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How young children explore, follow and impose rules during object-oriented play: a multiple case study

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ABSTRACT

In early childhood, young children frequently engage in object-oriented play. According to cultural-historical activity theory, object-oriented play provides children with opportunities to learn about the characteristics and cultural applications of objects and materials. These characteristics are referred to as rules or affordances of objects and materials. To date, what kind of rules children explore and follow, and how they do so, has not been extensively studied, even though the understanding of children's learning in object-oriented play is important for early childhood education. In the current explorative study, we analysed how six children aged between two and four years explore, follow, and impose rules during a 10-minute play activity in which they were presented with a fixed set of objects (e.g. oddly shaped blocks, boxes, abstract shaped puppets, etc.). Thematic analysis of video-observations revealed two themes: (1) children explore, follow and impose different types of rules using different strategies, increasing in complexity with age, and (2) children explore, follow or impose rules by various forms of repetition, with older children showing longer and more complex forms of repetition. In the discussion, these themes were interpreted using CHAT.

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Introduction

Between the age of 1 and 4, children frequently engage in the exploration and manipulation of objects that are available in their surroundings. In cultural-historical activity theory (CHAT) this is traditionally referred to as manipulative play. El'konin (1978) states that this type of play originates in the need for social contact that is manifest in emotional-contact play during the first year of life. Gradually, objects are introduced in emotional contact play for the purpose of creating shared attention between children and adults, which leads to an increase of joint object-centred activities. During the second year of life, children's need for social contact evolves to the need for exploration of the

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material reality and the effects of one's own actions. Children's concrete action with objects and the (real or imagined) reaction of reality is the stimulus to continue their play (Van Oers 2010). Manipulative play is characterised by association: The child acts without a plan and one action follows the other.

Following Wynberg, Boland, Raijmakers, and van der Veen (2021), this article uses the term object-oriented play to refer to all play that is focused on objects or materials. Based on an extensive literature review, object-oriented play involves different types of behaviour that evolve with age. These are (1) sensorimotor exploration, in which children incidentally explore the sensorimotor characteristics of objects or materials; (2) physical manipulation, in which children more or less intentionally explore what one can do with objects, and what effects can be reached by manipulating them, and (3) mental manipulation, in which children use symbolic thought in handling object(s). Sensorimotor exploration is already observed in infancy and mental manipulation seems to develop last, but how the three types of behaviour relate to each other in development is not yet clear.

Within CHAT, limited attention has been given to the value of object-oriented play for children's learning and developmental processes (e.g. Karpov 2005; Petr J 1980; Van Oers 2010). In contrast, most of the research within the CHAT-tradition has focused on sociodramatic play, being considered the most mature form of play. It has been argued that object-oriented play is closely related to development in other domains, such as language development and motor development (see for example Oudgenoeg-Paz, Leseman, and Volman 2020; Oudgenoeg-Paz, Leseman, and Volman 2015; Schijndel, Franse, and Raijmakers 2020; or Schröder, Gredebäck, Gunnarsson, and Lindskog, 2020). Therefore, we argue that object-oriented play involves an interesting developmental pattern that is important to understand in more detail. Besides, to date, within CHAT there is no systematic empirical research on object-oriented play. With this explorative study, we aim to study children's object-oriented play using a CHAT-lens and add to our knowledge on the developmental value of object-oriented play.

What is play?

Before we go deeper into object-oriented play, we discuss how play is theorised within CHAT. Vygotsky (1978) always referred to role (or sociodramatic) play, when he wrote about play, and claimed that play starts off from an imagined situation (Vygotsky 1987, 95). El'konin (1978) had a broader perspective on play, including social-emotional and manipulative play, and Orr (1983; in Van Oers 2014) rejected imagination as an inherent quality of children's private fantasy worlds *preceding* play. Imagination, he says, *emerges within* children's play activity. Vygotsky also identified *freedom* as a characteristic of play, but with the restriction that the freedom is not absolute, as play is also co-regulated by *rules*.

Although these characteristics are still relevant for a CHAT-based theory on play, Van Van Oers (2013, 2014) does not agree with the ideas of Vygotsky (1987), El'konin (1978) and Leont'ev (1983) that play is essentially characteristic for *early childhood*, that play is a *stage* in human ontogeny. Van Van Oers (2013, 2014), based on the writings of the historian Huizinga ([1938] 1951), argues that play should not be considered a distinct phenomenon but rather a way of executing any cultural activity. He argues that play is

a format in which an activity is carried out, rather than a specific type of activity. This play format is characterised by three parameters: (1) a high involvement of the participants, (2) exploring, following or using (implicit or explicit) rules in the activity, and (3) degrees of freedom for the participants in the execution of the activity. Every cultural activity can be performed as play if the aforementioned characteristics are met.

