

Structured flexibility: six case studies of how children with diagnosed autism develop independency in daily living activities

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The aim of this study is to describe in what ways variation can be used in learning situations for pupils with autism to evoke deep understanding of activities in natural settings. The combination of variation and structure was designed to make each pupil discern new aspects of their learning objects. The analysis of the six participants' learning was based on the variation theory, and focused on how variation in the learning situation had affected the learning outcome. All six children who participated deepened their understanding of their learning objects, demonstrated by observable differences in performance of activities in which the targeted ability was included. The results are stable over time, showing the increased abilities in new situations during a six-month period. The study shows the importance of making the pupils focus on the *connections* between different aspects, rather than single aspects one at a time, to evoke deep understanding.

Keywords: autism; variation theory; teaching; experiences of the environment; learning

Introduction

According to Vygotskij (1997), learning is a development of ability to interact with other participants in the environment. In this study, learning is generally defined as the ability to experience the world in a new way, or in new ways, different from those previously held by the learner (Marton and Booth 1997) – and by this, to understand how to act in the natural environment.

It is frequently claimed that children with autism benefit from special education (Jordan and Powell 1995; Schopler and Mesibov 1995; Quill 1995). However, it is hard to find what theoretical assumptions about learning the studies are based on. Instead, learning often seems to be identified as memorizing how to behave in restricted situations. In this article, learning is, as already mentioned, defined as new ways of experiencing the environment and more powerful acting in the environment. This point of departure differs from the focus in studies on learning and autism where instructional strategies are in focus. In such studies, the result is strongly connected to the observable behaviour in a restricted environment, instead of learning outcome concerning the content which cannot easily be quantified and measured. Education is thus seen as a form of behaviour treatment, instead of a development of the participant's deep understanding of the environment and how to

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act in new situations. By this, the unwanted behaviour is measured and if it has decreased it is claimed the participant has learnt. It is seldom questioned what has been learned. The behaviour could have decreased because of the participant's deep understanding of why s/he should not continue doing it, or the participant could have understood the instructor's reinforcers but not why s/he should change behaviour – which results in two quite different learning outcomes, even if the observable outcome is the same.

Lord and McGee (2001, 90) say, 'there is a small literature on instructional strategies designed to promote the academic performance of young children with autism'. The focus in the present study is not on academic performance. However, the focus on the children's deep understanding, instead of learning how to handle a couple of behaviours which for some reason have to be modified, is shared in the present study and in Lord and McGee's study. Learning situations for children with autism are often strongly focused on one single detail and carried out with strict structure and routine (Howlin 1998), based on the fact that flexibility is hard to achieve for individuals with autism. There is, however, no need to restrict the learning situation because of the participants' impairments, as it can end up in school situations where the only way it works is when the child does the same thing at the same place month after month. The theoretical assumption of learning used in this study would not define such activity as learning. As a consequence, this study has a holistic point of view; the child has to consider more than one variable at the same time (in a real situation) instead of single variables (in a restricted environment). If theoretical points of departure about learning were distinctly clarified in studies about autism, the understanding of how and what people with autism learn would be easier to grasp. Lord and McGee (2001, 92) say:

There is need for research on the development of more specific measures of important areas of outcome in cognition, including the acquisition and generalization of problem-solving and other cognitive skills in natural contexts (e.g., the classroom and the home) and the effects of these skills on families and other aspects of children's lives. There is also a need for research to define appropriate sequences of skills that should be taught through educational programs for young children with autistic spectrum disorders, as well as methods for selecting those sequences, while developing programs for individual children.

As autism is a rather new research phenomenon, the initial research focus has been how to cure the disease instead of how to help the individuals handle the symptoms of the disability. When autism was first described (Kanner 1943), research was overshadowed by the search for different cures (Baron-Cohen 1995; Holmqvist 1995a, 1996). Instead of developing scientific theories about learning applied to individuals with autism, there has been a strong emphasis on behaviour modification programmes (e.g., Lovaas and Buch 1997). But applied behaviour analysis and functional behavioural assessment approaches focus on the observable behaviour, instead of the ability to deeply understand a new concept (Austin and Carr 2000). The question of *how* to teach has been more developed than the question of *what* it takes to learn (Lord and McGee 2001). To distinguish between behaviour modification and learning, there is a need to explain the scientific theoretical assumptions about learning on which the studies rely – if the results claim learning has occurred. Otherwise it is hard to discuss if and what the participants really have learned.

