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Solitary symbolic play, object substitution and peer role play skills at age 3 predict different aspects of age 7 structural language abilities in a matched sample of autistic and non-autistic children

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Abstract

Backgrounds and aims: Early symbolic play abilities are closely related to long-term language development for both autistic and non-autistic children, but few studies have explored these relations for different dimensions of pretence and of language. The current study explores carer-reported measures of solitary symbolic play, object substitution and peer role play abilities at age 3, and their respective relations with parent-reported semantics, syntax and narrative abilities at age 7 for both autistic and non-autistic children.

Methods: We conducted secondary data analyses exploring links between different aspects of pretence and of language on the Longitudinal Study of Australian Children population cohort. We identified 92 autistic children and used propensity score matching to match them with 92 non-autistic children based on demographic and developmental information such as non-verbal IQ and socioeconomic status. We explored concurrent and longitudinal relations using correlation and regression models. **Results:** Both correlational and hierarchical regression analyses confirmed the significant effects of age 3 symbolic play abilities in facilitating age 7 semantics, syntax and narrative abilities for autistic children. We found that object substitution held most prominent influence, followed by peer role play and solitary symbolic play. In contrast, for non-autistic children, none of the age 3 symbolic play abilities were significant predictors, whereas socioeconomic status at birth and age 3 language abilities held significant influences on their age 7 semantics, syntax and narrative abilities.

Conclusion: We discuss the implications of our findings for play interventions targeting language outcomes.

Keywords
Autism, Pretend, Play, Language development, Narrative

Introduction

The complexity and diversity of play behaviours develops alongside the growth of language abilities in children. Representational competence and the learning of communicative rules play major roles in this process (Piaget, 1952). Among all types of play, symbolic play, which is rooted in the ‘nonliteral’ and takes an ‘as if’ nature, involves a complex representational system which facilitates comprehension and communication (Leslie, 1987). For example, symbolic play can involve the use of symbols to represent meanings, require metalinguistic awareness as players adjust their linguistic register to fit the roles they are playing and foster social communicative behaviours like turn-taking (Fisher, 1992; Giffin, 1984).

However, empirical studies of the associations between language ability and symbolic play, demonstrate inconsistent results. For typically developing children, reviews show small-to-medium *concurrent* associations between

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symbolic play abilities and language production/comprehension but their *longitudinal* effects are more ambiguous, possibly due to many studies having small sample sizes and failing to account for confounding factors like socioeconomic status (Lillard et al., 2013; Quinn et al., 2018). For autistic children, many studies have examined the effects of play-based interventions on promoting their language abilities (O'Connor & Stagnitti, 2011; Parsons et al., 2017). Furthermore, there is evidence that autistic children often face challenges in maintaining their symbolic play skills and adapting these skills to different contexts (Fragale, 2014).

We argue that these mixed findings and challenges highlight the need to better understand the longitudinal effects of different types of symbolic play behaviours on different aspects of linguistic ability. In this study we focus upon semantics, syntax, and narrative skills. This is because previous research has linked symbolic play to structural language abilities more generally (Quinn et al., 2018), and a sizeable proportion of autistic children are likely to exhibit language delay and structural language difficulties (Reindal et al., 2021), which can also affect pragmatic language abilities and social skills (Levinson et al., 2020).

Role play & object substitution and their associations with structural language competences

The current study focuses on two main types of symbolic play observed in the early years: role play and object substitution. The definitions we used were drawn from Sachet & Mottweiler's (2013) differentiations. Role play is social in nature and can be categorised into different types depending on the vehicle that drives pretence. Role-play involves a personified object where children grant certain human characteristics to the objects, e.g. feeding a teddy bear. Prop-based peer role play involves children impersonating a character with tangible objects, e.g. dress-up games with peers (Harris, 2000). In contrast, object substitution extracts the symbolic meanings of an object that may transcend the functions and form of the object itself, e.g. a stick used as a magic wand (Bigham & Bourchier-Sutton, 2007).

In the current paper we explore the idea that these different aspects of symbolic play may associate more strongly with different aspects of language abilities. Object substitutions involve the identification of similarities between objects, thereby inducing pretence by manipulating the substituted or imaginary entity with shared features and attributes of the present object (Westby, 2017). This has parallels with linguistic semantics, echoing the need for understanding of relations between words, and the relational mapping between a signified construct and the signifier. Previous studies have demonstrated strong associations between object substitution and semantic abilities, reflected by vocabulary and semantic organisation which were measured by School-age Oral Language Assessment and British Picture Vocabulary Scale at around age 6 (Reynolds et al., 2011; Stagnitti & Lewis, 2015).

Unlike object substitutions, there are fewer studies that demonstrate links between role play and different structural aspects of language development (Sachet & Mottweiler, 2013). As role-play is often driven by children's own interests and motivation, they are more likely to express their views and feelings during role play and move forward the symbolic plot (Rao & Gibson, 2019). Studies have found significant associations between role play and narrative skills, measured by coding the narrative volume including the amount of utterances and number of adjectives (Siller et al., 2014; Taylor et al., 2013). Therefore, relative to object substitution play, we hypothesise a stronger association between role play and narrative skills. Between solitary role play and peer role play, we suggest that peer role play may impose greater influence over narrative coherence owing to its inherent socio-communicative nature and its higher chances of eliciting negotiations between peers. However, we do not deny that solitary role-play can sometimes be more challenging as it relies on children's own abilities to facilitate the progression of the pretend plot (Kim & Kim, 2017; Sawyer & DeZutter, 2007). We argue that this can hold strong implications as a route for improving autistic children's narrative skills since there is evidence that some autistic children may find it difficult to produce coherent sequences when telling stories (Loveland et al., 1990).

In addition to semantics and narrative skills, many studies have shown that syntax develops in parallel with more sophisticated symbolic play, which involves a clear plan before symbolic play enactment and an awareness of multiple meanings involved in object substitutions (Kelly & Dale, 1989; McCune, 1995; Shore, 1986). This may be a result of general maturation. However, it is interesting to note both syntax and sophisticated symbolic play are rooted in rule-governed systems and demand hierarchical organisation. That is, they both depend upon a restricted number of permutations of "symbols" that form socially conventional linguistic expressions for syntax in the case of language and structurally meaningful symbolic events like object substitution in the case of play (McCune, 1995).

