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SHORT REPORT

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The relationship between object play, language, and visual and motor skills in children at risk of developmental disorders between 12 and 37 months

BACKGROUND
Exploratory object play is a primary strategy in amassing knowledge about one's environment and determines the development of language skills at a later age. However, still much remains unknown about how object play is related to visual and language development in children at risk of developmental disorders.

PARTICIPANTS AND PROCEDURE
Forty-four children at risk of developmental disorders aged 13 to 37 months took part in the study. The measurement of object play relied on observation of children manipulating novel objects. Language skills were assessed by the Mullen Scales.

RESULTS
The results indicate that there is a correlation between specific object play behaviours, language and visual skills.

CONCLUSIONS
The findings from this study support the hypothesis that the relationship between visual and language skills and object play in children at risk of developmental disorders is different in younger and older children.

KEY WORDS
object play; language skills; children at risk of developmental disorders; visual skills

ORGANIZATION – Faculty of Psychology, University of Warsaw, Warsaw, Poland

AUTHORS' CONTRIBUTIONS – A: Study design · B: Data collection · C: Statistical analysis · D: Data interpretation · E: Manuscript preparation · F: Literature search · G: Funds collection

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BACKGROUND

Exploration is one of the fundamental cognitive activities (Vig, 2007). According to research, the type of exploratory activity may be predictive of future cognitive, motor, and social development (Singer et al., 2006). The relationship of exploratory activity with cognitive and social development may be twofold. Children with better cognitive skills are more likely to explore the environment and engage in object play (Pellegrini et al., 2007). In turn, exploration and object play may facilitate the development of motor, cognitive, and social skills (Singer et al., 2006).

When observing children engaging in object play, we can distinguish at least three types of activity: sensorimotor play, functional play, and symbolic play (Lillard et al., 2013). With respect to the development of object play in children, it should be noted that this kind of play begins with sensorimotor exploration, since children need to recognize their ability to interact with objects before they are able manipulate them with purpose. After this initial period, children enter the phase of more complex physical manipulation of objects. At the next stage, with the development of symbolic skills, physical manipulation may be replaced by mental manipulation of objects (Wynberg et al., 2022). Mental manipulation may then evolve into more mature and even more complex forms of play, such as pretend play, in which objects become props in children's play narratives (Wynberg et al., 2022). Compared to sensorimotor play, symbolic play is more intricate, involving manipulation of a greater number of objects (Wynberg et al., 2022). Elements of mental manipulation emerge in children's play around 18 months of age, becoming very frequent at 36 months (Thompson & Goldstein, 2019). Importantly, in children of this age physical and mental manipulation co-occur, although the ratio changes: as children get older, they tend to engage in more complex forms of play featuring mental manipulation of multiple objects which gradually supplants physical manipulation of individual objects (Wynberg et al., 2022).

There is a large body of research demonstrating the relationship between the development of language and symbolic skills, including symbolic play (Lillard et al., 2013). Studies on typically developing children report a positive correlation between the level of language development and aptitude in symbolic play in children aged 8 to 24 months (Wynberg et al., 2022). Children who demonstrated certain symbolic play skills and engaged in more complex forms of play were more likely to possess language skills that required the same basic abilities associated with symbolic skills. Both symbolic play and language skills are associated with the ability to form mental representations. However, some studies have found that the relationship between language and symbolic skills changes over time. For example, Namy and Waxman (1998) discovered that in the early phases of productive symbol use, infants can map both words and gestures to object categories, and that with time, infants learning a spoken language develop an imbalance between words and gestures, with words supplanting gestures.

A number of studies have shown that both object play and language skills develop differently in children at risk of developmental disorders compared to their typically developing peers (Bruynell et al., 2019). Despite extensive research on children at risk of developmental disorders, little is known about those relationships in children at various stages of development. Comparisons of children aged 18 months with children aged 24 or 36 months reveal many differences with respect to play, cognitive function, and language (Chu & Schulz, 2020). It is not entirely clear, however, how object play is related to cognition and language development in children at risk of developmental disorders under 18 months of age, as well as older children aged 24 and 36 months.

