. with age the number of pictures used and the number of choices made will decrease and steps in conceptual thinking will begin to be observed;
2. with the increase of age the number of guesses lacking in equivalence and that of choices of a thematic complex kind will decrease, while perceptual superordinations, functional superordinations and thematic story-like choices will increase;
3. the number of optimal strategies and also the number of mixed searching strategies will increase with age, while choices made on the basis of mechanical guessing will decrease;
4. furthermore, it was expected that our measurement tool developed on the basis of age characteristics was to be suitable for unfolding and grasping the developmental steps of cognitive development within the age-range.

II. Hypotheses of the longitudinal study (the training process)

Our hypotheses concerning the effects of a regular, ongoing playing process involved in playing with the „Invicta" logic set in five to six year old children were the following**:**

1. the children will use fewer direct guessing questions;
2. irrelevant questions will become less frequent;
3. there will be a tendency for children to forget names less;
4. there will be fewer falters in the questioning process;
5. errors in instructions pointing to a lack of being able to change viewpoints will get fewer;
6. explanations accompanying choices will become more frequent; (explanation as a research parameter indicates learning in itself).

Post-testing: Hypotheses concerning the outcomes of the facilitation (post-testing)

Using the „Sorting" card game as a post-testing tool it was assumed that:

1. the number of pictures, concept pictures needed for the solution will decrease (solutions will be those of a higher level);
2. the number of conceptual superordinations and thematic story-like choices will increase while the number of guesses will become less;
3. choices of optimal strategies as evidenced in the protocols of individual strategies will increase, thereby mixed strategies will also improve
4. research parameters will indicate statistically meaningful changes in the components of conceptual processes; which will suggest that in addition to modeling, joint playing with the „Invicta" logic set and the „Clowns" card game have exerted a facilitating effect.

B.

Hypotheses concerning the case study (Gergo's case)

Using Raven's Coloured Progressive Matrices and WISC-III Gergo's performance fell into the average IQ range.

It was assumed that the „Sorting" card game can be used as a diagnostic as well as an analytic tool for untypical courses of development. A comparative analysis –a kind of microanalysis– of performances in the sorting tests was assumed to be helpful in identifying individual characteristics of development and the patterns of change:

1. It was assumed that Gergo, a child who had passed seven years of age, would be able to play the game, although his performance would be characterized by low level solutions and a high number of responses, as well as by signs of strong fatigue;
2. It was assumed that the number of conceptual answers in terms of conceptual equivalence would be low, and that Gergo's sortings would be predominantly based on associations through labeling;
3. We also hypothesized the use of mixed strategies as evidenced by the protocols of individual strategy-forming;
4. Playing the game was assumed to provide us with information as to Gergo's individual tendencies concerning task-keeping, fatigue and warming up.

Hypotheses concerning Gergo's facilitation process:

The hypotheses concerning the facilitation process corresponded to those set up with regard to nursery school children with normative development.

However in Gergo's case the facilitation phase, consisting of 10 sessions ranging over 10 months, was based on using the „Clowns" card set as a facilitation tool.

The choice was made following observations during playing the categorization game with the „Invicta" logic set at the beginning of the facilitation process, where Gergo was found to have increasing difficulty in labeling the items of the logical set due to his receptive and expressive speech development disorder The thematic clown face „offered" attributes that could be more easily labeled and thus be used for perceptual analysis.

RESULTS

A.
I. Findings of the cross-sectional study:

Our hypotheses concerning the outcomes of the cross-sectional study gained support as the game had revealed the gradually restructuring components of conceptual development and made them ready to be identified.
In the analysis the findings of three concept-searching tests („paired", „furniture" and „round") were used. Performance was compared by age from the point of view of conceptual generalization, levels of equivalence at the subconceptual and conceptual levels and conceptual strategies. Children between the ages of three and four did not yet grasp the rules of edge-matching games. Their attempts were characterized by chance steps and guesses, that is they couldn't tackle the task presented by the searching game.
The first steps pointing beyond guessing appeared between the ages of four and five.

1. The process of development could be traced by measuring and analyzing choices based on visual or verbal tools for achieving a solution. With age the number of pictures used had become fewer and the children's performance had improved.
2. Measurements could tap the decreasing occurrence of responses of a low level, and the increase in the occurrence of responses at a higher level showing conceptual equivalence. Subordinations and thematic story-like responses increased while mechanical guesses decreased with age.
3. The protocols of individual strategies revealed clear tendencies in strategy formation in terms of the ratios of optimal versus mixed or chance like strategies. The protocols gave a resource for identifying egocentric answers and answers relating to allocentric space and actions, which increased in a significant manner, while sortings without verbal comments gradually disappeared.
4. The transition between the ages of seven and eight years was marked by the fact that iconic representations were no longer exclusive. The „shift" around eight years of age, reported in relevant literature, was supported by our data in that the use of conceptual hypotheses within mixed strategies had become enhanced and the number of functional and abstract answers had also increased.