It is well established that children with autism have multiple problems involving joint attention and perspective-taking (Cohen 1998; Frith 1989; Gillberg 1995; Wing

1996). They display a number of deficits in the ability to jointly attend to objects with other people; they produce very few declarative gestures and they engage very little in symbolic or pretend play (Happé 1994). Some high-functioning children with autism have the ability to adopt the role of another, but lower-functioning children with autism are very poor at accommodating another person's perceptual perspective (Duvner 1994). One among many conclusions is that children with autism as a group have difficulties in taking another person's point of view, and sometimes they are characterized as being basically 'acultural' (Grandin 1986; Schopler and Mesibov 1995). One theory about the source of problems of children with autism is that they have difficulty in identifying with other people (Tomasello 1999). If they have deficits in understanding another person's intentional actions, it is hard for them to predict the behaviour of others, as well as to discern what other people expect of them. The question, 'Can you turn off the light, please?' answered by a 'Yes', but with no follow-through, is an example of such an environmental problem. When you are observing a child with autism, this complicates how to interpret and measure the observable behaviour, as you in fact do not know what it stands for. By the use of a theoretical framework it is possible to predict the intention of the observed behaviour, and based on such predictions arrange instruction. If the theoretical framework really works and seems to be powerful, the child should develop in the predicted way. Even if there are several studies describing how to increase ability or decrease unacceptable behaviours, it is hard to find studies with this point of departure. In most studies the behaviour seems to be in focus, and the work seems to be empirical based. The question of why some methods seem to benefit some children, as other methods seem to benefit other children, might be possible to answer if we can find a theoretical way to explain why the methods are or are not powerful in a defined situation. By doing this, it would also be easier to predict what kind of method or instruction is needed in new situations.

Unlike other children who have a common understanding of people as intentional agents, children with autism have a cognitive difficulty that emanates both from identification with other people and from the intentional organization of their own sensory-motor actions. This development emerges very early in normal infancy and is unique to the species, emerging around eight or nine months of age (Tomasello 1999). This exposes the normally developing child to the uniquely human forms of cultural inheritance, an area in which we cannot expect children with autism to participate without educational training. Other theories about the origin of cognitive disabilities related to autism are weak central coherence (Happé, Briskman, and Frith 2001), executive disorder (Russell 1997) and an extremely atomistic experience of the environment (Holmqvist 1995a, 1995b).

The extremely atomistic experience results, for example, in a deficient ability with joint attention. It is not an area of study in 'normal' children's education, because it is seen as a natural development. Although we can investigate the development of attaining joint attention, we are not yet accustomed to educate in areas which could be classified as 'learning to be a human being'. How can you discern aspects of a phenomenon if it is so integrated into your mind that you cannot even recognize it? The best we can do to help seems to be to build theories of learning which can be tested in natural settings. This study is one contribution in the direction of theorizing that learning is a broad environmental experience, focusing on both social action and cognitive skills, or in this case, learning to see the critical aspects that define what it means to act as a human being in our society.

Theoretical framework – the variation theory

Variation theory is one among many possibilities for increasing teachers' qualifications to help students with autism improve their ability to enter into society (Holmqvist 2004a, 2004b). It focuses on intentional learning, learning which is aimed to develop another person in a specified direction (Marton and Booth 1997; Marton and Fai 1999; Marton and Trigwell 2000; Marton and Tsui 2004; Holmqvist 2004b; Holmqvist, Gustavsson, and Wernberg 2008; Runesson 1999). Variation theory focuses on what an individual can possibly discern in the environment, what they can discern simultaneously and the kind of variation they can deal with to develop a deep understanding of the targeted learning object (Marton and Booth 1997). Based on the theoretical framework, three dimensions are analysed in a learning situation; the distinction between: (1) an intended object of learning (which is what the teacher has planned); (2) an enacted object of learning (what actually takes place in the learning situation, possible to observe by a researcher); and (3) the lived object of learning (the student's learning outcome) (Marton 2000). Instead of trying to find the right teaching methods, variation theory is a tool to use in examining different learning objects to find how learning develops in different ways connected to the learning object and the learner. For learning to take place, a way of understanding an object can be defined in terms of critical features that must be discerned and focused on simultaneously. An individual must experience some kind of variation in order to discern a particular feature. To develop a certain way of seeing something, a teacher needs to construct the pattern of variation that is necessary for students to experience it.

Variation theory is built on research about discernment (Rubin 1915; Wertheimer 1959; Gibson 1986), simultaneity and variation (Bransford and Schwartz 1999; Schwartz and Bransford 1998). In all phenomena, in every situation, certain aspects are discernable. If every aspect could be discerned and focused on at the same time by everyone, everything would be experienced in exactly the same way. However, only a limited number of aspects can be discerned and focused on at the same time.

To experience means to be able to discern something from a given context and relate it to this context or another. It also means discerning parts of what we experience and relating the parts to each other and to the whole (Carlgren and Marton 2002; Wertheimer 1959). To discern the geometrical shape in Figure 1 you have to discern the three black symbols as a whole to see the triangle. In order for us to discern something, we must focus on some aspects whereas others remain unfocused. To make it possible to focus on some aspects, they need to be varied against an invariant background, i.e., variation is necessary for discerning and discerning is necessary for experiencing. The contrasts between what varies and what does not, result in a pattern of contrasts which make it possible for us to discern. The contrasted aspects that are possible to focus on simultaneously make a new way of experiencing, which changes as different aspects change. If you describe a girl as short for her age, you have contrasted in your mind examples of other girls of the same age but of different heights. Otherwise you probably would not mention anything about her height.