An important characteristic of the play format are the rules. Van Van Oers (2014, 63–64) distinguishes four types of rules.

(1) Social rules are rules about social interaction. They include both rules about socially acceptable behaviour in the interaction with peers and adults as well as role-based rules: what behaviour, actions and language belongs to social-cultural roles, such as the role of 'parent' or 'doctor'?
(2) Technical rules are rules about the characteristics and proper use of objects or tools. How to use instruments or objects such as a stapler or building blocks?
(3) Conceptual rules are 'rules that explain how to use cultural objects properly on the basis of concepts'. During their play, children may feel the need for a deeper understanding of concepts. For example, they may want to understand why the lights in their doll house are no longer working and they may get interested in the concept of electricity.
(4) Strategic rules are rules that are meant to improve an activity, for example by monitoring and structuring an activity, by making plans, or agreements among the participants.

The aforementioned rules have mainly been theorised in the context of role play. For object-oriented play, it may be expected that especially technical rules play a part in children's play, and that children both explore, use, and impose this type of rules (or regularities) during their play. The current study tries to shed light on the question which rules or regularities are part of children's object-oriented play and how children explore, follow or impose these rules during their play.

Learning in play

How does play contribute to children's learning? According to Van Van Oers (2010, 505–506) learning should be understood as a process of sustainable qualitative change in action or activities. For example, when children learn to handle a scoop, they are able to dig deeper and quicker. Any activity can lead to learning, but the format of an activity defines the possible learning processes and outcomes that can take place. A play format specifically provides the opportunities for learning that is meaningful for the child. It allows children to explore an activity and discover their own needs for improvement of their actions or for new actions and use of new objects.

In CHAT, it is not clear how this view on learning, a qualitative change in actions, is related to the concept of rules. Van Van Oers (2014, 63) states that 'rules should be seen as products of cultural history: Rules are the most important elements of human activities as cultural-historical phenomena'. With respect to role-play, in which children imitate activities of adults from their own interpretation and experience, rules might be understood as 'ways of behaviour' that are culturally and socially acceptable and appropriate.

With the mediation of knowledgeable others, children may become more aware of those rules and their ability to incorporate more (complex) rules in their activity increases. However, what is the nature of rules in object-oriented play? And how do they relate to qualitative change in actions?

Learning and rules in object-oriented play

According to Podd'jakov (1979), children explore and manipulate objects to find out the properties of objects and to explore what they can do with those objects (i.e. what effects they can reach by using the objects). From this perspective, rules in object-oriented play might be described as the awareness of *sensorimotor* affordances of objects and growing experience with the *intentional* affordances of objects: how is this object used in our culture? (Petr J 2013).

Van Van Oers (2014, 64) states that 'for the youngest children most of the rules are better described as tacit regularities that children maintain in their actions, without being able to verbalise them properly (…) (like in manipulative play)'. In other words, children construct their own (tacit) knowledge about regularity in object-oriented play by repeating actions (Van Van Oers 2010, 506–507). They can also change their actions by trial and error and in that way explore rules (Van Van Oers 2013, 11).

The ideas postulated in CHAT about learning in object-oriented play, raise many questions about the role of rules in object-oriented play. Therefore, in the current study, we aim to answer the following research questions:

(1) What type of rules do children explore, use and/or impose during object-oriented play?
(2) How do children explore, use and/or impose rules during object-oriented play?

For both research questions, we are interested in possible obvious differences between children of different ages, both concerning prevalence and complexity, and how they relate to the three types of behaviours that are distinguished in object-oriented play: sensorimotor exploration, physical manipulation and mental manipulation (Wynberg et al. 2021).

Method

Ethical considerations

The present study was part of a larger research project investigating the development of young children's (aged 2–4 years) object-oriented play. For this larger research project, ethical approval was obtained from the ethical committee of the Faculty of Behavioural and Movement Sciences, Vrije Universteit Amsterdam. One large organisation with multiple child-care locations was approached for participation in the current study and all day-care practitioners were informed about the purpose and procedure of the project beforehand. All parents received a letter with information about the study and were asked to provide their informed consent. Only children for whom informed consent was received, and who themselves seemed willing to participate (e.g. happily went

along with the test-assistant) were included in the study. All data were anonymously processed and saved. Data were only used for research purposes and were not distributed to others.