As Kasari et al. (2013) note, the diversity within autistic children's symbolic play skills can provide insights concerning the significance of symbolic play for areas of development like language. A deeper understanding of this may reveal more about the underlying mechanisms behind symbolic play (for instance, theory of mind abilities), thereby explaining the inconsistent effects reported in research into the impact of symbolic play upon the development of typically developing children, summarised by Lillard et al. (2013). Thus, the question of whether links between different symbolic play abilities and different structural language abilities are similar between autistic and non-autistic children is of interest for understanding the role of play in development and its potential as an intervention mechanism.

Current study

The current study is undertaken amid inconsistent empirical results on the power of symbolic play in predicting long-term language development for both autistic and non-autistic children. We highlight that many existing studies do not differentiate different types of symbolic play but instead use an overall score to examine its relation with a global measure of language skills (e.g. the Preschool Language Scale) or just one aspect of structural language (e.g. syntax) (Durrleman et al., 2016; Kirkham et al., 2013; Lam & Yeung, 2012). In the present research we take a more integrative approach and examine the explanatory power of solitary symbolic play, object substitution, and peer role play at age 3 in predicting scores on semantics, syntax and coherence (as a reflection of narrative skills) at age 7.

We emphasise the need to control for developmental factors like previous language skills and cognitive abilities, which confound the effects of both age 3 symbolic play abilities and age 7 structural language abilities. Different types of symbolic play are often seen as emerging sequentially, but Barton (2010) conducted a systematic literature review and found inconsistencies among research on the sequential emergence of symbolic play among children with disabilities.

In addition, some argue that autistic children are more likely to experience delay in symbolic play than typically developing children (Kasari et al., 2013). However, the delay in symbolic play among autistic children may be more associated with language and cognitive levels rather than the autistic condition (Thiemann-Bourque et al., 2012). When autistic and non-autistic children are matched on these two factors, results from comparisons of their symbolic play abilities are mixed with some research indicating no significant differences (Bentenuto et al., 2016) and others suggesting significant differences only with a particular type of symbolic play (Thiemann-Bourque et al., 2019). These mixed results can be attributed to the heterogeneity within symbolic play skills among autistic children, which again highlights the need to distinguish the effects of different types of symbolic play (Bernard Paulais et al., 2019).

Thus, this leads to our research questions:

1. *Are there any significant concurrent and longitudinal correlations between age 3 symbolic play abilities and age 3 language ability and age 7 semantics, syntax and narrative abilities for both autistic and non-autistic children?* We approached this by examining their statistical correlations.
2. *How much variance in age 7 semantics, syntax and coherence is explained by sociodemographic variables, previous language ability and cognitive ability for both autistic and non-autistic children? How much extra variance in age 7 semantics, syntax and coherence is explained by different types of symbolic play (solitary symbolic play, object substitution, and peer role play) for both autistic and non-autistic children?* We approached these questions by running hierarchical regression analyses to examine the extra variance explained (if there was any) by symbolic play in addition to the variables included in baseline regressions.

Methods

Participants

The current study uses secondary data analysis on the baby cohort from the Growing Up in Australia: Longitudinal Study of Australian Children (LSAC) datasets Release 8. LSAC is an ongoing longitudinal study of children born in 2003/2004 that tracks their cognitive and psychosocial development every two years in Australia. Data collection involves face-to-face interviews and self-report questionnaires completed by parents and carers. The sampling frame followed the Medicare Australia enrolments database and LSAC had 5,107 study children in wave 1 (The Australian Institute of Family Studies, 2020). Figure 1 demonstrates the extraction of the study the sample. There were only 8 waves that were publicly accessible at the time this study was conducted. We excluded children with a history of hearing problems, epilepsy and attention deficit disorders at this stage, which leaves us with 4,666 children.

Children's play abilities at age 3 were not reported by parents but by qualified home-based or centre-based carers instead. That is, carers were only qualified to receive questionnaires if the children were either in centre or family day care. In addition, they had to provide more than 8 h of care per week (Gialamas et al., 2014). Overall, this left us with 1,499 children with play measures reported by their carers at age 3.

Extraction of autistic children across 8 waves. Between wave 4 (age 7) and wave 8 (age 15), parents were asked about children's ongoing conditions, i.e. "does study child have any of these ongoing conditions?… Autism, Asperger's, or other autism spectrum". We extracted 249 children with parent-reported autistic conditions in the entire LSAC baby cohort dataset. Among these children, we retained 92 autistic children who had information on their symbolic play behaviours at age 3 as illustrated in Figure 1.

Parents also rated the severity as mild/moderate/severe. Among 92 autistic children in this study, 79% were rated as mild, 19% as moderate and 2% as severe. We

