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# The script model in relation to autism

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## Introduction

Verbal IQ has repeatedly been demonstrated to be highly correlated with theory-of-mind skills (3, 4, 13, 15) which could also be the case with scripts. Understanding the meaning of other people's behaviour obviously requires common knowledge of the situations in which the behavior takes place. We take for granted that people behave in certain ways in certain situations. If we did not know how a particular situation usually takes place in our culture, we would be unable to interpret the motives of other people's actions. The need to know how knowledge about familiar social routines is organized in children with autism is an argument for using the script-model from cognitive psychology. From a theoretical standpoint, the scriptmodel (10, 12) appears to be obvious in relation to autism. Katherine Nelson (12, p. 6) writes about the model: "The central construct is the idea of situational

Abstract The primary purpose of this study was to investigate autistic children's scripts for social routines. Scripts specify familiar events in terms of who does what, when, to whom, and why. Scripts are verbalizations of mental event representations, containing and organizing generalized knowledge of how the world works. Scripts are presumed to be of vital importance for the development of shared meaning, communication, and social behaviour. In this study, children with autism were asked to explain wellknown social routines, such as how you shop in a supermarket, make a cake or celebrate a birthday. The

scripts of the 12 children with nonretarded autism were compared to scripts of matched normal control children. Despite the fact that all of the participating children with autism had an IQ above 90 and a mental age between 8 and 14, a significant difference in autistic and normal control children's ability to generate scripts for familiar social routines was found. The results are discussed in relation to the same children's ability to pass theory-ofmind tests and their verbal intelligence.

**Keywords** Non-retarded autism – script – theory-of-mind – verbal IQ

models that represent familiar experiences. Such cognitive models provide cognitive context, the context that is operational for the individual at any given time. The child acts within situations and activities, but the direction of that action is provided by the applicable internalized model of the situation (what fits from previous experience) in conjunction with specific present features of the situation (who, what, where, etc.). Together, these provide the cognitive context for action, and for the interpretation of the actions of others". At the beginning, the child's models are assumed to be representations of familiar, significant, and repeated events. In time these become generalized into the elaborated child world model that includes people, places, and a variety of activities (general event representations, here called mental event representations). The script model presumes correspondence between the structure in the narrated script and the mental event representation.

Until recently, studies of autistic individuals' capabilities in scripts have been sparse. Loveland and Tunali (8) describe an example where they ask a young autistic man to explain how a hotel holiday usually goes. He does not succeed. He would rather talk about his plans, concrete experiences, etc. They conclude that it may be because he is incapable of processing generalizing event representations a way that the construction of cognitive models demands.

It was the purpose of this study to examine autistic children's scripts for well-known social routines with the hypothesis that the inability to form scripts is one component of a range of cognitive disabilities observed in autism. With insufficient and inflexible cognitive models, the autistic child would be a poor social navigator which would explain preferences for strict routines and their reactions to change. The group differences in scripts may just reflect group differences in verbal IQ. As has often been shown in the verbal portion of the WISC, it is especially comprehension that is affected in children with autism.

#### **Materials and methods**

Twelve high-functioning children with autism and the same number of control children took part in this study. The children, between 6 and 15 years old, were diagnosed by either of two experienced child psychiatrists with no knowledge of the design or the purpose of the study. The child psychiatrists applied the research criteria of ICD-10 (7) on data from medical records, dating back from the first contact with a child psychiatric clinic plus actual clinical information. All of the children were given the diagnosis of autism and none met the criteria for Asperger's syndrome. Only autistic children with a full-scale IQ score above 90 (WISC, 18) were chosen for the study and they all had communicative language skills.

All of the children with autism had a full scale IQ within the normal range as shown in Table 1. The full scale IQ is 102 (SD 10.8) with a slightly higher performance IQ (107) than verbal IQ (97). The autistic children who participated in the study were very high

functioning, which is also shown by the low discrepancy between the group's average chronological age (10.7, SD 3.1) and its mental age (10.4, SD 2.7). The children in the control group were chosen in such a way that they and the autistic children were individually matched based on mental age. The control group consisted of children living in the neighborhood of the university and known to staff and students, but with above-average intelligence. In the attempt to obtain matches based on mental age, the more intelligent normal children were chosen slightly younger; 1 1/2 year on average. All children had similar social and cultural backgrounds. There were no significant difference between the groups concerning mental age (p = 0.9), verbal mental age (p = 0.7), or performance mental age (p = 0.1). Instead a significant difference between the groups was registered concerning full scale IQ (p = 0.001) and verbal IQ (p = 0.001), but not concerning performance IQ (p = 0.1).