Sample

For the purpose of the current study, six children were selected from the sample of the larger research project ($N = 146$ for the full sample). Children could only be selected if they (1) had obtained average scores on the subtests Mosaic (i.e. a score between 9 and 11) and Analogy (i.e. a score between 8 and 11) of the Snijders-Oomen Nonverbal Intelligence Test (see 'Measures') and (2) were videotaped for ten minutes while playing with a fixed set of different objects. From the children who met the selection criteria, we randomly selected two youngest children, two children who were average in age, and two oldest children. The total sample consisted of $N =$ six children (three boys and three girls) from four different childcare locations. Children's ages ranged from 1.10 years to 3.90 years, with a mean age of 2.83 years ($SD = 1.09$). Participating children were Dutch and the Dutch language was the dominant language spoken at home for all of them. Children's SES was calculated using the average of both parents' level of education. Parents had medium (16.7%) to high (66.7%) education levels. Family sizes ranged from one child to three children ($M = 1.60$; $SD = 0.89$).

Measures

Children's Spatial awareness and abstract reasoning

The Snijders-Oomen Nonverbal Intelligence Test (SON-R 2-8) was used to select children for the present study (i.e. children with an average level of intelligence). As the administration of the complete test takes long (i.e. 60–120 min) and the reliability of the subtests Mosaics and Analogies is the highest (Tellegen and Laros 2017), only the subtests Mosaics and Analogies were used in the present study. The subtest Mosaics consists of 15 items and assesses spatial awareness (i.e. the ability to analyse spatial-perceptual relations, visuomotor and visuoconstructive skills). The subtest Analogies consists of 17 items and assesses abstract reasoning (i.e. concept formation, categorisation, reasoning, and the ability to identify and apply analogies). During the administration of both subtests, items were presented according to the age and performance level of the child. After three errors, the test administration ended. SON-R 2-8 has a high reliability (Tellegen and Laros 2017).

Children's play behaviour

The videos of the play sessions were inserted in Atlas ti. and analysed. For each session, children's play behaviour was coded using a self-constructed coding scheme. The first author developed a first version of the coding scheme for children's play behaviours based on previously developed coding schemes that focussed on exploratory behaviours and play behaviours of young children (e.g. Fanning et al. 2021; Oudgenoeg-Paz, Leseman, and Volman 2015; Schijndel, Franse, and Raijmakers 2010). This first version of the scheme consisted of codes for objects and play actions and was trialled on pilot video-fragments. If an object or play action was observed, but not yet included

in the coding scheme, a new code was created and included in the coding scheme. The final coding scheme consisted of three categories of codes. Specifically, we coded (1) the objects with which children played, (2) the play actions in which children engaged in, and (3) whether or not children's attention was directed at their play. In total, the coding scheme consists of 57 codes for objects, divided in six categories: (1) puppets, (2) neutral-coloured blocks, (3) coloured blocks, (4) boxes, (5) jute bags, (6) wood wool; 49 codes for play actions (not divided in categories); and 2 codes for attention.

Procedure

The participating children were visited at their day-care centres. After a period of acquaintance, the test-assistant invited the target child to accompany her to a play area within the day care centre that was separate from the larger day-care group. The child was invited to sit on a play mat on which the play objects and materials were placed in a half circle (in a fixed order). In front of the child, a camera with a microphone was placed on a tripod to record the play sessions. Next, the test-assistant pointed to the play objects and materials and told the child that he or she could play with all of it. During these 10-minutes of play, the test-assistant did not interfere in the child's play, but was present in the same room, near the child. When the child did not start to play with the objects and materials, however, the test-assistant would try to stimulate play by using the verbal prompts that were clearly described in our research protocol. As soon as the child was engaged in the play, the test-assistant refrained from further involvement.

Play objects

Each child was presented with the following play objects and materials: two jute bags which contained a set of oddly egg-shaped wooden blocks with multiple planes (one neutral and one coloured set), five different sized wooden boxes with clasps that can be nested or stacked, twelve coloured wooden abstract puppets, and a box filled with wood wool shavings. These materials were selected for this study, because they can each elicit all three forms of object-oriented play: sensorimotor exploration, physical manipulation and mental manipulation.

Data analysis

The videos of the play sessions were imported in Atlas.ti version 22 and coded for children's actions during object-oriented play. In coding our data, we used thematic analysis (see Clarke, Braun, and Nikki Hayfield 2015) to systematically identify patterns in children's object-oriented play. We were primarily interested in the type of rules children explore, use or impose, and how they do so (e.g. are there particular sequences of actions or behaviours involved when children explore, use or impose rules or regularities).