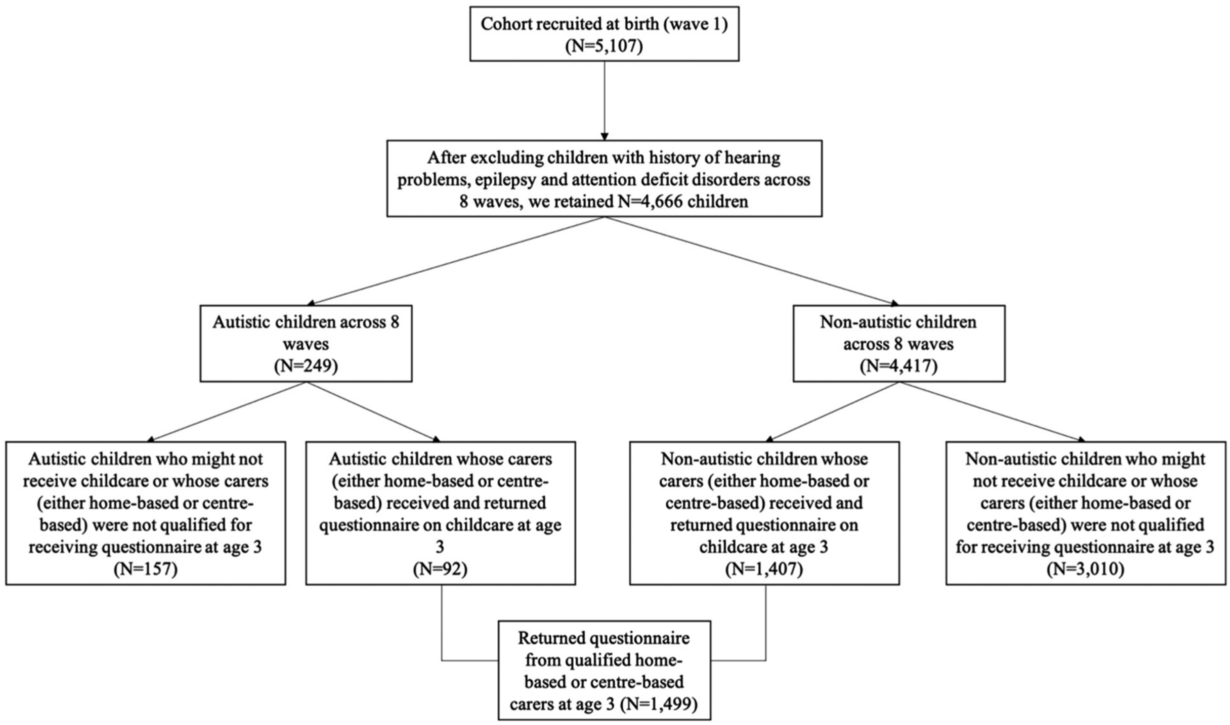

Figure 1. Data flow from recruitment of children at birth to the extraction of study sample.

acknowledge the limitation of using population cohort data, as no further assessments were used to validate the parent reported diagnosis (Randall et al., 2016). However, we argue that population cohort study gave us the ability to examine children's play abilities at age 3 even if their diagnoses happened later in life, as the average age of diagnosis in the current study was around 7 years with a standard deviation of 4 years.

Key measures

Demographic variables. Gender was reported by parents at birth. LSAC generated a composite score on socioeconomic index at birth from parents' years of education, income and occupational prestige (Blakemore et al., 2006).

Symbolic play ability at age 3. The current study examined three types of symbolic play: *solitary symbolic play*, i.e. how well the study child could perform simple symbolic play, for instance, feeding a doll or stuffed animal; *object substitution*, i.e. how well the study child could symbolically indicate that one object was substitute for something else, for example, using a towel as a blanket or a box for a house; *peer role play*, i.e. how well the study child could play symbolic games with other children by using props such as dress-up, using kitchen tools when playing house. They were each rated by carers on a 3-point scale: 1 = "doesn't do it at all", 2 = "does it, but not well" and 3 = "does it well".

Language ability at age 3. Age 3 language ability was measured by the MacArthur Communicative Development Inventories (MCDI) vocabulary and grammar, which measures children's expressive language abilities using parental report (Fenson et al., 2007). Parents were asked if they had heard their children using a list of 100 vocabulary items such as "because" and "think"; they were also given 12 pairs of sentences and they were asked which sentence out of each pair was most likely to be used by their child, for instance, "I like read stories" or "I like to read stories". Sentence with greater grammatical complexity received higher scores. Higher MCDI scores show better early language and communication development.

Non-verbal IQ (NVIQ) at age 7. Age 7 non-verbal IQ was administered by external assessors and measured by the Matrix Reasoning test from the Wechsler Intelligence for Children, 4th edition (WISC-IV) which mainly assesses children's nonverbal reasoning and concept formation abilities (Wechsler, 2004). It consists of 35 items with an incomplete set of pictures and children were required to complete the set by selecting from five different options. We used raw scores in our analyses.

Language outcomes at age 7. Age 7 semantics, syntax and coherence abilities were measured by the Children's Communication Checklist II (CCC-2) reported by parents (Bishop, 2003). We included the coherence scale as the scale closest to the construct of 'narrative', since it contains items relating to both micro- and macro-structure of narrative, assessing difficulties such as ambiguous pronoun reference and struggles with sequencing a story. Seven items were each assessed on these three dimensions and parents reported the frequency of each item from 0 = less than once a week to 3 = several times a day or always. Sample question on semantics: *uses words that refer to whole classes of objects rather than specific items*; sample question on syntax: *gets mixed up between he and she*; sample question on coherence: *muddles up the sequence of events*. All three structural language abilities shared decent construct validity, i.e. Cronbach's alpha = 0.67 for semantics, Cronbach's alpha = 0.68 for syntax and Cronbach's alpha = 0.72 for coherence. We reverse coded and summed the items for each dimension so that higher scores indicate better semantics, syntax and coherence abilities.

Statistical analyses

All statistical analyses were conducted by using R Studio Version 1.3.1073. First, we conducted random forest-based imputation to impute missing data. This is to maintain the maximum information on autistic children in our sample (N = 92). Second, we conducted propensity score matching in order to select a comparison group of 92 non-autistic children. Finally, we conducted regression analyses on each sample to answer the research questions.

Multiple imputation by using random forest-based method. We used the missForest package. Random forest-based method is rooted in machine learning. For autistic children, we imputed 2 cases (2.2% out of N = 92) each for their age 7 structural language outcomes. For their age 3 symbolic play abilities, we imputed 3 cases for peer role play (3.3%), 5 cases for object substitution (5.4%) and 7 cases for their solitary symbolic play abilities (7.6%). More details can be found in Table S1 in Appendix S1, where we justify the use of random forest-based method. We used the default setting in the missForest package to grow 100 trees in each forest and used the square root number of variables randomly sampled at each tree split. The NRMSE returned as 0.27.

Propensity score matching. For quasi-experimental designs, Bang and colleagues (2020) suggest the use of propensity score matching to control for pre-existing differences between groups, which otherwise would affect the implications of results. Therefore, this study used the MatchIt package to match 92 non-autistic children with 92 autistic peers based on their gender, socioeconomic status at birth, language ability at age 3, age in months and non-verbal IQ (NVIQ) at age 7 by using the nearest neighbour propensity score matching. More detailed steps can be found in Appendix S2.

Correlation and Regression analyses. We used Pearson intercorrelations to examine both the concurrent and longitudinal associations as suggested in the first research question.

