Creativity Research Journal

ISSN: 1040-0419 (Print) 1532-6934 (Online) Journal homepage: www.tandfonline.com/journals/hcrj20

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To cite this article: Valeska Grau, María Francisca Morales, David D. Preiss, Katherine Strasser, Fernanda Rufs, Daniela Lagos & Javiera Ramirez (04 May 2026): Does Pretend Play Predict Later Creativity Development? Exploring Creative Trajectories from Pre-Kindergarten Through First Grade, Creativity Research Journal, DOI: 10.1080/10400419.2026.2656864

To link to this article: https://doi.org/10.1080/10400419.2026.2656864

Published online: 04 May 2026.

CREATIVITY RESEARCH JOURNAL
https://doi.org/10.1080/10400419.2026.2656864

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Does Pretend Play Predict Later Creativity Development? Exploring Creative Trajectories from Pre-Kindergarten Through First Grade

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ABSTRACT

Creativity is widely recognized as a core skill for the twenty-first century, yet its early developmental pathways remain insufficiently understood. This longitudinal study examined trajectories of creativity in a sample of 230 children aged 4–7, assessed across five waves from pre-kindergarten to first grade. Using group-based trajectory modeling, we identified three distinct patterns: "Accelerated Growth" (22.3%), "Gradual Growth" (72.6%), and "Early Peak and Recovery" (5.1%). Higher quality of fantasy during pretend play quality predicted membership in the Accelerated Growth pattern (OR = 4.91), while higher receptive language predicted Early Peak and Recovery (OR = 1.17). Demographic factors such as gender and school-level socioeconomic vulnerability were not significant predictors. Trajectory membership was associated with developmental outcomes: children in higher-growth groups demonstrated superior expressive and receptive language skills, as well as higher divergent thinking scores, by the first semester of 1st grade. Socioemotional differences were limited, with fewer peer problems observed in the Accelerated Growth group. Findings underscore the importance of promoting high-quality fantasy play and language development in early childhood education. Limitations include small subgroup sizes and reliance on visual-narrative creativity measures. Future research should incorporate multidimensional assessments and explore diverse populations to advance the understanding of creativity development.

Introduction

Creativity is widely recognized as a vital skill for success in the twenty-first century, making its promotion a key priority in education. However, few studies provide clear evidence on how to design programs that foster creative thinking in early childhood. One challenge lies in persistent disagreements about how creativity should be defined, observed, and measured in young children. A commonly accepted definition describes creativity as the ability to produce something both novel and appropriate within a given domain (Runco & Jaeger, 2012). It may involve sudden insights, practical problem-solving, and the creation of products with lasting value beyond the creator's lifetime (Beghetto & Kaufman, 2013). Yet, this definition may not fully capture young children's creative expression, as their contributions often fail to meet conventional criteria for originality or utility. Indeed, many studies on early childhood creativity omit explicit definitions of the constructs they assess (Evans et al., 2018; Plucker et al., 2004). The Four-C Model of Creativity (Kaufman & Beghetto, 2009) provides a valuable framework for studying young children, as it recognizes creativity at multiple levels. It includes mini-c – personal insights and imaginative interpretations of experiences – and little-c – everyday problem-solving that may not be groundbreaking but is meaningful to the individual – alongside pro-C and Big-C, which denote higher-level, domain-impactful creative achievements.

Creative thinking is a multifaceted construct encompassing distinct abilities. One key component is divergent thinking (DT), which refers to the capacity to generate original ideas and combine information in novel ways. This form of creativity is essential for producing multiple possible solutions to a problem (Guilford, 1967). Beyond divergent thinking, creative thinking also involves convergent skills – the ability to identify the most appropriate solution – and synthetic abilities, which require interpreting, combining, and synthesizing elements in unconventional ways to create original solutions while considering existing constraints (Jaarsveld & van Leeuwen, 2005; Urban & Jellen, 1996).

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The present study focuses on this latter dimension of creative thinking.