The average duration of the play sessions was $M = 11.15$ min ($SD = 1.28$, min = 9.06, max = 12.25). 'Attention' was double coded to ensure that the episodes that were selected for further analysis were episodes during which children's attention was directed at their play. For attention, an intercoder agreement of 93.2% was found. On average, 83.90% of

the time that children were videotaped, children were focused on their play. In addition, the video of the play session of one child was double coded and then discussed to ensure that the codes were clear and both coders selected the same code(s) for the same video episode. To select video fragments for further analysis, we both looked at the patterns that became apparent from the co-occurrence tables and selected the fragments during which children were focussed on their play (i.e. the object(s) and/or their actions). This yielded a selection of four to five video fragments per participant.

Results

Descriptive results

What objects were used and combined?

Of all the objects, children played with the puppets for the longest time, and the neutral and coloured blocks share a second place (see Table 1). Only one child touched and used the wood wool (see the example of PP#184).

Table 2(a), concerning the co-occurrence of objects, shows an interesting pattern: Children most often combined blocks with other blocks and puppets with other puppets, indicating that they tended to make combinations with objects of the same category (see Table 2(a)). In fact, one child (aged 37 months) kept all categories of objects separate at all times. When different categories of objects were combined, children tended to combine blocks, puppets, and boxes (see Table 2(b)). The combinations of objects (whether within the same category or across categories) included any number of objects. Only one child (aged 24 months) did not combine more than two objects at a time.

What type of actions did children engage in?

Children engaged in a wide range of different actions. However, certain actions, such as filling, touching with fingers, and showing the object, were dominant (see Table 3). Based on our coding, we could distinguish a certain hierarchy in the type of actions the children engaged. This hierarchy seems to relate to children's age and the categories of sensorimotor exploration and physical manipulation, as distinguished by Wynberg et al. (2021). Regarding sensorimotor exploration, analysis of the video fragments indicated that some children engaged in sensorimotor behaviours, such as touching with fingers or mouthing (putting an object in the mouth). These actions seem to fulfil a need of gaining sensorimotor input regarding the object. Furthermore, the actions of opening or closing an object were also often engaged in (see Table 3). These actions could be labelled as part of sensorimotor exploration aimed at exploring the sensorimotor

Table 1. Overview of the descriptive statistics of the categories of objects ($N = 6$).

	Min	Max	Mean (number of minutes)	SD
Category: Puppets	10.21	33.50	22.76	9.65
Category: Neutral coloured blocks	1.15	28.33	11.59	10.16
Category: Coloured blocks	3.55	23.45	11.06	8.95
Category: Boxes	0.00	13.50	6.51	5.43
Category: Jute bags	0.00	3.18	1.14	1.58
Category: Wood wool	0.00	3.85	0.64	1.57

Table 2a. Co-occurrence table of objects which occurred at least 5 times together.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1. Big block aqua blue	–																		
2. Box 1 (smallest)		–																	
3. Box 2			–																
4. Small block dark orange 1				–															
5. Medium block green					–														
6. Medium block bright blue	5					–													
7. Neutral block big 1	5			5			–												
8. Neutral block small 1				5			8	–											
9. Neutral block medium 1							5	5	–										
10. Neutral block medium 2							8	6		–									
11. Puppet … purple											–								
12. Puppet yellow												–							
13. Puppet bright purple											5	6	–						
14. Puppet orange											8	6	6	–					
15. Puppet dark blue											5	6	9	6	–				
16. Puppet, green											8	6	6	10	6	–			
17. Puppet bright blue											6	7	9	9	9	9	–		
18. Puppet light green											7	5	5	10	5	8	7	–	
19. Puppet red											6	5	8	7	8	7	10	5	–

Table 2b. Co-occurrence table of categories of objects which occurred at least 5 times together.

Categories of Codes		1. 1.	2. 2.	3. 3.	4. 4.	5. 5.	6. 6.
1.	Category: Coloured blocks	–					
2.	Category: Woodwool		–				
3.	Category: Jute bags	21		–			
4.	Category: Boxes	43			–		
5.	Category: Neutral coloured blocks	105		17	28	–	
6.	Category: Puppets	135		20	103	64	–

Table 3. Overview of the descriptive statistics of the ten actions children were engaged in most of the time and the ten actions children were engaged in least of the time ($N = 6$).