One of the difficulties in teaching students in areas familiar to the teacher includes the lack of awareness as to how the students' understanding of the object of learning can differ from the teachers'. So, how do we know what dimensions of

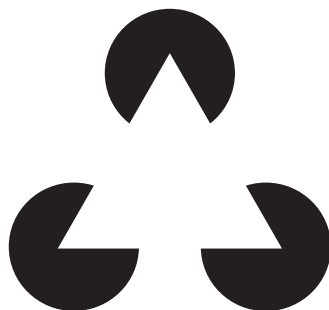


Figure 1. Geometrical shape, triangle, without edges.

variation to look for? How do we identify the critical features? According to Marton and Tsui (2004), the critical features have to be found empirically and they must be found for every specific object of learning.

The teacher must enable students to focus on critical aspects of the object of learning. Some aspects must be presented as basic and others focused on through variation. The basis is the knowledge shared by teacher and students. To create a learning space means to open up a dimension of variation that offers students new ways of discerning critical aspects (Marton and Tsui 2004). The dimensions include aspects of phenomena, but parts of the phenomena can be separated in new dimensions as a kind of differentiation or enrichment, when the learner gains a deeper understanding. But the question is: what kind of variation provides the students with the best opportunities to learn? Schwartz and Bransford (1998, 507) found:

In domains in which students have less prior experience, less complex contrasting cases may be more appropriate lest students get lost in the little contrasts [...] The contrasts between the tools are less ‘cluttered’ compared to the contrasting cases of these studies. This makes it so students with limited algebra knowledge can still locate the important contrasts.

Variation theory offers an opportunity to conduct microanalyses of the enacted object of learning (what actually happens in the lesson). The results of these microanalyses can be used to change very subtle details in the educational situation, which can result in totally different student learning outcomes. They also highlight the difficulties the pupils have in a learning situation, difficulties which may have been unnoticed without the microanalyses and hard to catch if they strongly differ from the teacher’s ways of understanding.

Aim

The aim of this study is to describe in what ways variation can be used in learning situations for pupils with autism to evoke deep understanding of daily activities in natural settings.

Method

In this study, already-existing teaching methods are used to instruct children with autism, such as the TEACCH-method (Schopler and Mesibov 1995), social stories

(Reynhout and Carter 2006), activity schedules (McClannahan and Krantz 1999) and how children read social situations and emotions (Howlin, Baron-Cohen, and Hadwin 1999; Gray 1995). However, the aim of this study is to describe in what ways variation can be used in learning situations for pupils with autism to evoke deep understanding of daily activities in natural settings, and not to study the effects of the teaching methods used. The methods for data collection are videotaped observations of the child's ability before and after the research lessons/activities and videotaped observations of the lessons/activities. To analyse the students' baseline ability, the variation theory is used, which means the focus is on three concepts; discernment, simultaneity and variation. Every participant was observed initially to describe what s/he already has discerned about the learning object, what could be discerned simultaneously and what kind of variation the participant seemed able to handle.

In six case studies participants with different abilities and different learning objects are described in a kind of technical action research project (McNiff and Whitehead 2005; Tomal 2003). The methods used are video observations and design experiments (Brown 1992; Kelly et al. 2000) in natural environments with factors that cannot be controlled as well as factors that can. The initial observations of the participants show which aspects of the learning object the child focuses on and which are unfocused, what the participants seem to discern, what they discern simultaneously and the kind of variation they can handle. The research team plan educational settings, based upon the initial analysis, which aim to help the participant discern new aspects or to focus on several aspects simultaneously. After the learning session/sessions, the ability to use the developed abilities is observed in natural environments. The video recordings are made twice initially (before the teaching situations), during the learning sessions (3–5) and as a single follow-up two to three months later. Each case is carried out within six months.

Participants

Six children participated in this research project. They were selected by a group of students who had attended a university course on autism. All of the students were also working with individuals with autism as professionals during the course period. First of all, the respondents were selected by their *differences* in age (7–15 years), developmental age, sex and language (four with different verbal abilities and two not verbal). Secondly, they should also have some kind of pervasive difficulties which made them impaired in their daily activities, regarding both their parents and professionals. Third, all of them have autism or Asperger's syndrome as a diagnosis through medical examinations carried out by specialized teams at hospitals, based on Wing's triad or DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders) (American Psychiatric Association 1994). All of them were placed in classes for children with special educational needs, and four of them also had cognitive disabilities. The reason for this kind of selection was to see if and how variation could be used in learning situations where *different* kinds of individuals with autism or Asperger's syndrome participate (see Table 1).

Table 1. Participants and learning objects in the six case studies.