Statistical analysis (Mann-Whitney) showed no significant difference between the performances of six year olds and those in the first class (seven year olds) in any tests. Comparing the performance of successive age groups (5-yrs – 6-yrs; 7yrs/2nd class–8yrs/3rd class, 8yrs/2nd class – 9yrs/3rd class) no significant difference was found. However, leaping one chronological year in the comparisons, a significant difference in the results of the 1st class (7yrs) group and the 3rd class (8yrs) group could be demonstrated in the „Paired" test.
Data of the table below demonstrate that development in a non-facilitation framework was not fast. Statistically meaningful progress was made after two years; our data has attested to continual development followed by „shifts".

Groups TESTS	**PAIRED**	**FURNITURE**	**ROUND**
5-yrs-6-yrs	–	0.02	–
5-yrs—7 yrs(1stclass)	**0.05**	**0.05**	0.01
5-yrs— 8 yrs(2nd class)	0.01	0.01	0.01
5-yrs–9 yrs (3rd class)	0.01	0.01	0.01
6-yrs – 7yrs (1st class)	–	–	–
6-yrs–8yrs (2nd class)	0.01	–	–
6-yrs – 9yrs (3rd class)	0.01	–	0.02
7yrs (1st class) – 8 yrs (2nd class)	–	–	–
7-yrs (1st class) – 9 yrs (3rd class)	**0.05**	0.01	0.01
8-yrs (2nd class) – 9-yrs (3rd class)	–	–	0.02

II. Findings of the longitudinal study

1. The use of direct questions and that of guesses (making specific hypotheses) in nursery school children participating in the facilitation sessions was getting less frequent over the facilitation period including 10 facilitation sessions.
2. Irrelevant questions, i.e. questions with logical, formal flaws and the questions they could ask as the last one decreased in number.
3. They tended to forget the names of forms less.
4. They showed fewer falters in their questions.
5. The number of instructions errors indicating a lack of the ability to change viewpoints, for example „yes" or "no" answers given to the adult, got fewer and fewer.
6. explanations accompanying choices will become more frequent; (explanation as a research parameter indicates learning in itself).

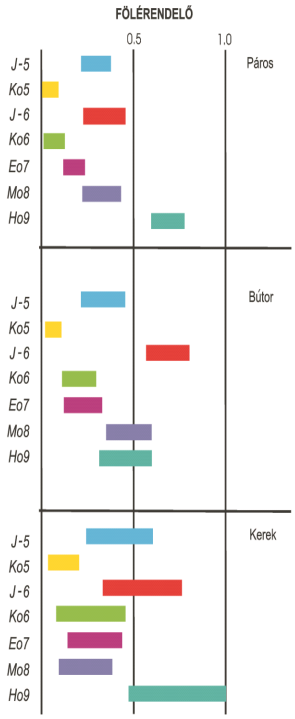
Findings of the post-test:

1. Children in the facilitation group needed increasingly fewer steps to reach a solution by virtue of using high level strategies and concepts as a result of facilitation to support maturation-development.
2. As to conceptual generalizations superordinations ensuring a logical constraining course to searching became more numerous: the ratio of high level superordinations and story-like responses increased.
3. Attempts at solutions without making hypotheses that are of a trial and error type got fewer.
4. As to strategy formation optimal strategies became more frequent, and there was a significant decrease in mechanical answers based on chance.

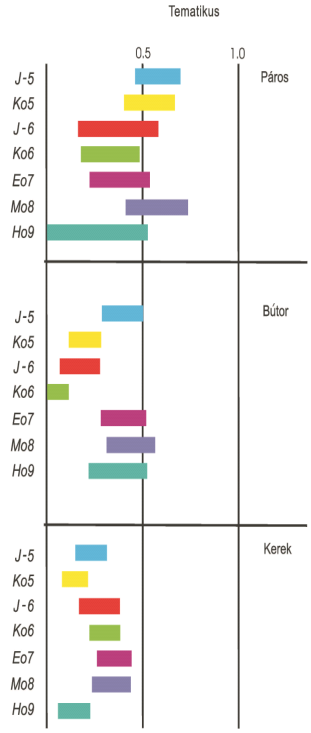
The statistical processing of the data (Wilson – Hilferty χ^2 formula) pointed out consistent changes in several research parameters of older nursery school children (six year olds) taking part in the facilitation process, which demonstrated a level of performance in the use of superordination comparable to that of 2nd grade elementary school pupils (8 year olds) as established in the „Cross-sectional study".

Responses of five year old nursery school children also pointed out a significant difference as compared to control group findings. They showed progress from guesses and other unproductive steps towards more efficient moves: preconceptual, complex-like collections as well as chainlike and edge matching type answers had become more frequent. It was intriguing, that, in the lack of equivalence, provided the pictures were prompting thematic responses, story-telling had increasingly become part of the response repertoire. When conceptual thinking couldn't yet be manifested vivid fantasy work had got mobilized in line with the children's age characteristics.

Superordinations



Thematic



(Markings: P-5: Playing five-year-olds; Co-5: control five-year-olds; P-6: playing six-year-olds; Co-6: control five-year-olds; Fg-7: First grade 7 year olds; Sg-8: Second grade 8 year olds; Thg-9: Third grade 9 year olds;.)