We first ran regression analyses using sociodemographic variables, previous language abilities and cognitive abilities to predict age 7 *semantics*, *syntax* and *coherence* abilities for both autistic and non-autistic children. We called these baseline models.

Then, we added solitary symbolic play, object substitution and peer role play ability to each baseline model to examine how much extra variance in age 7 structural language outcomes was explained by age 3 symbolic play abilities by using ANOVA to test the change in adjusted R-square when comparing against baseline models. For instance, the extra variance explained by object substitution in predicting semantics ability would be the difference between adjusted R-square explained by *object substitution and control variables* minus adjusted R-square explained by *control variables only* (baseline model). By comparing the differences in this change in variance, we could compare the predictive power across three different symbolic play abilities, which answers the second research question.

We transformed cubically the language outcome variables. This is often used to reduce left skewness (Mangiafico, n.d.), thereby meeting the six key linear regression assumptions (i.e. linearity, normality, homoscedasticity, independence, multicollinearity and outliers).

Results

Descriptive statistics

We made several comparisons to better understand the representativeness of our samples. We first compared autistic children with play reports (N = 92) and autistic children without play reports (N = 157), see Table S2 in Appendix S2. The comparison showed that autistic children with play reports did not have statistically significant differences in terms of their socioeconomic status, age 3 language score, age 7 age in months and age 7 structural language outcomes. However, autistic children with play reports tended to have significantly higher non-verbal IQ than autistic children without play reports.

We then compared autistic children (N = 92) and non-autistic children with play reports (N = 1,407) see Table S3 in Appendix S2. The comparison showed that these two groups of children did not have any significant differences in socioeconomic status at birth, age 7 age in months and age 7 cognitive abilities. However, autistic children had significantly poorer levels of age 3 language abilities, age 3 symbolic play abilities and age 7 structural language outcomes. We further elaborate these findings in the limitations part of the discussion section.

After multiple imputation and propensity score matching. We achieved a matched pair of autistic and non-autistic groups, with 25 girls and 67 boys in each sample.

Figure 2 shows the distribution of standardised continuous variables with a mean of zero and a standard deviation of 1 of both autistic and non-autistic peers (i.e. N = 184). In other words, zero means the same score for both autistic children and their matched peers. Figure 2 visually represents that the autistic children tended to accumulate on the lower ends (i.e. −2 SD) of all three types of symbolic play at age 3. Similarly, more autistic children tended to score below the average for semantics, syntax and coherence abilities.

Table 1 reports the means and standard deviations of all the continuous variables in the current study. We conducted two-tailed Wilcoxon rank sum tests to examine the mean differences. Both the p-values and the 95% confidence intervals of effect sizes show that autistic children had lower scores on solitary symbolic, object substitution and prop-based peer role play at age 3 and lower scores on semantics, syntax and coherence at age 7.

Research question 1: Concurrent and longitudinal correlations

Table 2 demonstrates the Pearson intercorrelations between continuous variables for autistic and non-autistic children. We observed significant correlations between the age 3 language ability and age 7 semantics, syntax and coherence abilities of autistic children and non-autistic children. However, we did not observe any significant concurrent correlations between the three types of age 3 symbolic play and age 3 language ability for autistic children and non-autistic children.

In terms of longitudinal correlations, we observed significant correlations between age 3 solitary symbolic play and autistic children's age 7 semantics ability (r = .27, p = .009), age 7 syntax ability (r = .25, p = .015) and age 7 coherence ability (r = .29, p = .005). There were also significant correlations between age 3 object substitution ability and autistic children's age 7 semantics ability (r = .37, $p < 0.001$), age 7 syntax ability (r = .33, p = .001) and age 7 coherence ability (r = .38, $p < 0.001$). Age 3 peer role play was also significantly correlated with autistic children's age 7 semantics ability (r = .3, p = .003), age 7 syntax ability (r = .26, p = .011) and age 7 coherence ability (r = .25, p = .016). However, for non-autistic children, there were no significant longitudinal correlations between age 3 symbolic play and age 7 language outcomes.

Research question 2: Unique variance explained by symbolic play abilities

Semantics. Model 1 in Table 3 shows the baseline model of the semantics ability of autistic children. It demonstrates that sociodemographic factors, age 3 language abilities and age 7 cognitive abilities are significant in explaining autistic children's semantic ability at age 7, i.e. $F(5, 86) = 6.201$, $p < 0.001$ with adjusted $R^2 = 22.23\%$. These factors were also significant in predicting the age 7 semantics ability of non-autistic children as shown in Model 5 in Table 3, i.e. $F(5, 86) = 3.832$, $p = .004$ with adjusted $R^2 = 13.47\%$.

Autistic children. Shown in Table 3, compared to the baseline model (model 1), model 2 including age 3 solitary symbolic play explained 23.79% of variance in autistic children's age 7 semantics ability but this change in R^2 was not significant, $F(1, 85) = 2.76$, $p = .1$. Age 3 language ability was the only significant predictor of age 7 semantics ability (B = 48.01, β = 0.423, $p < 0.001$) as shown in Table S4 in Appendix S4.

In contrast, compared to the baseline model, model 3 including age 3 object substitution explained a significant change of 7.57% variance in age 7 semantics ability, $F(1, 85) = 10.223$, $p = .002$. Both age 3 object substitution ability (B = 1009.68, β = .287, p = .002) and age 3 language ability (B = 48.96, β = 0.43, $p < 0.001$) were significant in predicting age 7 semantics for autistic children as shown in Table S4.

Moreover, compared to the baseline model, model 4 including age 3 peer role play also explained a significant change of 3.49% variance of age 7 semantics ability, $F(1, 85) = 5.04$, $p = .027$. Both age 3 peer role play ability (B = 705.99, β = .207, p = .027) and age 3 language ability (B = 47.73, β = .42, $p < 0.001$) were significant in predicting age 7 semantics for autistic children as shown in Table S4.