Name	Biological age	Functional age	Sex	Verbal/ Non verbal	Diagnosis	Learning object
Charles	7	1,5-4	M	V	Autism, Developmental disorder	Discern food at the table in a meal situation
Liza	10	4	F	V	Autism, Developmental disorder	Understand the use of a schedule
Max	11	1,5	M	NV	Autism, Developmental disorder	Discern the difference between my food and others
Jessica	12	3	F	NV	Autism, Developmental disorder	Shopping
Mary	13	13	F	V	High functioning autism, Epilepsy	Taking care of yourself when reaching puberty
Paul	15	15	M	V	Asperger's syndrome	Physical movements

Procedure

The case studies have been carried out in this sequence:

- (1) *Choosing learning object.* The learning objects were defined in discussions between the respondents' parents, teacher and one member of the research team. In most cases, the member of the research team is also the respondent's teacher or student assistant.
- (2) *Initial knowledge.* Analysis based both on the participants' behaviours, documented by video recording, and the variation theory focusing on what s/he has discerned (A), if s/he can discern more than one aspect at a time (B) and what kind of variation s/he can handle (C). Two video observations per child were made during the same week, one at home and one at school. The analysis was made by a group of 19 researchers and special needs teachers attending a university course about autism. All of them have worked for several years among individuals with autism. The team was divided into six smaller groups, with the focus on one child each. After each video observation, the team met and analysed the videos together, to reach a high inter-reliability.
- (3) *Defining the chosen learning object.* After analysing the video sequences, more exact suggestions were made about what aspects should be focused on at the instruction. Each case group contacted parents and staff to define an ability that needed to be further developed by the respondent.
- (4) *Critical aspects* in a dimension of variation of the learning object are analysed by answering the question: 'What does it take to master the ability analysed?' This means to consider, by reading previous research, what is already known as being difficult to learn for a child with this kind of impairment. If the learning object was eating food, we had to understand what kind of obstructions the child struggles with; otherwise we can hardly make a successful learning situation.

- (5) *Video observations of target situations.* The respondents are observed in situations where the ability is needed. Every team group video recorded the child in the targeted situations, to see how s/he handles the critical aspects.
- (6) *Analysis,* in the whole team group, of the aspects the participant responded to, and those which were not responded to. By studying the participant in a natural situation, attempts are made to capture the aspects s/he has already experienced and those s/he has not. Since it is impossible to talk with four of the participants about their understanding, observations became very important.
- (7) *Creating the learning situation.* Based on the observations, a teaching situation is planned in the entire research group, but carried out in the smaller case groups (one per respondent). The teaching situation aims to enable the participant to experience more or other aspects of the learning object, such as part/whole connections or to generalize to other situations. Video-observed teaching activities (three–five lessons per participant) took place over one month or until the targeted ability was reached.
- (8) *Assessment* of increased quality of the ability the study is focusing on. During and after each teaching situation, focused video observations are carried out to verify if the ability has improved or if more instruction is needed. If the latter is true, the process starts again at step five. A comparison of the different observations was analysed to determine in which way and how changes have occurred. This is based upon the children's responses to the aspects made discernable by the instruction, such as showing how to pick items in a shop or how to use a schedule.
- (9) *A follow-up* study was made to see if the ability remains or changes over time. Two months after the ability was stated as learned, video observations were made in the small groups, and analysed by all the team members together.

Results

Charles

The first case study is about a seven-year-old boy who has difficulties in understanding a meal situation. Charles is verbal, but he uses language in his own way, very little of which includes using words in a conversation. It is also difficult to understand how much he understands what he is told. He appeared to be unaware of the meaning of food during the meal and the rules for how to join in social activities at the table. He ate if someone gave him food on his plate, but he was unable to ask for food if it was not served. On the other hand, he often asked for food when he was not sitting at the dinner table.

The first analysis resulted in an assumption that he did not ask because he did not see where the food that was put on his plate came from. If he did not experience the food aspect when it was served in deep opaque dishes, and was not able to make the connection as to how others got food on their plates by serving themselves, it is obvious he could not act differently. However, when the food was served in deep transparent glass dishes, he showed exactly the same lack of ability. Seeing the food aspect was not the problem.

The second analysis resulted instead in an assumption that he was used to being served, and so he just waited until someone served him. A meal situation was constructed in which he was not served any food while the others at the table had

their dinner. He did not make any attempt to ask for food or serve himself during the meal. A while after the meal was completed, and the other people left the table, he was served, otherwise he would not have had anything to eat. Although he was able to see the food and to serve himself, there was no change in his way of participating.

In the third analysis the focus was on the patterns of variation possible for Charles to experience during a meal situation. There were four to seven people sitting at the table. During the meal, they conversed and the sound of cutlery against china could be heard. Along with all the movements the people made while serving themselves, it seemed as if there were too many varied aspects. We had assumed that Charles had better previous knowledge than he in fact had. This was shown by how he acted when the ‘cues’ he needed to act were removed. We found that he turned off his attention during the meal. So, not seeing the food and not serving himself turned out not to be the critical aspects. We had observed this in other situations. It was, in fact, the number of varied aspects that made him unable to focus on the aspects which were critical to developing knowledge about how to act at meals. The balance was not maintained between the learner’s previous knowledge and the complexity offered in the contrasted aspects as shown in Figure 2.