The construct of synthetic creativity may, in fact, be developmentally privileged in early childhood because it involves the ability to combine multiple ideas or concepts to create something new – an ability that children naturally display when they play, solve everyday problems, and interact with others. Observing creativity through this more integrative lens may therefore better capture children's authentic creative expression. As Urban (1991) noted, "*constructions and products which are new and original for the child are more or less the incidental results of playful actions*" (p. 178).

Measurement of creative thinking in young children

Measuring creativity in young children presents unique challenges. While there is broad agreement on evaluation methods for adults, assessing creativity in early childhood raises several issues. For instance, evidence suggests that some traditional tasks used to measure creativity are closely linked to verbal ability – a concern given that preschool years are marked by rapid language development and significant individual variability (Bai et al., 2023; Evans et al., 2021). Consequently, there is a growing consensus on the need for diverse assessment approaches that go beyond typical verbal divergent thinking tasks, such as naming as many uses as possible for an everyday object (Wallach & Kogan, 1965). Instead, assessments should incorporate activities like drawing, movement, or evaluating creative products, ideally within playful contexts (Evans et al., 2021). Examples include the "Unusual Box Task" (Bijvoet van den Berg & Hoicka, 2014), where children interact with a box featuring unusual elements – ropes, protrusions, ladders, and compartments – and their actions are coded for fluency and originality. Another promising method is the "Consensus Evaluation Technique," in which multiple judges rate creative products such as stories, drawings, collages, or other creations (Amabile & Gitomer, 1984; Fehr & Russ, 2016; Mottweiler & Taylor, 2014).

Despite these methodological innovations, most studies on early childhood creativity continue to focus on divergent thinking (DT) techniques, which represent only one facet of creative thinking. These tasks have also been criticized for being decontextualized, as their format differs significantly from children's natural interactions. For instance, when children are asked to provide multiple answers to the same question, they often assume their initial response was incorrect, which can hinder their ability to demonstrate their creative potential (Evans et al., 2021). Furthermore, in alternative uses tests, recent findings indicate that children aged 4–5 years fail to provide clear, codable explanations for nearly 50% of their responses (Bai et al., 2023).

Development of creativity

Although developmental research on creativity is limited, the development of divergent thinking has received the most attention. A recent meta-analysis of 41 studies across grades 1 through 12 found an overall upward trend in divergent thinking across school years, despite some discontinuities. Contrary to the widely cited "fourth-grade slump," no consistent evidence supported its occurrence; instead, a decline appeared around seventh grade (Said-Metwaly et al., 2020). For younger children, Bai et al. (2023) conducted a longitudinal study of divergent thinking between ages 4 and 6, finding a linear increase in flexibility and originality during this period.

Beyond divergent thinking, recent work has examined synthetic creative abilities – skills that involve combining and interpreting elements in novel ways. Jankowska and Karwowski (2025) used the Creative Thinking – Drawing Production Test (TCT-DP) in a longitudinal design with sessions six months apart. Their latent growth curve analysis revealed an overall upward trend in synthetic creativity, but with substantial variability in the rate and pattern of change. Three distinct developmental trajectories emerged: (1) "low-beginning, moderate-growth," where abilities started low but improved gradually; (2) "medium-start, intensive-growth," marked by steep increases over time; and (3) "stable-high," in which children maintained consistently high scores throughout the study.

Taken together, these findings suggest that developmental trends in creativity vary considerably depending on how creativity is defined and measured. While meta-analyses indicate a general increase during preschool and early primary school years, research remains scarce for preschool-aged populations. Few studies have explored a broader range of creative skills beyond divergent thinking, such as synthetic creativity. Also, trajectory-based analyses of longitudinal data are particularly limited in this regard (Jankowska & Karwowski, 2025).

Play and its relationship to creativity

Although empirical evidence on creativity in young children is limited, play has long been theorized as a key contributor to the development of creativity. Play enables children to reconstruct experiences and generate new ideas by combining representations and

narratives, thereby fostering creativity (Brunner, 2006; Vygotsky, 1967). From this perspective, engaging in playful activities should promote creative thinking. Indeed, research shows that children who engage in play are more likely to exhibit creative skills; however, most studies report correlational rather than predictive or causal relationships (Ghanamah, 2025; Holmes et al., 2022).