All children were tested with first order theory-ofmind (this procedure was similar to the "Sally and Ann" procedure described by Baron-Cohen (2, p. 41)), and second order theory-of-mind (similar to the "John and Mary" procedure described by Baron-Cohen (1, p. 290)). They were also given a script interview with questions about how some well-known situations, such as baking a cake, shopping in a supermarket, celebrating Christmas Eve and celebrating a birthday, usually take place. These are all well-known situations that, in spite of differences from event to event, should contain stable elements in a relatively stable sequence of which the children should be aware. To be sure that lack of initiative did not limit the children's replies, supplemental questions were given and the interviewer tried to make the child tell as much as possible without structuring the child's statements. The interviews with the children were taped and transcribed afterwards. The children's verbal scripts were categorized A or B following these criteria:

Category A (Minus script): The child talks about isolated actions and things concerning the situation. No underlying schematic structure or sequence in organizing things are visible. The criterion was less than three actions or occurrences in one sequence (an example will follow in the qualitative description).

		Chronolog. age	Mental age (WISC)			IQ (WISC)			
			accumulate	Verbal	Performance	Full scale	Verbal	Performance	
Autism	Mean Std. Dev.	10.7 3.1	10.4 2.7	9.6 3.2	11.1 2.6	102 10.8	97 18.8	107 13.6	
Control	Mean Std. Dev.	9.1 2.1	10.5 2.6	$10.0 \\ 2.7$	10.9 2.7	118 11.2	120 13.0	116 13.6	
T-Test P=2-tail		0.1509	0.923	0.7168	0.8684	0.0015	0.0019	0.1043	

Table 1 Intelligence test

Category B (Plus script): The child talks about actions and things revealing at least one simple sequence. The criterion for a simple script was one sequence with at least 3 actions (an example will follow in the qualitative description). Some children talk about actions and things revealing a more elaborated sequence with a) additional actions: "it can also—", b) alternative actions: "it can either —, or —, and/or", c) conditional actions: "if–, then–". Only the control children gave such elaborated scripts.

The author and two experienced psychologists (blindly) scored the written interviews. There was an interrater agreement of 0.69 (Kappa coefficient). Verbal IQ was covaried in all analyses (ANOVA), which made the significant difference between the groups disappear. This issue will be dealt with in the discussion.

#### Results

Table 2 shows that autistic children with an accumulated mental age of 10.4 years (st 2.7) have significantly less well-organized scripts than normal control children with an accumulated mental age of 10.5 years (st 2.6). If all of the script answers are examined together, there is an outspoken significant difference (p < 0.0014) between the autistic group and the control group. This calculation is made with the Mann-Whitney (2 tail). Table 2 also shows that the autistic group and the control group do not differ significantly on first order theory-of-mind (p < 0.50), but on second order theory-of-mind (p < 0.045). Nelson and Gruendel's (10, 11) studies of children in pre-school show that even 3-year-old normal children have well-organized scripts for familiar situations.

# Examples of script narratives

The following examples illustrate the qualitative difference between scripts of autistic children and those of children in the control group. The autistic children tend

to begin organizing experiences in a causal-temporal sequential sequence at an older age than the control children.

Question: What do you do when you bake a cake? Dialogue with a 6 year old with autism (minus script): You put it in the oven and then it becomes delicious. (can you tell more) Yes! (What else do you do) Raisins in. (repeats question) You just have to put it in the oven.

Dialogue with a 9 year old with autism (minus script): You.. have to.. use flour and yeast and eggs and also sugar and milk and melted butter. (can you tell more) No (try to tell more about how you bake a cake)

(try to tell more about how you bake a cake) With a tin, with a baking tin

Dialogue with a 6 year old control child (plus script) Then you take the batter, put it in a tin, and then– no, when the batter has rested then you put it in the tin, and then you put it in the oven, and if you have a clock – a clock that can ring when the cake is done, then you can take the cake out, and you can eat it.

Dialogue with an 8 year old control child (plus script) What to do? You just take some custard, then you buy some pancakes, and then – then you put them on a plate and then you take some custard or some strawberry jam and splash it on and then you take another - maybe - and then some whipped cream on top, and then it's done.