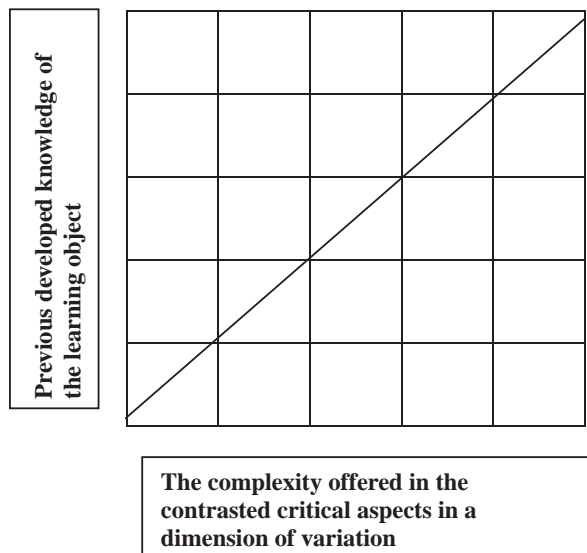


Figure 2. The learning diagonal. The relationship between the learner’s ability to learn by discerning the critical aspects offered in the learning situation in relation to their previous knowledge.

In the third analysis we examined which aspects could vary and which were kept invariant. To focus on the food dimension (represented by many different aspects, such as potatoes, vegetables, etc.) we chose to let Charles eat alone initially. In so doing, we maintained invariance in the situation at the table. The aspects of food did vary in order to make him understand how to choose and ask for different things. The food was represented in pictures, which were kept near Charles’s plate. To get a desired food he had to ask by words or signs (pointing at a picture). He also had to discern the quantity aspect, since he had to serve himself from the deep dishes. The teacher asked him how

much he wanted, if it was too much or too little, while he served himself. In this way, he could understand the meaning of the expressions ‘too much’ and ‘too little’ and connect them to how much he could eat; at the same time he was to learn how to get food on his plate. In this situation, he was able to understand which aspects were critical to focus on in a meal situation and which were not. Other people’s conversation and movements should be unfocused, which was demonstrated to him by reducing them initially. Charles was placed in a situation where he only had to discern the critical aspects concerning food. This was necessary as he otherwise focused on aspects not critical for understanding a meal situation. When he had developed knowledge about the learning object, this ability was transferred to a situation including more people also eating sitting around the table. By analysing Charles’s activities, we found that he was able to understand and act appropriately in a meal situation, with the pictures as support. In this way, variation was decreased in the beginning to make him focus on the critical aspects, and then increased in terms of letting more people join the meal situation without losing the focus on the critical aspects in it (see Table 2). The results show how Charles improved his ability to act more appropriately in a meal situation. He now asks for different items, and he focuses on eating when sitting at the table.

Table 2. The relation between varied and constant aspects in a dimension of variation.

Case study 1: Charles	Varied aspects	Constant aspects
Situation 1	Representation of food. Deep dishes containing food. People at the table. Verbally unfocused discussion between different people.	Adult help from people sitting next to him. The quantity of food he got on his plate, served by the adult.
Situation 2	Representation of food. People at the table. Verbally unfocused discussion between different people.	Deep transparent dishes containing food.
Situation 3	Representation of food shown by pictures. Quantity of food he could take from the dishes.	Adult sitting with him at the table. Pictures of food as a reminder of what to ask for. Verbally focused discussion between him and one person.
Situation 4	Representation of food shown by pictures. Quantity of food he could take from the dishes. People at the table. Verbally unfocused discussion between different people.	Pictures of food as a reminder of what to ask for.

Liza

The second case study involved a 10-year-old girl with difficulties in understanding her work schedule. Liza can speak a few words. Her independent work activity was observed, and critical aspects were identified. Her schedule consisted of pieces of paper on which there were circles in different colours. They were fastened to a board with four paper clips and were attached to the board in the same order every day, as shown in Figure 3.

The teacher said this was because Liza became confused if the order was changed. Four plastic boxes were placed on a shelf beside her workstation. They had the same

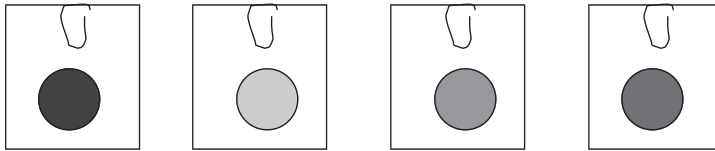


Figure 3. Schedule board.

symbols as the pieces of paper on the schedule and were placed in exactly the same order every time.

To learn the concept of the schedule, the situation was studied from theoretical assumptions about discernment, simultaneity and variation. We found that Liza had not been offered the opportunity to discern the function of the schedule. It was removed and a second observation of how she handled her work without the schedule was carried out. It showed that she managed to perform the tasks anyway, by taking the boxes from the shelf in the order from left to right.