	Code play action	Min	Max	Mean	SD
1	Filling 1 by 1	0.00	2.69	1.36	0.91
2	Touching with fingers	0.20	1.60	0.82	0.52
3	Showing the object or giving the object	0.00	2.29	0.67	0.94
4	Laying objects in a row	0.00	1.87	0.62	0.79
5	Moving the object purposefully	0.08	1.20	0.55	0.51
6	Emptying 1 by 1	0.00	0.88	0.45	0.30
7	Relating the objects to one another	0.00	1.23	0.43	0.60
8	Closing object	0.00	1.04	0.41	0.41
9	Sorting/grouping object based on type of objects	0.00	1.27	0.40	0.62
10	Opening object	0.00	0.72	0.39	0.31
40	Shaking object	0.00	0.15	0.03	0.06
41	Moving object with foot	0.00	0.12	0.03	0.05
42	Rolling	0.00	0.11	0.03	0.04
43	Laying object on its side	0.00	0.07	0.02	0.03
44	Bouncing objects against each other	0.00	0.07	0.01	0.03
45	Looking at the object without touching it	0.00	0.05	0.01	0.02
46	Putting object in mouth	0.00	0.05	0.01	0.02
47	Transfer	0.00	0.02	0.01	0.01
48	Looks at the object in his/her hand	0.00	0.00	0.00	0.00
49	Making groups	0.00	0.00	0.00	0.00

Note: codes are not mutually exclusive.

affordances of the object. Children also engaged in the action of showing the object, which could be sensorimotor exploration aimed at creating shared attention. Regarding physical manipulation, analysis of the video fragments also showed many complex actions geared towards using the object or the affordances of the object with a certain purpose, such as sorting/grouping objects or filling the boxes with other objects (see Table 3).

When age is taken into consideration, our data indicates that especially the two youngest children exhibit the most sensorimotor exploration actions compared to the older children. The middle age children seem to be engaged in more purposeful actions, as is visible through the result of their actions: They, for example, start by purposefully moving an object from one place to another, to 'create' a row of objects or to 'create' groups of objects based on an affordance such as colour. This presents itself quite clearly in Table 4, when looking at the co-occurrence of actions: The simple action 'moving the object purposefully' often co-occurs with other 'more complex' actions, especially with 'laying objects in a row'. These more complex actions that are governed by a certain purpose or pattern are only engaged in by the older children. It is interesting to note, however, that even the oldest participant engages

in sensorimotor actions from time to time, only a shorter time compared to the younger children.

Themes: different types of strategies for different types of rules and the role of repetition

Two themes appeared from both our qualitative and quantitative analyses of the selected video fragments: (1) Children explore and use different types of rules using different strategies, and (2) children show different forms of repetition.

Theme 1. Children explore, follow and impose different types of rules using different strategies

The first theme that emerged from our data relates to the rules that children explored, followed or imposed during object-oriented play. Throughout the video fragments, a myriad of different types of rules – affordances, patterns, regularities – were discernible:

(1) By engaging in sensorimotor exploration such as touching, mouthing or rotating, children explored the sensorimotor characteristics or affordances of objects, such as 'the block is hard and flat'. For example, when one of the younger participants (24 months) rubbed a block against the palm of her hand, she discovered the sensorimotor affordances of the object (e.g. it is smooth, it has edges, etc.).
(2) By following the sensorimotor characteristics or affordances of objects to engage in an action, such as 'the block is hard and flat', children sometimes explored and followed a new affordance: Based on an exploration of the sensorimotor affordances of a block ('the block is hard and flat'), for example, children explored or followed a new affordance 'blocks can be stacked'. This pattern is seen when the youngest participant (22 months) grabbed a box and the box opened as he tried to move it. Once he explored this affordance (i.e. he opened and closed the box a couple of times), he started filling the box with blocks. So, the exploration of the sensorimotor affordances of a box (i.e. 'it opens and closes') leads to the exploration of a new affordance (i.e. 'as a box can open, it can be filled').
(3) By imposing rules on the object based on a sensorimotor affordance of this object children created patterns or categories. These patterns or categories can be made based on the underlying concepts that relate sensorimotor affordances to each other and can increase in complexity. For example, one child (37 months) placed each small block on a medium-sized block, creating little stacks of two blocks: This child imposes the concept of size to create a pattern.
(4) By experimenting with or comparing affordances of objects and the different actions these affordances allow, children discovered or imposed new affordances. For example, when the oldest child (44 months) puts the wood wool in the box and shakes it, it did not make a sound, but when she put some blocks in the box and shakes it, it did. Hence, this child experimented with objects with different affordances (i.e. hard versus soft) and thereby discovered a new affordance (i.e. a soft material nestled inside the box does not produce a sound when shaken, several hard objects do).