In the responses of five year old nursery school children mechanically sorting pictures becomes less frequent while pictures chosen by preference increase in number.

B.
Findings of the case study (Gergo's case)

Pre-testing was made using the „Sorting" card game. Gergo's performance was sufficient for being evaluated; he gave a high number of responses, made use of 35 cards but could not reach the solution. High-level conceptual responses appeared following a prolonged warming-up period. In line with his age functional responses appeared (characteristic of the age shift between seven and eight years). Having failed to reach a solution however lead to a dramatic fall in the level of the answers and the good sorting achievement reached earlier was not to be

restored. The last third of the protocols attested to mechanical, „labeling only ”types of searching.
Despite a good level of hypotheses based on superordinations, repetitions and perseveration appeared to be followed by a sudden falling back onto the level of labeling. On the whole, the protocols demonstrated a mixed strategy containing several high-level responses in succession, which fell apart with fatigue; at some points showed perseveration, then fell back onto the level of labeling the pictures only.

The outcome of the facilitation process
In the facilitation process the „Clowns” card set served as a facilitation tool.
Gergő became increasingly steady and began to show a growing interest over the facilitation period. The pattern of his performance given at the start of the process, namely that his „school” attention collapsed after a ten minute period and could not be restored, gave way to change very slowly. The number of guesses and direct questions decreased, and so did the number of irrelevant questions, even in the presence of growing fatigue.
With respect to falters, although facilitation resulted in the disappearance of the tendency of growing fatigue, falters could still be observed occasionally as testified by the last protocol. At the beginning of the facilitation process errors and faulty sortings increased with time indicating growing fatigue. It was these accumulating errors that had become less frequent during the facilitation process. However, these errors hadn’t disappeared entirely, nor had the other types of errors. Instruction errors indicating the lack of the ability of changing viewpoints, had decreased to a minimum. Gergő’s questions had become controlled, showing focusing, his choices were all explained.

The results of the outcome study
As a measurement tool the „Sorting” card set was used.
In the post-testing task Gergo did not reach a solution, that is he could not find the concept to be identified. However, his play indicated improvements in several respects. The total number of his responses had become less. Labeling responses and choices not including conceptual equivalence had disappeared. Superordination responses followed an interesting oscillating tendency, but drops in response level were no longer dramatic, giving way to affective, contributive, complex-like and thematic story-like answers. This fact indicated Gergo’s persistent effort to give reasons for his choices. On the whole the protocols suggested considerable progress in that the mixed strategies no longer contained any labelings, mechanical solutions or trial and error answers.

SUMMARY

In both the Cross-sectional study revealing age characteristics and the Second study involving facilitation the performance of nursery school children was higher than established in earlier studies. The games did not impose undue burden on the children and did not present them with logical inconsistencies while, at the same time, provided proper support to the functioning representational systems. In terms of Bruner's theory (Bruner, 1956, 2005) a gradual restructuring had occurred from the dominance of iconic representations towards symbolic representations.

Considering that the facilitation process was medium-term and of a medium intensity, – following the ordinary frequency of rule playing, – claims on a developmental leap would be unjustified. It is a much more likely explanation that superordination as a cognitive process is a natural operation in children's thinking. The facilitation process itself also supports this notion. Such fast observation of the constraining model would not have occurred, had this approach been radically novel for the children. In our understanding more effective solutions represent steps in the modularization process as described by Karmiloff-Smith (1992) and Anderson (1992, 1994, 1998). Karmiloff-Smith (1992, 1996) maintains that these steps offer opportunities for representational redescriptions

In line with the principles of natural pedagogy (Gergely and Csibra, 1998, 2007) these steps appear in a fast learning process.

The games developed by us present tasks that do not involve logical inconsistency and are more in line with the children's everyday experiences. Our findings and the features mentioned above suggest that the games can be successfully utilized in facilitation, differentiation and integration settings or even in inclusive education, jointly with other types of intervention tools to promote the maturation, development and facilitation of thinking. Using Vygotsky's term of the proximal zone of development, they could be useful in narrowing the gap between a potential, a not yet conscious capacity, hardly able to be manifested (Kalmár, 1975; Bryant, 1974) and actual knowledge. According to our study our facilitation method also makes the tracking and exploration of both the syntactive, story-telling aspects of thinking and its categorical, pragmatic aspects constituting the precursors of scientific concepts; aspects described by Bruner (1975) as the two types of knowledge. The children's answers illustrated the personal, individualized, narrative approach, which manifested itself in the considerable increase in thematic answers following the facilitation process. Based on the conceptual pictures they correctly identified, children construed stories often following scripts from their own lives. Answers pointing to relationships between categories, that contribute to the structure of conceptual hierarchies indicate knowledge of the other type. Our findings fit into the body of findings supporting the theory of natural pedagogy (Gergely and Csibra, 1998; 2007) which assumes an open and pre-set system ready to receive particular social instructions; an assumption which enables a shift from individualized forms of learning towards the socio-cognitive ways of social acquisition.

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