Among different types of play, imaginative or pretend play – defined as activity in which children act "as if" and use imagination to manipulate reality through objects, actions, or ideas – has the strongest and most consistent association with creativity (Lillard et al., 2013). Sociocultural theories suggest that pretend play helps children recreate roles and understand the physical and social world (Vygotsky, 1967/2004). Vygotsky emphasized that play is a foundational activity in the development of creative imagination. Although early forms of play rely more on recollection than imagination, mature play is not merely imitative; it involves the creative reworking of past experiences to construct new realities. Through play, children learn to separate meanings from objects and to substitute those objects with alternative objects or actions. As children grow older, these imaginative activities become internalized, enabling them to engage in fantasy or imagination without relying on physical objects or concrete actions. Consequently, pretend play gradually evolves into goal-directed creative imagination during adolescence and adulthood. In this sense, imagination in adolescents and school-aged children can be understood as play without action (Vygotsky, 1966/2015, 1967/2004). Therefore, pretend or fantasy play constitutes a developmental context that supports later creative growth.

Russ (2014) argues that mature pretend play – a type of pretend play that involves elaborated themes, roles, narratives, and scenarios (Leong & Bodrova, 2012) – connects language development and creativity. Empirical studies support this claim, showing links between pretend play and divergent thinking as well as narrative creation skills (Fehr & Russ, 2016; Mottweiler & Taylor, 2014; Russ, 2020). Conversely, solitary play that does not involve symbolic transformation – such as simple material exploration – tends to correlate negatively with creativity tasks, reinforcing the importance of mature pretend play (Lloyd & Howe, 2003).

Moreover, in pretend play, children act out spontaneous thoughts and images, similar to when we are involved in mind wandering (MW). a spontaneous flow of thought not connected to current environment (Smallwood, 2013). This is consistent with recent neurological findings stating that there is a *default mode network* (DMN) (Buckner et al., 2008) associated with MW, that reflects a baseline pattern of brain activity that predominates during spontaneous thoughts and creativity (Beaty et al., 2016; Raichle & Snyder, 2007; Raichle et al., 2001). Together, these findings provide a plausible explanatory mechanism for how pretend play may foster creativity: by expressing spontaneous ideas during pretend play, children may activate the DMN, which in turn supports creative thinking (Russ, 2020).

Could promoting play foster creativity? A systematic review of interventions conducted over 70 years (1950-–2020) found that only 7% targeted play as a mechanism for enhancing creativity in children aged 5 to 13 (Alves-Oliveira et al., 2022). These interventions, including creative, free, and pretend play, demonstrated positive effects on creativity. Additional evidence suggests that enriching playgrounds with loose parts and natural elements (e.g., pebbles, shrubs, bamboo) can enhance creative behaviors (Brussoni et al., 2017; Cankaya et al., 2023; Spencer et al., 2019), although findings are not entirely consistent (Christie, 1983; Fehr & Russ, 2016). Methodological variability across studies makes it difficult to identify clear patterns (Evans et al., 2021). Further research is necessary to establish causal links between play and creativity, as well as to investigate whether variables such as language and self-regulation may be involved in this relationship (Francis & Gibson, 2023; Whitebread & OuO'Slivan, 2020). Longitudinal studies examining the interplay between pretend play and creative behaviors are particularly needed.

Other abilities may explain the link between play and creativity. Bauer and Gilpin (2025) propose that play fosters self-regulation (SR) and executive function (EF), which in turn support creativity by enabling children to select and refine ideas. However, a recent review indicates that these associations vary by EF component: cognitive flexibility consistently correlates positively with creativity, inhibition correlates negatively, and evidence for working memory remains inconclusive (Pasarín-Lavín et al., 2023). Studies focusing on SR suggest it may mediate the relationship between playfulness and creativity (Ghanamah, 2025). Whitebread and O'Sullivan (2020) argue that SR underlies both pretend play and creativity, with reciprocal benefits for language development.