The aim of this activity was for her to develop an understanding of a schedule, which could be used in new situations. Liza had learned to find the work material in the different boxes, but not the intended object of learning, i.e., to use a schedule. To provide her with possibilities to do so, she had to focus on the critical aspects of the object of learning. One critical aspect was to follow the schedule, in one direction, no matter what colour the shapes were. The invariant aspect was to read the symbols from left to right every time, and the varied was where the symbols were placed on the board. The second critical aspect was the connection between the symbols on the schedule and the symbols on the boxes. To get Liza to focus on this connection, variation was built in by changing the order of the boxes, avoiding duplication of the order on the schedule. In this case, the invariant aspect was to match the symbols on the schedule with the symbols on the boxes and the varied was the order in which to pick the boxes from the shelf. Learning how to use a work schedule includes discerning the connection between the schedule and workboxes simultaneously. This became possible by building a necessary amount of variation in the educational situation. Liza has since developed the ability to use the schedule which includes accepting changes indicated by it (see Table 3).

Table 3. The relation between varied and constant aspects in a dimension of variation.

Case study 2: Liza	Varied aspects	Constant aspects
Situation 1	Content of work material in the boxes on the shelf.	Order of how to read the schedule: left–right. Order of symbol cards on the schedule. Order of boxes with work material on the shelf. Order of how to pick the boxes on the shelf: left–right.
Situation 2	Content of work material in the boxes on the shelf.	Order of boxes with work material on the shelf. Order of how to pick the boxes on the shelf: left–right.
Situation 3	Content of work material in the boxes on the shelf. Order of symbol cards on the schedule. Order of boxes with work material on the shelf.	Order of how to read the schedule: left–right. Order of how to pick the boxes on the shelf guided by the colours of the symbol cards.

Max

Max is an 11-year-old boy. He does not speak but he uses sound to communicate how he feels. His problem is to join in a meal situation, as was the problem for Charles, but Max's situation is the opposite of Charles's. Charles did not serve himself, but Max did not know which food he was allowed to eat and which he had to share with others. He was totally focused on food the whole day and would run to the kitchen as soon as he could to get more. When he did not succeed, he became angry with the staff and would bite and hit if they did not give him food.

The first analysis resulted in identifying two critical aspects: food as a thing to share with others and the distinction between food on his plate and that in the serving dishes. Max saw all food as his, and he could eat from any plate or dish he found. He did not seem to understand that others at the table should share the food served. He also ate any food he saw, as if he could not see food without eating it. He was very worried when he saw the symbol for food on the schedule, and he was focused on it instead of the present activity. If food was represented as the third symbol, he did not read the schedule from top to bottom; instead he focused on the symbol for food without noticing the order of the activities in the schedule. This was another critical aspect – the understanding of a schedule – also present in the case study of Liza.

The two learning objects (to read a schedule and to reduce the obsession with food) had to be dealt with in two different ways. To get him to focus on the order of the schedule instead of the activities in it, he was offered a schedule with decreased variation. By using a schedule which only showed activities in a sequence where the first always is a meal (constant) and the other activities are not connected to food, he did not have to wait for the meal situation in the same way. The varied aspect in the schedule was the order and content of the other activities, while the meal sign was kept invariant or constantly first in the sequence. Secondly, to provide him with a new experience of food, he was offered increased variation of the food dimension. This was a variation in which different shapes of food were introduced and in activities where he had to work with food without eating it. He could also watch TV programmes about cooking, an activity he liked very much. After a few weeks, a change in his behaviour at meals was observed. He did not run to the kitchen any more; he did not eat everything he saw and he really seemed to enjoy cooking for both himself and others. The way variation was used (Table 4) to change his

Table 4. The relation between varied and constant aspects in a dimension of variation.

Case study 3: Max	Varied aspects	Constant aspects
Situation 1	All activities on the schedule.	Food on a food trolley from the kitchen. Food served at the lunch table.
Situation 2	Food in different situations. Food shared by many people. Activities after the meal sign in the schedule.	Meal activity first on the schedule. Only eat food on his own plate.
Situation 3	Representation of food in reality and on television. Food in different situations. Food shared by many people. Activities after the meal sign in the schedule.	Meal activity first on the schedule. Always put food from the dishes on his own plate without eating. Only eat food on his own plate. Food in cooking situations, no eating allowed.

experience of the environment has been very effective in making him understand the critical aspects needed to participate in activities concerning food. In addition, he is much calmer in other situations, as his food obsession has decreased and he now allows himself to concentrate on other activities. Max has developed an ability to handle food without eating it in situations where it is not supposed to be eaten, and to act in an acceptable way at the table.

Jessica

The fourth case study is about a 12-year-old girl who finds it difficult to shop. Jessica does not use verbal language. By observing her, information was gathered about which dimensions of learning she seemed able to experience. The teacher assumed it would be too difficult to buy more than one thing at a time. She went to the shop with a teaching assistant to buy rolls for the afternoon break at school. She showed a great amount of anxiety in the shop, and it was hard for her to find the rolls as well as to understand how to queue up. Instead of understanding the meaning of shopping, she was totally focused on getting the rolls. She was not able to focus on more than one item at a time. A situation was designed where she had to focus on the whole shop simultaneously with the function of queuing to pay. To give her opportunities to focus on the varied range of items, variation was offered in the educational situation, represented by pictures of items in the shop other than the rolls. After looking at the pictures, the teaching assistant and Jessica went to the shop to find the items in the natural setting. The connection between shopping and just visiting the shop was shown in the distinction of paying or not paying.