Motor skills have been linked to cognitive, linguistic, and social development. Motor abilities are associated with the development of language (Libertus & Violi, 2016; West et al., 2019), joint attention (Yu & Smith, 2017), and cognition in infancy (Soska et al., 2010). Moreover, studies show that some motor skills, e.g. imitation skills, are related to object play (McDuffie et al., 2007). Although object knowledge is learned through nonimitative investigation of object properties by the child, knowledge about what to do with conventional objects is acquired through seeing what others do with them (McDuffie et al., 2007). As a result, imitation has been defined as a learning mechanism by which infants learn and master new object play skills. There is widespread agreement that children with autism have a significant deficiency in their capacity to imitate the activities of others. Moreover, motor imitation has been proven to predict language and play abilities in children with ASD (Gonzalez-Sala et al., 2021).

The play skills of children with significant visual impairments differ from those of typically developing children. Children with visual impairments explore objects by holding them close to their bodies, engage in more physical manipulation and repetitive or stereotyped play, engage in less spontaneous play, rarely animate toys, dolls, or animals, and show delays in the development of symbolic and role play (Vig, 2007).

The purpose of this study was to investigate how object play is related to motor skills, visual reception and language skills in children at risk of developmental disorders aged 12-18 months and those aged 24-36 months. We can expect children in the younger group to engage in simple activities typical for sensorimotor exploration and the stage of physical ma-

nipulation of objects, meaning that they will often touch objects, pick up, shake or drop them. In contrast, older children, with ostensibly better developed symbolic manipulation skills, are likely to engage in more complex play involving more frequent manipulation of several objects at once, e.g. by arranging them in rows or combining them. We can therefore assume that the younger a child and the better their motor, visual and language skills, the more time she will spend engaging in less complex manipulation of individual objects comparted to a child in whom those skills are less developed, as this is a common form of play for children under 18 months of age. In turn, older children (over 24 months), who have better-developed motor, visual and language skills, will be more likely to engage in complex manipulation by combining multiple objects.

PARTICIPANTS AND PROCEDURE

PARTICIPANTS

A total of 44 children at risk of developmental disorders aged 13 to 37 months (M = 22.20, SD = 8.77) took part in the study. The group included 10 girls and 34 boys. Considering the relatively wide range of age in the sample, participants were divided into two age groups. The younger group consisted of 23 children aged 13-18 months (M = 14.75, SD = 1.42), 4 of them girls and 19 boys. The older group consisted of 21 children aged 24-37 months (M = 30.00, SD = 5.86), 6 girls and 17 boys. Boys are often overrepresented in studies on children at risk of developmental disorders (Messinger et al., 2015) and the prevalence of ASD is more frequent in boys than in girls. This explains why more boys than girls participated in this study.

PROCEDURE

Two strategies were employed for participant recruitment. The first was to place ads in social media and on internet forums addressed to parents of children under 3 years of age. This way 6 children from the Warsaw region (Poland) were enrolled in the study in the years 2017-2018. The second strategy was to contact the parents of children who took part in the research project on the development of children at risk of developmental disorders. The instrument used to identify children at risk was the First Year Inventory (FYI; Reznick et al., 2007; unpublished Polish version – Kawa et al., 2015). Children were screened with this instrument between 11.5 and 12.5 months of age. Inclusion criteria included age (12 to 37 months), term pregnancy (38 to 42 weeks), FYI score above 13 points (over 88th percentile for risk of developmental disorders) and no diagnosis of developmental, genetic or neurological disorders at the time of entry. The parents of children who met the inclusion criteria were asked to provide consent for participation in this study. In total, 83 inquiries were sent, with 44 parents consenting to their children taking part. The study protocol was approved by the ethical committee of the Faculty of Psychology, University of Warsaw (approval number: 18/2015).

MEASURES

First Year Inventory. The FYI (Reznick et al., 2007) is a 63-item parent-report screening questionnaire that uses norms to determine which 12-month-old infants are likely to receive an ASD diagnosis in the future. Social-communication and sensory-regulatory processes are two of the core developmental categories that the FYI measures behaviour across. For each of the eight components as well as the two domains, a quasi-logarithmic risk score is used, ranging from 0 to 50 points. To get the overall FYI risk score, the sensory-regulatory and social-communication domain scores are averaged. Higher scores indicate that the child's parent reported more atypical behaviours.