As they grow older, the autistic children also develop more sequentially organized scripts, but the quality of them often vary. They are more rigid and more narrow, whereas the normal children's scripts are more flexible with various options within the different categories of actors, actions, and objects. This is illustrated in the following answer from a 15 year old boy with autism on what takes place when you shop in a supermarket:

	Theory-of-mind			Script						
		1st order	2nd order	category	script no. 1	script no.2	script no. 3	script no.4	Total	
Autism no = 12	Pass Don't pass	11 1	5 7	B A	6 6	7 5	6 6	5 7	24 24	
Control no = 12	Pass Don't pass	12 0	10 2	B A	10 2	11 1	12 0	12 0	45 3	
P = Fisher exact test Mann-Whitney P = 2-tail		0.50	0.045						0.0014	

When I have to buy something in a supermarket, I first enter the shop. Then in there I take a basket, and find the groceries I want. The groceries I put in the basket. Then I find the money and go to the cashier and pay for the groceries. When I have paid for the groceries I put them in a bag that I have brought, and put the basket back. Finally I go out of the supermarket with the groceries in the bag.

Below is an example illustrating the correlation between script and theory-of-mind. It comes from an initial interview with one of the children with autism, an 11 year old girl:

(What happens when you have music lessons) But I am not having that today! (no, but what happens, when you have?) But why can't you wait and come along on Thursday? (can't you tell me now?) It's because. because I don't have anything to do with those matters on the days when I am not going there. (Can't you tell me although you are not going there today?) Then come again on Thursday! (No, won't you please tell me today?) No. (You can tell me what you usually do when you have Music lessons) But, - because I want to wait until Thursday! Are you coming then? (No, I am not) Why aren't you coming? (I'm not, and I won't know it, if you won't tell me today) Then you must come on Thursday (I can't, won't you tell me now?) What is your work? (I teach) Where? (At the university) Then don't you know the things you do in a school?

This child with autism demonstrates theory-of-mind of first order. She wonders what the interviewer knows, but she needs help to realize that the interviewer wants to know what she knows, which indicates that she does not master second order theory-of-mind. In contrast, a 14 year old child with autism demonstrates second order theory-of-mind. After the first few questions, he asked: Do you want to know what an autistic boy like me thinks about such things?

# Discussion

This study shows that only half of the scripts given by the non-retarded autistic children fulfill the minimum criterion for simple scripts, in spite of all of the autistic children having a mental age between 8 and 14 and an IQ above 90. In comparison with the group of matched normal control children, the results show that the group of non-retarded children with autism have significantly fewer well-organized scripts for familiar social routines.

The autistic children were individually matched to the control children on verbal mental age, yet to ensure a match, the more intelligent control children were 1 1/2 years younger. As a result the autistic and control groups differed significantly on verbal IQ, but not on performance IQ. When the effect of verbal IQ on the experimental measures was controlled, the significant difference between the groups disappeared. The situation may be similar to that of theory-of-mind, where a high correlation between verbal IQ and theory-of-mind repeatedly has been demonstrated. This finding makes the interpretation of the results more difficult. A control group of children of the same age and matched in terms of verbal IQ would have been a better control for the influence of verbal IQ on the results.

The biggest difference in the verbal part of the WISC was noticed in the comprehension subtest, which is in accordance with earlier results concerning the test profiles of children with autism. It has often been demonstrated that it is precisely comprehension that is most affected in autism (16, 17). As a test of social reasoning, comprehension has many similarities to the script interview, which might also explain the correlation between verbal IQ and script-performance.

In the young child, mental event representation are presumed to be of vital importance for the development of shared meaning between child and caretaker and, thus, for the development of language and communication (9, 11). A connection between verbal IQ and scripts is not surprising and may be a result of the fact that they are both dependent on an ability to form mental event representations.

A significant difference was also found between the groups on second order theory-of-mind, though not on first order theory-of-mind. In this connection, it is of special interest that Happé (5, 6) found a correlation between the ability to solve theory-of-mind tasks and comprehension in the verbal portion of the WISC. This is interesting because of the aforementioned similarity between what is asked for in script interviews and in comprehension sub-tests.

In conclusion, it is possible that the deficits found in the scripts of autistic children are connected with their lower verbal IQ. The results of the tests for second order theory-of-mind and comprehension could, however, also be interpreted in such a way that deficits in these fields, as well as deficits concerning scripts from children with autism, are due to a lack of ability to form mental event representations, which is a hypothesis that demands further study.

It is clear, however, that the children in the autistic group have great difficulties in giving well-organized scripts for everyday routines. The cognitive model may replace a supportive perceptual context and, thus, make the child capable of independent thoughts while simultaneously supporting the interpretation of other people's actions (14). Therefore, one must be aware of the specific consequences the lack of ability to generalize event memory may have on children. If one cannot create cognitive models for familiar everyday situations, one cannot share in context and participate in our culture.

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