Non-autistic children. Shown in Table 3, compared to the baseline model for non-autistic children (model 5), model 6 including age 3 solitary symbolic play explained 12.61% of variance in non-autistic children's age 7 semantics ability but this change in R^2 was not significant, $F(1, 85) = 0.004$, $p = .689$. Model 7 including age 3 object substitution explained 13.05% of variance in non-autistic children's age 7 semantics ability but this change in R^2 was not significant, $F(1, 85) = 0.59$, $p = .445$. Model 8 including age 3 peer role play explained 12.58% of variance in non-autistic children's age 7 semantics ability but this change in R^2 was not significant, $F(1, 85) = 0.123$, $p = .727$. Both socioeconomic status at birth and age 3 language ability were significant in predicting non-autistic children's age 7 semantics ability in models 6, 7 and 8 shown in Table S5.

Syntax. Model 1 in Table 4 shows the baseline model of the syntactic ability of autistic children. It demonstrates that sociodemographic factors, age 3 language abilities and age 7 cognitive abilities are significant in explaining autistic children's syntactic ability at age 7, i.e. $F(5, 86)$

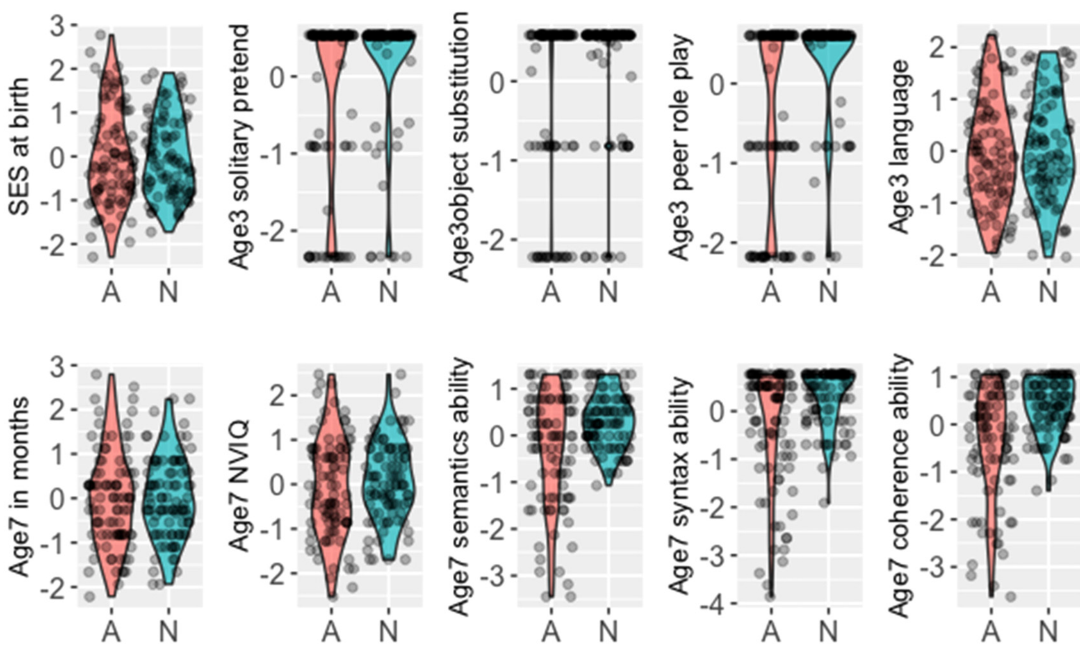

Figure 2. Distribution of standardised continuous variables by groups based on the mean and standard deviations of both autistic and non-autistic children.

= 9.876, $p < 0.001$ with adjusted R^2 = 32.78%. The same developmental factors were significant in explaining non-autistic children's syntactic ability at age 7, i.e. $F(5, 86)$ = 2.8, p = .022 with adjusted R^2 = 9%.

Autistic children. Shown in Table 4, compared to the baseline model for autistic children (model 1), model 2 including age 3 solitary symbolic play explained a significant change of 2.5% variance in age 7 syntactic ability, $F(1, 85)$ = 4.32, p = .04. Both age 3 solitary symbolic play ability (B = 741.57, β = .18, p = .04), socioeconomic status at birth (B = 836.33, β = .276, p = .003) and age 3 language ability (B = 58.09, β = 0.444, $p <$ 0.001) were significant in predicting autistic children's age 7 syntax as shown in Table S6 in Appendix S4.

Compared to the baseline model, model 3 including age 3 object substitution explained a significant change of 6.88% variance in age 7 syntax ability, $F(1, 85)$ = 10.8, p = .0015. Both age 3 object substitution ability (B = 1107.75, β = .273, p = .0015), socioeconomic status at birth (B = 829.53, β = .274, p = .002) and age 3 language ability (B = 59.95, β = 0.458, $p < 0.001$) were significant in predicting autistic children's age 7 syntax as shown in Table S6.

Compared to the baseline model, model 4 including age 3 peer role play explained 34.17% of variance in autistic children's age 7 syntax but this change in R^2 was not significant, $F(1, 85)$ = 2.818, p = .097. Both socioeconomic status at birth (B = 775.29, β = .256, p = .005) and age 3 language ability (B = 58.68, β = .456, $p < 0.001$) remained significant in predicting autistic children's age 7 syntax as shown in Table S6.

Non-autistic children. Also shown in Table 4, compared to the baseline model for non-autistic children (model 5), model 6 including age 3 solitary symbolic play only explained 7.9% of variance in non-autistic children's age 7 syntax ability and this change was not significant, i.e. $F(1, 86) < 0.001$, p = .997. Compared to the baseline model, model 7 including age 3 object substitution only explained 8.1% of variance in non-autistic children's age 7 syntax and this change was not significant, i.e. $F(1, 86)$ = 0.16, p = .69. Compared to the baseline model, model 8 including age 3 solitary symbolic play only explained 8.55% of variance in non-autistic children's age 7 syntax and this change was not significant, i.e. $F(1, 86)$ = 0.58, p = .45. Only age 3 language ability was significant in predicting non-autistic children's age 7 syntax in model 6, 7 and 8 shown in Table S7 in Appendix S4.