Exploratory activity measurement sessions. The measurement of object play in the study group involved designing and manufacturing objects for the children to manipulate. During a measurement session, children were shown 4 objects in the form of 3D-printed cubes fitted with magnets so that they could be connected (Figure 1). Each block measured 10 × 10 × 10 cm and was made from blue and red plastic. Each block was equipped with 6 liquid-crystal displays showing identical animations. When the objects were separate, each display showed a simple cartoon (e.g. a rocket travelling through space). Once cubes were connected, the animations changed so that displays were combined into one screed. Changes depended on the number of connected blocks. The more blocks were connected, the more complex the cartoons became (e.g. a rocket travelling through space and passing other planets with two objects combined; a rocket travelling through space, passing planets and trying to outrun a comet with three objects combined, etc.). Measurement sessions were conducted in the experimental room with floor covering, wall cabinets, and video cameras. The objects for exploration were placed on the ground.

The length of each measurement session was 6 minutes. In research on object play in children of comparable age (Flippin & Watson, 2011), measurement sessions are typically short, between 5 and 15 minutes. During a session, the child was in the experimental room with the parent and experimenter. Before measurement started, the experimenter asked the caregiver to sit on the floor next to the child and only observe them playing, without ini-

Figure 1

Objects used to measure object play

tiating interaction. This was followed by a demonstration: the experimenter sat in front of the child, placed the blocks between them and made 3 different types of connections, combining the blocks into a row, making a tower or an L-shape. There were no verbal instructions directed at the child during the demonstration or trials where the experimenter directed the child's attention to animations. Next, the experimenter pushed the objects towards the child. At this point the actual measurement session began, with the experimenter offering no comments on the child's behaviour and initiating no interactions. Measurement sessions were recorded with two HD video cameras. Two video cameras were used in order to improve reliability and to ensure that the child's behaviour would be recorded even if she was facing away from one of the cameras. The experimenter was a child psychologist, with an MA degree, trained in various measurement procedures, including the Mullen Scales of Early Learning.

After each measurement session, the recording was coded by a person not involved in the session using the partial interval method (van Schijndel et al., 2010). The intervals were 10 s each. Two people were involved in the coding process. Inter-rater reliability was 93%.

Coding of videotaped sessions involved recording of the following exploratory activities:

- looking towards the object – the child directs gaze towards the object;
- touching the object with hands – the child touches the object with a part of the hand. The contact does not result in moving the object;
- picking up the object – the child takes the object in hands. The object does not touch the caregiver or other items (objects, walls, floor) in the room;
- dropping the object to the ground – the child drops the object, which falls to the floor within 50 cm of the child;
- throwing the object – the child drops the object, which falls to the floor further than 50 cm from the child;
- moving the object – the child moves the object while it remains on the floor;
- waving the object – while holding the object, the child makes a repetitive movement with it at least twice. The object maintains the same orientation with respect to its axis;
- rotating the object – the child turns the object around its axis;
- hitting the object – the child hits the object with an open or closed palm or with another object;
- putting 2 objects together in a row – the child touches one object to another, they become connected and the displayed animations change;
- putting 3 objects together in a row – the child touches one object to two already connected objects, it becomes attached and the displayed animations change;
- putting 4 objects together in a row – the child touches one object to three already connected objects, it becomes attached and the displayed animations change;
- putting 2 objects one on top of the other – the child places one object on another, they become connected and the displayed animations change;
- putting 3 objects together in various configurations – the child touches one object to two already connected objects, it becomes attached and the displayed animations change;
- putting 4 objects together in various configurations – the child touches one object to three already connected objects, it becomes attached and the displayed animations change;
- disconnecting objects.

Mullen Scales of Early Learning. Visual, motor and language skills were measured using the Mullen Scales of Early Learning (MSEL; Mullen, 1995). This tool is an individually administered comprehensive measure of cognitive functioning for infants and preschool children from birth to 68 months. The scale assesses a child's abilities in visual, linguistic, and motor domains, and distinguishes between receptive and expressive processing. A non-published version of the scale translated into Polish was used in the study. Internal consistency of individual subscales in the study was as follows: large motor skills, $\alpha = .88$; visual reception, $\alpha = .94$; fine motor skills, $\alpha = .87$; receptive language, $\alpha = .93$; expressive language, $\alpha = .94$.

DATA ANALYSIS

The data analysis was based on Spearman's rho partial correlation coefficients. The total score of cognitive functioning measured by MSEL was analysed as a controlled variable. The controlling let us analyse

correlations between exploratory activity and specific contents of each cognitive functioning scale. Correlations were calculated separately in the group of children aged 13-18 months and in the group of children aged 24-37 months.

RESULTS

Table 1 presents the values of Spearman's rho partial correlation coefficients acquired in the younger group of children aged 13-18 months.