The teaching assistant wrote an instructional story, describing the critical aspects of going shopping, based on a theoretical analysis of the girl's observed experience. She also made a portable schedule, with pictures of different articles in the shop, and pictures of the different steps required for queuing to pay for the articles. After three shopping trips, Jessica showed no anxiety at all, rather excitement. In the last videotape from her shopping, she even turned to the teaching assistant with a smile, pointing at a box of soft cheese (which had not been introduced as an article for her) with a face expression saying: 'Could we buy this too?'. Shopping has become more to her than just picking up rolls for the afternoon break. She continued her shopping skills with her family. Instead of having experienced shopping as a chaotic activity for all involved, she now helps her mum choose articles instead of having outbursts because she does not have a clear and understandable picture of the activity. Shopping includes doing different things every time, which in turn blocks every attempt to create an 'everyday theory'. This frustrated her when she went to the shop because she did not experience the invariant aspects of the concept.

In this case she now is able to make connections at a more developed level, which helps her to deal with the variation she has to consider simultaneously with queuing in the shop. Jessica was given the opportunity to become aware of the connection between choosing items and paying for them as a sort of exchange. The other difficulty, queuing up to pay, showed she had not realized how to move when the queue moved forward. Finally, she was not able to see the connection between when to place her own items on the conveyor belt in relation to the other customer's items. For Jessica to gain these insights, i.e., to focus on the needed critical aspects, the teaching assistant initially enabled her to focus on the 'next customer' stick. Jessica was shown to put her items on the conveyor belt after this divider. The problem was

that she did not wait to put the ‘next customer’ stick on the conveyor belt until the previous customer had placed all of her items on the conveyor belt, which resulted in a mix-up of items. In the next learning session, the teacher instead had her focus on the belt having to be empty before Jessica could put her items on it. This was presented to Jessica by photos of an empty conveyor belt the next time they visited the shop. In this study, the shop was kept invariant, while the things that varied were the items to buy. Further development includes a variation of shops, as described in situations 4 and 5 in Table 5. Jessica has improved her ability to go shopping in how to choose items, how to queue before paying and how to act when she is supposed to pay for her items.

Table 5. The relation between varied and constant aspects in a dimension of variation.

Case study 4: Jessica	Varied aspects	Constant aspects
Situation 1	Queue to pay. Put items on conveyer belt.	Item. Shop. Help by teaching assistants.
Situation 2	Items. The order of items to buy shown in the portable schedule.	Shop. Portable schedule. Move forward in the queue as the person in front moves. Put items on conveyer belt after next customer stick.
Situation 3	Items. The order of items to buy shown in the portable schedule.	Shop. Portable schedule. Move forward in the queue as the person in front moves. Put items on conveyer belt when it is empty.
Planned situation 4	Shop.	Items. Portable schedule. Move forward in the queue as the person in front moves. Put items on conveyer belt when it is empty.
Planned situation 5	Shop. Items. The order of items to buy shown in the portable schedule.	Portable schedule. Move forward in the queue as the person in front moves. Put items on conveyer belt when it is empty.

Mary

Mary is 13 years-old. She is verbal and on a higher level than the four previous presented participants. Because of this, her disabilities are not as explicit. However, the learning object is in an area not often talked about in public. Mary’s difficulty in understanding her menstruation cycle is grounded in her strong connection between blood and death. She thought she was very badly hurt when she saw blood in her bed one morning. In the interviews with Mary, critical aspects concerning what blood is and when blood is dangerous, along with the biological differences between men and women, had to be discussed. First, the teacher showed Mary a picture of a woman (similar to a paper doll) where the blood circulation was depicted (Table 6). Then, she showed the same doll with the menstruation cycle depicted. By that she was able to discern the difference between losing blood from the two systems, one as dangerous and the other as normal. After that, she gave Mary the opportunity to see how she could predict when she would have her period. This was done from two perspectives: according to the cycles of the months and according to the life cycle. From the second perspective she was also informed that young girls and women over 50 usually do not menstruate, which is related to becoming pregnant. From this perspective she also realized that the reason men were not able to have babies was because they do

Table 6. The relation between varied and constant aspects in a dimension of variation.

Case study 5: Mary	Varied aspects	Constant aspects
Situation 1 Learning object A		Representation of blood in the circulatory system. Different kinds of injuries causing bleeding.
Situation 2 Learning object A	Representation of blood (in the circulatory system and in the menstruation cycle). Weeks with and weeks without menstruation.	Women have both systems because they can be pregnant. Men, children and older women do not have a menstruation cycle.
Situation 3 Learning object B	Toilets for women to use to take care of their intimate hygiene.	How sanitary towels are disposed of in a toilet with special waste boxes.
Situation 4 Learning object B	Mixed toilets to use to take care of intimate hygiene.	How sanitary towels are disposed of in a toilet without special waste boxes.

not menstruate. Finally, she was informed how to take care of her feminine hygiene. The critical aspects found in this learning object were the differences between toilet facilities. Those for women usually have a waste box for sanitary towels, which is not the case in toilets for both women and men. Because of that, she had to be instructed in two different ways to take care of this. The teacher considered the variation needed to create new learning about the two different learning objects, and the outcome showed that Mary was able to take care of her situation independently and her anxiety disappeared. She had developed an understanding of how to handle her period and the related hygiene.