Coherence. Model 1 in Table 5 shows the baseline model for the coherence ability of autistic children. It demonstrates that sociodemographic factors, age 3 language abilities and age 7 cognitive abilities were significant in explaining autistic children's coherence ability at age 7, i.e. $F(5, 86)$ = 5.329, $p < 0.001$ with adjusted R^2 = 19.21%. Model 5 in Table 5 shows the baseline model for the coherence ability of non-autistic children. The same developmental factors were significant in explaining non-autistic children's coherence ability at age 7, i.e. $F(5, 86)$ = 2.77, p = .023 with adjusted R^2 = 8.8%.

Table 1. Descriptive statistics of matched autistic children and non-autistic children.

	Age when collected (reported by whom)	Score range	Matched non-autistic children Mean (SD) N=92	Autistic children Mean (SD) N=92	p-value of mean difference	Effect size [95% confidence interval]
SES at birth	Birth (parent)	-2.13-2.8	0.09 (0.87)	0.12 (1.07)	0.995	0.001 [-0.155, 0.131]
Solitary symbolic play	Age 3 (carer)	1-3	2.78 (0.55)	2.48 (0.79)	0.01**	0.189 [0.053, 0.331]
Object substitution	Age 3 (carer)	1-3	2.73 (0.59)	2.44 (0.80)	0.03*	0.158 [0.018, 0.296]
Peer role play	Age 3 (carer)	1-3	2.79 (0.5)	2.34 (0.83)	<0.001**	0.304 [0.161, 0.437]
Age 3 language ability	Age 3 (parent)	1-106	52.16 (24.35)	50.18 (24.8)	0.538	0.046 [-0.102, 0.195]
Age 7 in months	Age 7 (parent)	74-92	81.97 (3.28)	81.94 (3.9)	0.824	0.017 [-0.117, 0.172]
Non-verbal IQ	Age 7 (external assessor)	3-27	15.46 (4.19)	14.79 (5.35)	0.299	0.077 [-0.074, 0.226]
Semantics	Age 7 (parent)	3-21	17.17 (2.19)	14.93 (4.63)	0.004**	0.213 [0.075, 0.36]
Syntax	Age 7 (parent)	2-21	19.03 (2.41)	16.67 (5.03)	0.002**	0.229 [0.097, 0.367]
Coherence	Age 7 (parent)	0-21	17.98 (2.53)	14.56 (5.3)	<0.001***	0.341 [0.208, 0.468]

Note. * p < 0.05, ** p < 0.01 *** p < 0.001. p-value of two-sided Wilcoxon rank sum test or chi-square test. Effect size r for Wilcoxon rank sum test

Autistic children. Shown in Table 5, compared to the baseline model for autistic children (model 1), model 2 including age 3 solitary symbolic play explained a significant change of 4.25% variance in age 7 coherence ability, $F(1, 85) = 5.77$, $p = .018$. Both age 3 solitary symbolic play (B = 846.81, β = .228, $p = .018$) and age 3 language ability (B = 49.19, β = .414, $p < 0.001$) remained significant in predicting autistic children's age 7 coherence ability as shown in Table S8.

Compared to the baseline model, model 3 including age 3 object substitution explained a significant change of 11.3% variance in age 7 coherence ability, $F(1, 85) = 14.976$, $p < 0.001$. Both age 3 object substitution ability (B = 1271.56, β = .35, $p < 0.001$) and age 3 language ability (B = 51.29, β = 0.432, $p < 0.001$) were significant in predicting autistic children's age 7 coherence as shown in Table S8.

Compared to the baseline model, model 4 including age 3 peer role play explained a significant change of 4.68% variance in age 7 coherence ability, $F(1, 85) = 6.28$, $p = .014$. Both age 3 object substitution ability (B = 834.3, β = .234, $p = .014$) and age 3 language ability (B = 50.03, β = 0.421, $p < 0.001$) were significant in predicting autistic children's age 7 coherence as shown in Table S8.

Non-autistic children. Shown in Table 5, compared to the baseline model for non-autistic children (model 5), model 6 including age 3 solitary symbolic play explained 7.8% of variance in non-autistic children's age 7 coherence ability but this change in R^2 was not significant, $F(1, 85) = 0.0018$, $p = .966$. Compared to the baseline model, model 6 including age 3 object substitution explained 7.8% of variance in non-autistic children's age 7 coherence ability but this change in R^2 was not significant, $F(1, 85) = 0.032$, $p = .859$. Compared to baseline model, model 8 including age 3 peer role play explained 8.2% of variance in non-autistic children's age 7 coherence ability but this change in R^2 was not significant, $F(1, 85) = 0.41$, $p = .525$. Only age 3 language ability was significant in predicting non-autistic children's age 7 coherence ability in model 6, 7 and 8 shown in Table S9 in Appendix S4.

Table 2. Pearson intercorrelations between continuous variables for autistic and non-autistic children.

	1	2	3	4	5	6	7	8	9	10
1.Age 3 solitary symbolic play		0.76***	0.8***	−0.03	0.2	−0.05	0.09	0.27*	0.25**	0.29**
2.Age 3 object substitution	0.67***		0.65***	0.01	0.12	0.08	0.16	0.37***	0.33**	0.38***
3.Age 3 peer role play	0.53***	0.66***		0.07	0.16	−0.02	0.06	0.3**	0.26*	0.25*
4.Birth SES	−0.01	0.11	0.06		0.02	<0.01	0.24*	0.15	0.33**	0.13
5.Age 3 language	0.06	0.02	0.02	0.04		0.18	0.23*	0.45***	0.44***	0.38***
6.Age 7 months	−0.06	−0.08	−0.02	−0.08	0.21*		0.09	0.02	0.01	0.02
7.Age 7 NVIQ	0.13	0.14	0.01	0.22*	0.05	−0.14		0.29**	0.33**	0.25*
8. Age 7 semantic ability	0.01	0.11	0.07	0.28**	0.32**	0.04	0.06		0.81***	0.8***
9. Age 7 syntax ability	0.08	0.04	0.14	0.17	0.31**	0.16	0.08	0.54***		0.8***
10. Age 7 coherence ability	0.12	0.11	0.11	0.18	0.27**	0.13	0.06	0.6***	0.76***	

Note. * p < 0.05, ** p < 0.01 *** p < 0.001. Below the diagonal: non-autistic children. Above the diagonal: autistic children.

Table 3. Models predicting variance in age 7 semantics ability: autistic and non-autistic group.