Play and mental health

Various studies have linked play and a playful disposition to experiences of enjoyment, engagement, and social connection – fundamental components of socio-emotional well-being. Although empirical evidence remains limited, recent research has reported

associations between participation in challenging or risky play and better emotional regulation, including lower anxiety (Dodd & Lester, 2021). Conversely, deprivation of free play has been associated with a higher risk of anxious and depressive symptoms in childhood (Gray, 2011). Importantly, evidence highlights not only the frequency of play but also its quality as a key protective factor. For example, Zhao and Gibson (2023) found that high-quality peer play at the age of three predicts fewer behavioral problems, hyperactivity, emotional difficulties, and peer conflicts at the age of seven. These protective effects persist even among children with temperamental characteristics associated with elevated mental health risk, such as low persistence or high emotional reactivity.

The association between play, creativity, and socioemotional well-being cannot be understood in isolation; it must be considered in relation to the psychosocial factors that influence the development of these skills. Evidence suggests that socioeconomic status (SES), school context, and maternal education may affect children's creativity and executive functions (Kupczyszyn et al., 2024). For instance, a recent study found that a pretend-play intervention aimed at improving executive functions was effective only for children from higher socioeconomic status (SES) background (White et al., 2021). However, the inclusion of SES in studies on interventions for young children and creative thinking remains scarce. A meta-analysis examining the relationship between SES and creativity found that although a positive association exists, it is weaker than those with general intelligence or academic achievement and tends to decrease from primary school to higher education (Acar et al., 2022). Notably, no data were available for younger children. Therefore, further research is needed to examine the relationships between play and creativity, not only in terms of developmental patterns but also across more diverse populations.

The present study

The present study aims to advance our knowledge of the relationship between pretend play and creativity by examining the developmental trajectories of synthetic creativity, their predictors, and outcomes in a Chilean sample of children aged 4 to 7.

The research questions guiding this study were (1) What trajectory groups of creativity can be identified from pre-kindergarten entry to the beginning of first grade?, (2) Which variables measured in pre-kindergarten -including child gender, school-level socioeconomic vulnerability, receptive and expressive language, quality of fantasy play, working memory, and narrative abilities- predict trajectory group membership?, and (3) Which developmental outcomes in first grade -specifically in receptive and expressive language, divergent creativity, and socioemotional functioning (behavioral and emotional problems, as well as prosocial behaviors)- are associated with the identified subgroups?

Methods

Sample

Children aged 4 to 7 years old from 15 schools in Santiago de Chile participated in the study. 57% of the children attended fully publicly funded schools, and 43% attended partially subsidized schools (a voucher-like system in which parents in some cases pay a small fee). Also, 6.9% of the children were reported by their educators as having special educational needs. However, due to the young age of participants and unclear diagnostic classifications, no children were excluded, as all were able and willing to follow the instructions. They were evaluated five times over two years (2022–2024): during the first and second semesters of pre-kindergarten and kindergarten, and in the first semester of first grade. Two hundred eighty-six children (159 girls) participated in the first wave, and 214 (99 girls) remained in the fifth wave.

Instruments

Synthetic creativity trajectories (waves 1–5)

Creative intelligence Task for synthetic creativity. The research team developed a test of creative performance inspired by other synthetic creativity tests available (e.g., Urban, 2004). We developed an app with a blank space and geometric figures (triangles, squares, circles, and rectangles) in different sizes and colors (blue, yellow, green, and red). These figures had to be manipulated on the touchscreen of a tablet to create the requested product, according to the following prompt:

> [Child's name] let's listen carefully to the following story … In a very, very secret place, the strangest scientists in the world gathered. They wanted new challenges because they were bored with studying the same animals and plants over and over again; they already knew them by heart! They sat in their thinking chairs and let their imagination fly until one of them had a brilliant idea. What if we created new animals, animals that no one had ever seen before? They worked day and night until [child's evaluated name], the youngest scientist, was ready to show their creation to the world.

Table 1. Internal consistency by batch.

Batch	Number of Products	Cronbach's Alpha
1	1–50	0.89
2	51–150	0.85
3	151–250	0.89
4	251–350	0.92
5	351–450	0.87
6	451–550	0.90
7	551–650	0.86
8	651–750	0.85
9	751–850	0.92
10	851–950	0.87
11	951–1050	0.91
12	1051–1150	0.91
13	1151–1250	0.92
14	1251–1350	0.89
15	1351–1418	0.91

Note. Values represent Cronbach's alpha calculated for each batch of products.