Paul

Paul is in puberty and is rather high functioning. He is 15 years-old and his problem is connected to physical movements. He still moves as though he was a little boy, even though he is a tall young man. His movements include jumping, ritualistic walking patterns and other repetitive movements. Since he is so tall, he risks hurting himself by hitting the ceiling when he jumps indoors. People who do not know him find this behaviour very odd and it results in more repudiation than needed. Paul is able to understand written instructions and social stories have been used to help him shop independently. However, his physical movements appear as if he has no control over them. But since he seems to enjoy these activities, the aim is not to forbid them entirely; it is instead to give him the chance to learn other, more age-appropriate ways of moving, and the situations when his own ways of moving are allowed. The critical aspects identified are Paul's very limited ways of moving his body and his limited understanding of what are typical movements for his age and in different settings. To get him to focus on these aspects, the teacher offered him an increased variation concerning physical activities and a decreased variation concerning where the different physical activities were allowed to take place. These two aspects needed to be focused on simultaneously. First of all, the teacher introduced different ways of walking instead of letting him walk back and forth in the same spot as usual. Then

she showed him examples of how other boys his age move, compared to how younger boys move. He was told that every person has his own private area, where he can do things that are not appropriate in other places. If he was not supposed to jump inside at school and in public where other people could see him, he was still allowed to jump in his room, as long as he did not hurt himself (Table 7). Although this has been a problem for Paul for four years, he now moves more like other teenagers. His parents have reported that they see him now and again coming from his room, warm and red in his face from jumping. But no comments are made and he feels secure in his privacy. Obviously, this activity is something that gives him pleasure and forbidding it would not be fair. If variation had not been used in this learning situation, the teacher would have probably forbidden all jumping to reduce such behaviour. In this case, Paul has been given the opportunity to learn the connection between his acts and those of other people. By doing so, he developed an understanding of the differences between doing things when people are present and when they are not, a difference he was not aware of initially.

Table 7. The relation between varied and constant aspects in a dimension of variation.

Case study 6: Paul	Varied aspects	Constant aspects
Situation 1	Physical activities in different places.	The physical activities performed.
Situation 2	Different physical activities.	Each activity connected to a place where it is allowed.
Situation 3	Boys in different ages and their physical activities.	The physical activity.

Discussion

Teaching children and young people with autism has often been characterized by training rather than focusing on learning as a development in experiencing the environment. The training is often built on routines, carried out over and over again, and reinforcers are used, aiming to correct the person's behaviour. If learning is seen as a new way to experience, and by that to act in the environment, such school situations cannot be seen as learning activities. The results in this study show how variation, in a planned and structured way, makes the respondents in the six case studies more aware of what is expected of them in a situation. By making them discern connections between isolated events, their ability to act appropriately seems to develop. The disability has been described in terms of weak central coherence, lack of executive functions or theory of mind, etc. Findings show agreement in the literature that special needs education is the best way to help these individuals. Despite this, in most of the studies it is unclear how learning and special education are defined in a theoretical perspective. Because of this, educational practices seem to lack theory, at least in terms of theories on learning. In this study, we have examined how to use a theory to develop more insight into knowing *what* it takes to learn. Educational situations were designed in a way that made the pupil focus on the critical aspects of learning, and to make connections between different aspects, thus creating a better way of understanding the object of learning. The studies have demonstrated the advantage of making the student focus on the *connections* between different aspects rather than single aspects, one at a time. To make this happen, the

balance between variation/invariance has to be considered. Instead of creating methods for teaching children with autism, the focus has been on the relation between how an individual experiences the world and which critical aspects have to vary to make it possible for the individual to discern new aspects. The variation presented in the case studies is very distinct in identifying the critical aspects in a learning situation. Even if the same method is used, a change in those aspects which vary and those which do not vary makes the difference. Variation theory is powerful both in the analysis and the planning of learning activities. The results of the case studies also show possible connections among different assumptions of the features of autism. This has to be further developed, but it is worth considering the fact that these individuals show an extremely atomistic way of organizing experiences in the environment, which results in a weakness in central coherence and executive functions. As a result, it is hard for them to develop a theory of mind or intersubjectivity. This might be the reason that special education seems to be the most powerful way to assist children with autism in their development. If the main characteristic of autism is a way to experience the world as extremely atomistic, the other features are a result of this extremely atomistic way of organizing experiences. By that, the behaviour is the expression of the extremely atomistic way of organizing experiences. Even if finding the cause or the main feature of autism was not the aim of this study, the results raise new, interesting questions in such a research area.

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