Table 4. Co-occurrence table of actions which occurred at least 5 times together.

	1. 1.	2. 2.	3. 3.	4. 4.	5. 5.	6. 6.	7. 7.	8. 8.	9. 9.	10. 10.	11. 11.	12. 12.	13. 13.	14. 14.	15. 15.	16. 16.	17. 17
1. Classifying based on size	–																
2. Classifying based on colour		–															
3. Closing			–														
4. Holding object high and drops it				–													
5. Emptying 1 by 1					–												
6. Laying objects in a row						–											
7. Making groups							–										
8. 'Closing' the object			7					–									
9. Opening the object									–								
10. Holds multiple objects simultaneously				5						–							
11. Presents or gives the object										5	–						
12. Sorting/grouping based on type of object												–					
13. Counting the objects													–				
14. Sweeping all (or part of) the objects together	5													–			
15. Moving the object															–		
16. Moving the object purposefully		13				103	10					28	9		5	–	
17. Filling, 1 by 1			6		8				6								–

The Role of Age. We see a difference in the complexity of the rules and affordances explored and used when we take the ages of the participants in consideration. First, the type of actions the younger children engaged in are more often sensorimotor oriented, and the rules they encounter relate more often to the affordances of the object, such as 'this block is hard, smooth or flat'. Second, because of the longer sequence of actions and the more complex combinations made (on purpose) and their repetition of these actions and combinations, the older children are seen 'exploring' a new affordance that is created by their combinations and actions. To illustrate the latter: If a child combines a box with one or several objects such as blocks or puppets, closes this box with the clasp and shakes it, it produces a sound. Even though the youngest child engages in a similar sequence of actions, the sequence he engages in is shorter and less complex and, therefore, does not provide him with the opportunity to explore this new complex affordance.

Theme 2. Children explore, follow or impose rules by various forms of repetition

The second theme that emerged from our data, was that all children showed frequent repetition of actions, where repetition of actions is considered different from repetitive behaviours such as banging or shaking. The sequence of these actions can vary in length before the sequence is repeated: A child can repeat one single action or repeat a longer sequence of actions. In our data, we found the following forms of repetitions of actions:

- Repetition of single actions such as repeatedly opening and closing a box;
- Repetition of single actions with variation in objects, such as rotating one block, then the next block or a doll;
- Repetition of complex actions with a single object, such as opening a box, getting out a block, putting it back in, close the box and lock the clasp;
- Repetition of complex actions with different objects, for example putting different blocks one-by-one in the box and closing the lid and the clasp in between each next block, or stacking blocks and then stacking boxes;
- Repetition of complex actions with objects with variation in the actions, such as first putting blocks in a row and then stacking those same blocks;
- Repetitions with systematic variations: first putting wood wool in a box and shaking it, then putting puppets in the box and shaking it, and then putting blocks in the box and shaking it. For the repetition to be systematic in its variation, it needs to be repeated multiple times where with every repetition only one variable varies, so either the object (s) or the action.

The Role of Age. It is possible to see a trend in the patterns of repetition when we look at the different ages of the children. Where the youngest children tend to repeat simple actions in short sequences, the older children repeat more complex sequences of actions. Only the oldest participant engages in what we explained as repetition with systematic variation. The sequence of the two youngest children is between 1 and 3 actions before it is repeated; with the oldest children this sequence can exist out of 6–9 actions before it is repeated. The longer the sequence of actions is before it is repeated, the more

opportunities it provides the children to make variations in either the objects or the actions involved. Another finding related to the age of the children is that when the older children do in fact engage in the repetition of simple actions, these simple actions are often part of a longer sequence of actions that can be subsumed under a broader label, such as organising or categorising. In these cases, these simple actions are bound together by an underlying concept, pattern or rule: such as moving the puppets purposefully one by one and repeating this action to eventually set all of the puppets in a row (see Table 5).

Examples to illustrate the themes

The following examples illustrate how these themes presented themselves differently in a similar sequence of actions, centred around filling boxes, across participants of different ages. We chose this particular sequence of actions as an example, because almost all (with one exception) children filled a box or jute bag with objects at some point during their play and this was supported by the patterns we saw in the different co-occurrence tables: The co-occurrence of the categories of objects showed that the puppets, as well as blocks are often combined with boxes, and are often involved in the actions of opening, closing, filling, emptying and shaking (see Table 2(b) and 5).