The Creative Intelligence Task was scored by assessing creativity along a single dimension, considering the novelty and originality of the visual representation and narration across the total sample evaluated over the five measurement waves. We decided not to separate the product into distinct dimensions – narrative and visual representation – because doing so did not seem developmentally appropriate given the variability in children's abilities across these potential subcomponents (e.g., language, motor skills, figural imagination) at different evaluation waves. Instead, we adopted a holistic scoring approach that could more accurately capture children's creativity while ensuring greater reliability and comparability over time.

This assessment process was conducted by a team of 5 people who were previously trained in the creation and application of the instrument and were blind to the participants' ages, the distribution of the evaluation waves, schools, or SES. Each of the products, totaling 1418, was randomly added to a database to avoid bias in the scoring process.

The creativity dimension was evaluated on a scale from 1 to 7, with agreements made on the score assignments, defining points 1, 4, and 7 as follows: (1) Existing animal with qualities typical of the existing animal, but basic/poor. Lacking visual or narrative coherence. Poor and/or disorganized visual composition, without a developed narrative. (4) An animal that has at least one novel quality (not typical of the mentioned animal, e.g., a flying cat). Poor visual composition, but coherent. (7) Non-existent animal with a new name and qualities, along with a visual composition coherent with the narration.

Each member of the scoring team assigned a score to the products independently, and the total score was calculated as the average of all scores. This process involved dividing the 1418 products into batches, starting with 50 and increasing by 100 each time. For each batch, internal consistency was calculated using Cronbach's alpha. Table 1 shows the internal reliability of the scoring process for each batch:

Predictors (Wave 1)

Affect in Play Scale – APS-P (Kaugars & Russ, 2009). The APS-P is a standardized tool that assesses cognitive and affective processes associated with pretend play. It consists of a 5-minute play task with a set of toys, in which the examiner tells a child a short, open-ended story and then encourages free play. The children play with the toys independently, without interacting with other children. Children's play is scored on elements such as imagination, organization and elaboration. It is designed for children aged 4 to 5 in its preschool version. The quality of fantasy in the play was scored, as was the time spent in pretend play, functional play, or no play. Trained psychologists coded the videos; they had to reach 80% agreement to code independently. We did not code for affect during play, only fantasy, comfort during play and type of play.

A. *Fantasy* was a compound of 3 scores:

- Imagination: higher scores are related to frequent simulation with more original and creative elements.
- Organization and coherence: More coherent relates to sequences of events.
- Elaboration: Complexity of themes, sound effects/voice tones, character development, use of different toys.
- *Comfort*: reflects a child's interest, involvement, and comfort with the play activity
- *Type of play*: For each 20-seconds interval, the rater should indicate which of the three types of play was the predominant activity:

- No play: Child does not move the objects or interact with them; hold an object but not move it; name an object or describe its actual properties.
- Functional play: Child makes simple, repetitive muscle movements with or without the objects.
- Symbolic or pretend play: Any activity that involves pretend play, such as actions that do not lead to their usual outcome; treating inanimate objects as if they were alive; substituting one object or gesture for another; or performing an activity typically done by someone or something else.

Nexos (Rosas et al., 2022) evaluates working memory and consists of presenting a series of images associated with numbers; the stimuli are presented depending on the level. Participants must establish corresponding associations based on previously observed relationships.

WISC-5 Vocabulary Scale: The expressive vocabulary test was used to evaluate the intervention's impact on the general expressive language of boys and girls. The WISC-5 vocabulary scale requires the participant to define a list of words. Although in Chile the standards for this test begin at age 6, the test's raw score can be used for research purposes.

Peabody Receptive Vocabulary Test, TVIP III (Olabarrieta-Landa et al., 2017): This test measures receptive vocabulary and has been widely used in research in Chile.

Narrative comprehension task: "A Boy, a Dog and a Frog" (Paris & Paris, 2003). The child has to identify the narrative, characters, and scenario within a book without words.