In the younger group, the results in the waving and rotating objects subscales were negatively correlated with scores on receptive language scales. All significant correlations in the study were negative.

Table 2 presents the values of Spearman's rho partial correlation coefficients acquired in the older group of children 24-37 months.

In the older group, we found statistically significant positive correlations between scores on the disconnecting objects variable and scores on the visual reception and receptive language scales, between the connecting 2 objects in a row scale and scores on the visual reception scale, and between the scores on the putting 2 objects one on top of the other scale and the receptive language scale. All significant correlations in the study were positive.

Since the scores on the disconnecting objects variable correlated with both the visual reception and receptive language scales regression analysis was also performed to investigate the relationships further. When both the visual reception and receptive language scales were included in a single regression model as predictors only, the visual reception was positively related to the disconnecting objects variable, $\beta = .79$, $t = 1.89$, $p = .080$. The relationship between the receptive language scale and the disconnecting objects variable was not even close to statistical significance, $\beta = -.24$, $t = -0.56$, $p = .582$. Furthermore, the visual reception and the receptive language scales were highly positively correlated with each other, rho = .86, $p < .001$. The conclusion is that significant multicollinearity exists between the two predictors. However, out of these two the visual reception was a better predictor for the disconnecting objects variable than the receptive language scale.

DISCUSSION

The purpose of the study was to investigate how motor skills, social reception, and language skills are related to object play in children at risk of developmental disorders aged 12-18 months and 24-37 months. It was expected that these relationships would be different in younger and older children due to divergent levels of object play development and the children in the older group already having developed symbolic manipulation (Wynberg et al., 2022).

Statistical analyses demonstrated no correlations between motor skills and object play in either age group. The relationship between these skills should be strong, since, on the one hand, engaging in object play may help develop motor skills, and on the other, children with high motor skills are able to engage in more diverse object play (Lillard, 2013). It should be noted, however, that the cubes used to measure object play in this study are relatively large compared to toys measuring object play in other research (Wynberg et al., 2022). Studies on object play often use toys familiar to children that enable functional play (e.g. vehicles, figurines). Perhaps, therefore, the size of the cubes compared to small figurines or other toys contributed to the lack of relationship between motor skills and object play in the present study.

With respect to visual skills, we noted a positive correlation with object play in the older group. Higher levels of visual skills coincided with more frequent combining of 2 objects to make a row and more frequent disconnecting of objects. In other words, children better developed in terms of visual skills engaged more often in more complex forms of play than children with lower levels of visual skills. These findings are in support of the adopted hypothesis about the relationships between visual skills and object play in children at risk of developmental disorders. Interestingly, no such correlations were found in the younger group. Perhaps the fact that younger children engaged in complex object play less often than their older counterparts explained why no statistically significant relationships were noted in this respect. On the other hand, the objects used in this study were equipped with LCD screens and projected animations after connecting objects together. Perhaps that is the reason why such correlations were found in older children.

In addition, older children demonstrated positive correlations between language skills and putting 2 objects one on top of the other and disconnecting objects. In other words, older children with higher visual and language skills tended to engage in complex play more often. By contrast, no negative correlations were found between visual and language skills, and less complex forms of play, such as moving objects. In all likelihood, children with better developed visual and language skills had higher levels of symbolic skills and were more likely to engage in complex forms of play than children with lower levels of these skills (Wynberg et al., 2022). No such correlations were found in the younger group.

In turn, in the group of younger children at risk of developmental disorders, we found negative correlations between language skills and less complex forms of object play, such as waving or rotating objects. Younger children who were better developed in

Table 1

Correlation coefficients between cognitive functioning and exploratory activity acquired in the younger group of children aged 13-18 months