- PP#181 is 22 months old. He puts blocks and puppets into the different boxes, one by one or sometimes two at a time. Every once in a while, he first feels the object with his fingers or puts the object in his mouth before using it to fill the boxes. Sometimes, he hands one of the objects to the test-assistant after taking it out of the box. He closes and opens the boxes in between at random moments but he is not able to close the box properly with the clasp yet and does not seem to notice the clasp and its function. There seems to be no particular order in which this action of filling is repeated or when a block or doll is first 'felt' or given to the test-assistant.
- PP#201 is 37 months old. After playing with the blocks and puppets for a while, he grabs the smallest box, fills it, closes it with the clasp and puts the box aside. He then takes the second smallest box and fills this one, etc. He repeats this until all the boxes are filled, working from the smallest to the biggest box. He then empties all the boxes in a seemingly random order but makes sure all the boxes are empty by shaking them. This sequence of actions is somewhat structured, in the sense that he starts with the smallest box and works his way up to the biggest as well as that he makes sure all the boxes are empty.
- PP#184 is 44 months old. She fills the smallest box with some wood wool, closes it with the clasp, shakes the box, opens it and adds some more wood wool and shakes it again. Then she grabs a slightly bigger box, shakes it while it is empty, opens the box and fills it with some blocks and shakes it again once it is closed with the clasp. This is the beginning of a repeated sequence in which she fills different boxes with different objects. She also fills up a jute bag with some of the blocks and shakes it. She makes the most complex combination of objects and actions by filling a jute bag with objects and subsequently filling the biggest box with this filled jute bag. Overall, it seems that she takes a more systematic approach in her sequence of actions.

Table 5. Co-occurrence table of categories of objects and actions which occurred at least 5 times together.

	Category: Coloured blocks	Category: Woodwool	Category: Jute bags	Category: Boxes	Category: Neutral coloured blocks	Category: Puppets
Looking at the object without touching it						24
Classifying based on colour	6					15
Closing	62			68	56	129
Rearranging	16			11	22	35
Holding object high and dropping it	10				8	12
Emptying 1 by 1	8		5	31	14	60
Emptying, multiple simoultaneously	10		7	12	14	23
Laying objects in a row					8	76
Making groups						12
Nesting	9			10		21
Closing the object	22			48	22	96
Opening the object	43	5		55	39	99
Putting the object upright					6	6
Grabbing multiple objects at the same time	16			7	18	46
Showing or giving the object	53			13	22	79
Relating the objects to each other	18		5		15	17
Rotating	9					9
Shaking the object				8		
Shaking the object after putting something in it	12			22	20	76
Sorting/grouping objects based on type of object						21
Stacking				13	32	15
Counting the objects						14
Transfer	5				7	
Sweeping all the objects together	12				12	
Moving the object	6				11	31
Moving the object purposefully	15			10	27	748
Touching with fingers	17			8	8	42
Filling 1 by 1	75		10	45	40	167
Filling, multiple simultaneously	13			8	7	19

Discussion

In the current study, we studied how young children (aged 1;10-3;90 years) explored, used or imposed rules during object-oriented play. Specifically, we were interested in the following research questions: (1) What type of rules do children explore, use and/or impose during object-oriented play? and (2) How do children explore, use and/or impose rules during object-oriented play? For both research questions, we were also interested in possible differences between children of different ages.

To answer these questions, we selected six children from a larger sample who played with a fixed set of objects for a duration of 10 min. We coded children's actions and use of objects during their play activity and used thematic analysis to explore patterns in how children explored, used or imposed rules. Descriptive analyses indicated that during object-oriented play, children made different *combinations of objects*, with no clear age differences. Children most often combined objects of the same category (e.g. puppets with other puppets). They also engaged in a large number of different actions. In these different *type of actions*, we noticed a certain hierarchy based on the age of the children: The youngest children mainly exhibited sensorimotor explorations of the objects and the older children engaged in more complex and purposeful sequences of physical manipulation of objects. This hierarchy could be interpreted in terms of the categories of sensorimotor exploration and physical manipulation as distinguished in Wynberg et al. (2021) developmental model of object-oriented play. Further thematic analysis of our video-observations revealed two themes.