Models	R^2	Adjusted R^2	R^2 change	F change	p value of change
Autistic children					
Model 1: Baseline model for autistic children	26.5%	22.23%	-	-	-
Model 2: baseline model for autistic children + solitary symbolic play	28.81%	23.79%	1.56%	2.76	0.1
Model 3: baseline model for autistic children + object substitution	34.39%	29.76%	7.57%	10.22	0.002**
Model 4: baseline model for autistic children + peer role play	30.62%	25.72%	3.49%	5.04	0.027*
Non-autistic children					
Model 5: Baseline model for non-autistic children	18.22%	13.47%	-	-	-
Model 6: baseline model for non-autistic children + solitary symbolic play	18.38%	12.61%	−0.86%	0.16	0.689
Model 7: baseline model for non-autistic children + object substitution	18.78%	13.05%	−0.42%	0.59	0.445
Model 8: baseline model for non-autistic children + peer role play	18.34%	12.58%	−0.89%	0.12	0.727

Note: * $p < 0.05$, ** $p < 0.01$ *** $p < 0.001$.

Discussion

We found distinctive patterns in both the concurrent and the longitudinal relations between different types of symbolic play at age 3 and structural language outcomes at age 7 for both autistic and non-autistic children. Overall, when children are matched on sociodemographic and developmental levels, early symbolic play tends to hold more significant influence over long-term language development for autistic children relative to non-autistic children.

Correlations between symbolic play abilities and language outcomes

Concurrent correlation. In contrast to empirical reviews that identified significant small-to-medium effect sizes in concurrent relations between symbolic play and language abilities for typically developing children at around 3 years old (Lillard et al., 2013; Quinn et al., 2018), our study found no significant concurrent associations between any of the three types of symbolic play and language abilities at age 3 for non-autistic children. Similarly, we did not observe significant correlations between age 3 symbolic play and age 3 language abilities.

For non-autistic children, we argue that this could be due to the ceiling effect of the measure of symbolic play abilities. As shown in Figure 2, most of the non-autistic children accumulated at the higher end on each of the three symbolic play abilities, indicating that they could do solitary symbolic play, object substitution and peer role play well at age 3.

In contrast, previous studies that identified significant concurrent correlations usually took a different approach to examining symbolic play ability. For example, some used tests with props like the Test of Symbolic Play to rate children's ability to manipulate props and elicit pretence (Kirkham et al., 2013). There are also studies that video coded different aspects of children's symbolic play and generate respective scores which normally reflect the frequency of symbolic play behaviours (Stagnitti & Lewis, 2015). We argue that these studies test contextually specific and time-specific symbolic play behaviours. While we acknowledge that these measures examine symbolic play on detailed and nuanced level, our measure has the advantage of being based reports of children's symbolic play ability in a more naturalistic setting and over a period of time by someone who knows them well. That is, the symbolic play ability was reported by carers who can observe the child on a regular basis and for at least 8 h per week. Their reported measure, even though being more general, may therefore describe more consistent and ecologically valid levels of children's symbolic play abilities.

In addition to consistency in reported symbolic play abilities, this particular measurement of symbolic play abilities could serve as a good independent indicator for identifying autistic children in the early years, particularly for children with poorer language abilities at age 3. By using propensity score matching, both the autistic and non-autistic children in the current study had poorer language ability at age 3 compared to the rest of the cohort (as shown in Table S3). Therefore, when children demonstrate poorer language ability at age 3, children's symbolic play abilities reported by home-based or centre-based carers could potentially serve as a quick screening tool to differentiate autistic and non-autistic children (subject of course to further validation).

Longitudinal correlations. There were no significant relations between age 3 symbolic play abilities and age 7 structural language outcomes for non-autistic children, possibly also due to the ceiling effects of symbolic play scores at age 3. However, solitary symbolic play, object substitution, peer role play at

Table 4. Models predicting variance in age 7 syntax ability: autistic and non-autistic group.

Models	R^2	Adjusted R^2	R^2 change	*F* change	*p* value of change
Autistic children					
Model 1: Baseline model for autistic children	36.48%	32.78%	-	-	-
Model 2: baseline model for autistic children + solitary symbolic play	39.55%	35.28%	2.5%	4.32	0.04*
Model 3: baseline model for autistic children + object substitution	43.64%	39.66%	6.88%	10.8	0.0015**
Model 4: baseline model for autistic children + peer role play	38.51%	34.17%	1.39%	2.82	0.1
Non-autistic children					
Model 5: Baseline model for non-autistic children	14%	9%	-	-	-
Model 6: baseline model for non-autistic children + solitary symbolic play	14%	7.9%	−1.1%	0	0.997
Model 7: baseline model for non-autistic children + object substitution	14.16%	8.1%	−0.9%	0.16	0.69
Model 8: baseline model for non-autistic children + peer role play	14.58%	8.6%	−0.4%	0.58	0.448

Note: * $p < 0.05$, ** $p < 0.01$ *** $p < 0.001$.

age 3 each significantly correlated with autistic children's semantics, syntax and coherence abilities at age 7.

Predictive power of symbolic play abilities over long-term language development

For autistic children, age 3 object substitution predicted 7.53% of variance whereas age 3 peer role play predicted 3.49% of variance on the age 7 semantics measure; both age 3 solitary symbolic play and age 3 object substitution were significant in predicting age 7 syntax, accounting for 2.5% and 6.88% of the variance respectively; age 3 object substitution predicted 11.3% of age 7 coherence whereas solitary symbolic play predicted 4.25% and peer role play predicted 4.68% of age 7 coherence.

In line with our hypotheses, object substitution held the strongest predictive power, by explaining the largest amount of extra variance in age 7 semantics, syntax and coherence. This could be due to the shared use of symbolic representation skills and inherent rule-governed nature of both symbolic play and language (McCune, 1995; Reynolds et al., 2011; Stagnitti & Lewis, 2015). Slightly different from our prediction, object substitution had more a prominent effect than peer role play over coherence ability. Our hypothesis was rooted in the fact that peer role play is driven by individual interest and the context naturally facilitates socio-communicative skills, which are key factors in narrative language abilities (Taylor et al., 2013). This could be because coherence ability is built on children's semantic and syntactic abilities, thus object substitution holds stronger influence over coherence ability as it reinforces the effects of semantics and syntax. We call for more research to empirically test this theory.