Exploratory activity		Gross motor	Visual reception	Fine motor	Receptive language	Percentage of intervals with observed behaviour
Looking towards objects	rho	−.06	−.03	.02	.32	86.29
	p	.797	.883	.918	.135	
Touching object with hands	rho	−.01	.20	.07	.12	74.83
	p	.954	.359	.769	.587	
Picking up object	rho	−.001	−.23	.03	−.23	19. 04
	p	.996	.297	.900	.292	
Dropping objects to the ground	rho	−.03	−.23	.05	−.25	3.20
	p	.903	.284	.805	.261	
Throwing objects	rho	−.02	−.37	−.21	−.16	0.62
	p	.925	.080	.332	.471	
Moving objects	rho	−.18	−.04	−.35	−.26	20.00
	p	.410	.858	.106	.237	
Waving objects	rho	.03	−.02	−.31	−.43	0.29
	p	.888	.930	.153	.040	
Rotating objects	rho	−.01	−.22	−.06	−.46	20.16
	p	.954	.324	.790	.026	
Hitting objects	rho	.16	−.21	−.34	.13	5.04
	p	.466	.327	.118	.545	
Disconnecting objects	rho	−.01	−.12	−.29	−.11	11.16
	p	.953	.591	.173	.606	
Putting 2 objects in a row	rho	.04	.10	−.31	.04	6.25
	p	.867	.652	.156	.875	
Putting 3 objects in a row	rho	.10	−.13	−.17	.14	2.00
	p	.654	.565	.427	.539	
Putting 4 objects in a row	rho	.23	.28	.37	.41	0.83
	p	.288	.197	.083	.053	
Putting 2 objects one on top of the other	rho	.08	−.17	.11	−.16	3.45
	p	.706	.450	.627	.459	
Connecting 3 objects in any configuration	rho	.02	−.24	.13	−.08	3.16
	p	.922	.278	.552	.726	
Connecting 4 objects in any configuration	rho	−.05	−.11	.30	.08	2.37
	p	.830	.622	.163	.710	

Note. rho – Spearman's rho correlation coefficient; *p* – statistical significance.

Table 2

Correlation coefficients between cognitive functioning and exploratory activity acquired in the older group of children aged 24-37 months

Exploratory activity		Gross motor	Visual reception	Fine motor	Receptive language	Percentage of intervals with observed behaviour
Looking towards objects	rho	.23	.27	.29	.26	88.00
	p	.428	.347	.308	.378	
Touching object with hands	rho	−.12	.08	.08	.11	76.31
	p	.676	.796	.786	.704	
Picking up object	rho	−.26	−.18	−.20	−.25	12.77
	p	.377	.539	.501	.382	
Dropping objects to the ground	rho	−.23	−.04	−.07	−.08	1.00
	p	.435	.892	.826	.784	
Throwing objects	rho	.38	.35	.28	.35	0.27
	p	.181	.227	.337	.221	
Moving objects	rho	−.14	.07	−.24	−.12	16.81
	p	.646	.813	.407	.690	
Waving objects	rho	.01	−.12	−.17	−.09	1.36
	p	.961	.689	.572	.756	
Rotating objects	rho	.14	.06	.31	.13	19.81
	p	.646	.834	.286	.670	
Hitting objects	rho	−.05	.36	.22	.08	5.09
	p	.876	.212	.454	.789	
Disconnecting objects	rho	.31	.60	.52	.55	17.86
	p	.286	.022	.054	.041	
Putting 2 objects in a row	rho	.30	.56	.35	.52	7.54
	p	.292	.036	.218	.058	
Putting 3 objects in a row	rho	−.05	.20	−.12	.05	6.77
	p	.863	.504	.691	.858	
Putting 4 objects in a row	rho	−.36	−.01	−.08	−.17	2.00
	p	.203	.983	.793	.552	
Putting 2 objects one on top of the other	rho	.41	.52	.49	.59	3.00
	p	.145	.058	.078	.027	
Connecting 3 objects in any configuration	rho	−.01	.41	.16	.20	4.45
	p	.965	.150	.591	.487	
Connecting 4 objects in any configuration	rho	−.36	−.01	.00	−.15	2.45
	p	.207	.975	1.000	.604	

Note. rho – Spearman's rho correlation coefficient; *p* – statistical significance.

terms of language skills engaged in simpler forms of play less often.

These findings support the hypothesis that the landscape of relationships between visual and language skills and object play in children at risk of developmental disorders is different in younger and older children. These results are also consistent with previous reports on cognitive and language development and object play in typically developing children (Lillard et al., 2013). Children who have more highly developed visual and language skills tend to engage in complex forms of play more often. The findings may be useful for further development of diagnostic procedures, especially regarding object play in children at risk of developmental disorders.

One of the limitations of the present study was the fact that a translated version of the MSEL was used in this study. An adapted version with Polish norms would make the process of measurement of visual, motor and language skills more reliable. Another limitation was that the study did not control for mental age/level of development. This factor may have significantly affected the complexity of participants' play. Moreover, in this study dialogues and comments of children were not analysed, which could provide more insight in symbolic thinking of the participants.

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