Theme 1. Children explore, follow and impose different types of rules using different strategies

To answer our first research question, our analyses indicated that *children explore, follow and impose different types of rules using different strategies*. Based on our data, we could distinguish four types of rules or regularities: (1) engaging in sensorimotor exploration; (2) following the sensorimotor affordances of objects to engage in new actions; (3) creating patterns or categories by imposing rules on an object based on the sensorimotor affordances of this object; (4) exploring or imposing new affordances or actions by experimenting with or comparing affordances of objects

Based on the analysis of these fragments, we argue that at times the sensorimotor affordances govern the action(s) of the child (see Petr J 1980) and at times the action (s) of the child determine what rules, patterns or affordances can be explored, followed or imposed. The latter is an example of what Pelligrini (2013) refers to as intentional affordances. This is inherently linked to the ability of the child to perform these actions: the more developed their motor and cognitive skills, the more complex the actions they can engage in.

Within CHAT, rules have mainly been defined and distinguished between in the context of sociodramatic play. Van Oers, for example, argues that children use or impose four types or rules during (sociodramatic)play activities. In the context of object-oriented play, however, it is important to note that these rules can also refer to patterns or affordances that are explored, followed or imposed. As it is often not clear what motivates a young child's action during object-oriented play, the distinction between the different types of rules or strategies can be difficult to make. Also, since object-oriented play occurs quite early in the development of a child, there is often

not much language involved that could give insight into why a child is engaging in a particular action. Results of our study indicate that object-oriented play might be an important activity for children to explore or and follow rules and affordances of objects and materials. More research is needed to understand how these often tacit rules, patterns or affordances (see van Van Oers 2014) that we observed in young children's object-oriented play might develop into more explicit rules.

With age, the complexity of the rules and affordances children explore or follow increases. The two younger children in our sample engage more often in sensorimotor play. In contrast, the older children engage in more complex forms of exploration and impose new affordances by experimenting with objects. In doing so, they show more developed forms of object-oriented play referred to as physical manipulation (Wynberg et al. 2021) in which they explore what effects they can cause by manipulating the objects (see also Podd'jakov 1979).

Theme 2. Children explore, follow or impose rules by various forms of repetition

To answer our second research question, analysis of our data revealed an interesting pattern. It seems that repetition (in its many forms) plays an important role in *how* children explore, follow or impose rules during object-oriented play. In our data, we found different forms of repetition from repetitions of single actions (repeatedly opening and closing a box) to repetitions with systematic variations (first putting wood wool in a box and shaking it, then putting puppets in the box and shaking it, and then putting blocks in the box and shaking it). Older children showed longer and more complex sequences of repetitions (consisting of 6–9 actions); sequences of younger children were shorter (1–3 actions) before they were repeated. Furthermore, older children seem to show forms of repetition that are guided by underlying rules. These rules can determine what form of repetition takes place. In CHAT, repetition has been identified as a crucial part of learning. In our data, we found that repetition can present itself in several different types and forms in relation to object-oriented play.

Limitations and directions for future research

There are two main limitations of this study that need to be addressed. First, although this qualitative, explorative study yielded interesting insights in how young children explore, use and follow rules and affordances during object-oriented play, the small sample size makes it impossible to generalise our findings. Future studies should include more participants to analyse if the patterns we found in these six children are also present in a larger sample. Furthermore, with a larger sample size consisting of children with different ages levels, it becomes also possible to study how children develop in their exploration and use of rules during object-oriented play. Second, we analysed children's object-oriented play in a controlled setting, with a fixed set of objects and without interaction with cultural others. Although this made it possible to compare children, we were not able to study how children negotiate rules or support one another to explore new rules or affordance. We know from both CHAT and evolutionary psychology that language and cooperation are important cultural tools to communicate and think together (Tomasello 2008; Vygotsky 1987). Therefore, future studies should also explore how interaction and cooperation

between children (or between a child and a more knowledgeable cultural other) during object-oriented play might support children's exploration and use of rules and affordances. This makes it also possible to study how the more tacit rules and affordances observed in object-oriented play develop into more explicit rules, such as the different rules proposed by Van Van Oers (2014; social rules, technical rules, conceptual rules and strategic rules).

Conclusion

To conclude, results of this study indicate that young children explore, use and/or impose different types of rules and affordances during object-oriented play, and that repetition plays an important role in this process. Furthermore, our data revealed that children, depending on their age, differed in the way they explore, follow or impose these rules; with age, the length and complexity of children's repetitions increases. These longer sequences of actions give more possibilities to explore or use different rules and affordances. Although our study was explorative in nature, our observations give some indication of the importance of object-oriented play for children's learning and development. Results of this study might support early childhood educators in observing children's development in the context of object-oriented play.

Based on the results of the current study, we suggest testing the following hypotheses in future research: (1) With age, the complexity of the rules and affordances young children explore, use or follow during object-oriented play increases; (2) The different types and forms of repetition support learning in the context of object-oriented play.

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