Age 3 solitary symbolic play and age 3 peer role play predicted similar amounts of variance in age 7 coherence. This is in line with our hypothesis that autistic children need to independently facilitate the symbolic plot which

Table 5. Models predicting variance in age 7 coherence ability: autistic and non-autistic group.

Models	R^2	Adjusted R^2	R^2 change	*F* change	*p* value of change
Autistic children					
Model 1: Baseline model for autistic children	23.65%	19.21%	-	-	-
Model 2: baseline model for autistic children + solitary symbolic play	28.51%	23.46%	4.25%	5.77	0.018*
Model 3: baseline model for autistic children + object substitution	35.09%	30.51%	11.3%	14.98	<0.001***
Model 4: baseline model for autistic children + peer role play	28.91%	23.89%	4.68%	6.28	0.014*
Non-autistic children					
Model 5: Baseline model for non-autistic children	13.86%	8.8%	-	-	-
Model 6: baseline model for non-autistic children + solitary symbolic play	13.86%	7.8%	−1%	0.002	0.966
Model 7: baseline model for non-autistic children + object substitution	13.89%	7.8%	−1%	0.03	0.859
Model 8: baseline model for non-autistic children + peer role play	14.27%	8.2%	−0.6%	0.41	0.525

Note: * $p < 0.05$, ** $p < 0.01$ *** $p < 0.001$.

could be equally challenging as in peer role play where the symbolic plot is mutually constructed and sustained (Kim & Kim, 2017; Sawyer & DeZutter, 2007).

For non-autistic children, while controlling for demographic variables, previous language abilities and cognitive abilities, none of the three symbolic play abilities significantly predicted age 7 structural language abilities. However, the age 7 syntax and coherence abilities of non-autistic children were only significantly predicted by their age 3 language ability, whereas their age 7 semantics ability was significantly predicted by their socioeconomic status at birth alongside their age 3 language abilities. This finding fits with well-established results showing the longitudinal impact of SES at birth upon early vocabulary among typically developing children (e.g. Fernald et al., 2013).

Strengths and limitations

The LSAC dataset allows us to examine the relations between three types of commonly seen symbolic play at age 3 and three structural language outcomes at age 7. This is important evidence for further understanding of the mechanisms behind symbolic play for both autistic and non-autistic children. Children's abilities to perform solitary symbolic play, object substitution and peer role play at age 3 may also be an indicator for not only for autism diagnostic status but also for long-term language outcomes.

Another strength of current study is to use propensity score matching to match 92 autistic and 92 non-autistic children on both demographic backgrounds and developmental levels. This strategy helps control for confounding factors that affect both age 3 symbolic play abilities and age 7 structural language outcomes (Kasari et al., 2013).

Regardless of these strengths, we acknowledge the limitations of this secondary data analysis study. Firstly, for want of a direct measure of narrative we used coherence ability as a proxy for children's narrative skills.

Secondly, we also acknowledge that this is not a clinically ascertained sample of autistic children and diagnosis is not independently confirmed. However, we argue that a population cohort has its advantages since we were able to retrieve information on children's play abilities at age 3 while the diagnoses on average take place after age 7 (in the current sample).

Thirdly, even though the 3-point scale play measure was reported by carers who were likely to report on children's consistent symbolic play abilities, it is undeniable that this scale lacks information on the quality of symbolic play abilities as defined by each care giver. Additionally, to the best of our knowledge, this is the very first study to use this play measure, and the dataset does not provide a very detailed overview of the rationale behind this instrument. Thus, for future research we recommend use of a detailed symbolic play measure in combination with this 3-point scale carer-reported play, where possible.

Finally, we acknowledge that implications drawn from this study will be most relevant to autistic children with similar characteristics to the present sample. According to parents' reports, 79% of autistic children in the study were reported as having a 'mild' condition, whereas 19% were reported as 'moderate' and 2% were reported as 'severe'. We do not have any supporting information to understand how parents were making these 'severity' judgements but the heterogeneity in the autistic sample could explain the significant correlations between autistic children's symbolic play and language abilities at age 3 and 7 due to their distributions being more spread out as observed in Figure 2.

When we compared autistic children with and without carers' reports, we found that the study sample (N = 92) had relatively higher non-verbal IQ than the rest of autistic children in the population cohort (N = 157), but they did not have significant differences in both their age 3 and age 7 language abilities. It is reasonable to question whether carers were less likely to report symbolic play abilities for autistic children whom they considered to have limited cognitive or social skills. However, unfortunately, this question cannot be answered given limited publicly accessible information on the reasons behind this loss in sample size. The LSAC data user guide acknowledges the relatively poorer response rate of carers but the reason for this is unclear (The Australian Institute of Family Studies, 2020).

Conclusions

Our research found significant correlations between age 3 symbolic play abilities and age 7 structural language outcomes for autistic children reporter as having 'mild' characteristics. In addition to age 3 language abilities, we found that age 3 symbolic play abilities had more pronounced effects over age 7 language abilities for autistic children compared to non-autistic children. In contrast, socioeconomic status at birth and age 3 language abilities significantly predicted the age 7 language abilities of non-autistic children. In particular, autistic children's age 3 object substitution ability contributed the most towards age 7 semantics, syntax and coherence, followed by their age 3 peer role play ability which contributed to both age 7 semantics and coherence, while age 3 solitary symbolic play ability significantly predicted age 7 syntax and coherence. Our study therefore underscores the role of object substitution and demonstrates the importance of paying attention to autistic children's peer role play skills. Potentially, peer role play activities could be explored as a strategy which may not only benefit pragmatic language skills, but also act as a route for targeting structural language abilities if language intervention is indicated. We encourage future research to replicate the indicative findings of the present study and to pay attention to developing more comprehensive measures of symbolic play quality.

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Supplemental material

Supplemental material for this article is available online.

Notes

1. p-value of two-sided Wilcoxon rank sum test or chi-square test
2. r for Wilcoxon rank sum test
3. p-value of two-sided Wilcoxon rank sum test or chi-square test
4. r for Wilcoxon rank sum test

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