Outcomes (Wave 5)

"Instances" task for divergent thinking. We created a version of the instances task for young children, asking them to answer two requests: "Name things that fit in your hand," and then "Name things that are noisy." Responses were evaluated for fluency, flexibility and originality.

The instructions were as follows:

> "*Now I'm going to tell you a characteristic, and the idea is that you name all the things you can think of that have that characteristic. For example, I might say, 'Tell me all the things you can think of that are cold,' and you could say things like: 'Ice, a refrigerator, a swimming pool, snow,' and so on. The important thing is to name everything you can think of—the more, the better. Let's try: If I ask you to tell me two things that are shiny, what things could you say?" The participant is expected to respond, checking whether they understood the instruction.*
>
> *"Very good. Now, you will have 3 minutes to respond. I'm going to tell you a characteristic, and the idea is that you try to say everything you can before time runs out. I'll tell you when to start and when the time is up." It must be confirmed that the child understood the instruction."Now let's begin. Tell me all the things you can think of that fit in your hand. You can start now . . . go." The participant is given 3 minutes to name all the things they can think of. Once finished, a second round begins.*
>
> *"Now I'm going to ask you to tell me all the things you can think of that make loud noises." Again, the participant is given 3 minutes to name all the things they can think of.*

The Instances task was scored by two trained educational psychologists with experience in coding creativity and other child-generated productions. Intercoder reliability was calculated using several indicators. Four agreement indicators were calculated for all variables.

Pearson correlation. The most typical correlation used for numerical variables. Technically, it is intended for continuous variables, but it is also commonly used for count variables.

Sample percent agreement. Simply the percentage of agreement. The percentage is calculated as agreements/total_responses *100. For the originality variables, the maximum difference allowed was 0.5 points. This is the most commonly used in the literature.

Cohen's weighted kappa with quadratic weights. This agreement indicator is similar to the standard Cohen's kappa but it also considers the magnitude of disagreement. The term "quadratic weights" means that small differences are penalized much less than large differences.

Cohen's weighted kappa with linear weights. The same as the weighted kappa with quadratic weights, but the penalty, while still increasing as the difference increases, grows at a constant rate. In this sense, the penalty for a small difference is not much different than the penalty for a large difference.

All indicators show a good level of agreement between coders. The values of these indicators are provided in Tables 2 and 3.

Strengths and Difficulties Questionnaire (SDQ): We used the parent-report scale designed to detect mental health problems in children and adolescents aged 2 to 17 years. It consists of 25 items divided into 5 subscales: behavioral problems, emotional problems, hyperactivity/inattention, peer relationship problems, and prosocial behaviors (Goodman, 1997). Among its advantages

Table 2. Inter-rater reliability statistics for the item "things that fit in your hand"

Measure	n	Pearson Correlation	Percent Agreement	Quadratic Weighted Kappa	Linear Weighted Kappa
Fluency	73	.981	79.5% (±1)	.979	.880
Flexibility	73	.948	75.3% (±1)	.948	.803
Originality (average)	70	.899	98.6% (±0.5)	.927	.794
Originality (top 2 responses)	70	.861	90% (±0.5)	.836	.707

Note. Sample sizes and reliability indices were calculated from coder calibration data. Fluency and flexibility were coded for 73 participants, while originality metrics were coded for 70 participants due to exclusion of cases without adequate responses.

Table 3. Inter-rater reliability statistics for the item "things that make a lot of noise"

Measure	n	Pearson Correlation	Percent Agreement	Quadratic Weighted Kappa	Linear Weighted Kappa
Fluency	70	.918	81.4% (±1)	.916	.772
Flexibility	70	.893	87.1% (±1)	.893	.734
Originality (average)	69	.931	97.1% (±0.5)	.922	.796
Originality (top 2 responses)	69	.877	88.4% (±0.5)	.857	.713

Note. Fluency and flexibility were calibrated for 70 participants; originality variables were calibrated for 69 participants due to one case without adequate responses.

are that it is a brief questionnaire, easy to complete, and covers the most important mental health problems in children and adolescents (Dahlberg et al., 2019; Rodríguez-Hernández et al., 2012)

WISC-5 Vocabulary Scale (described above)

Peabody Receptive Vocabulary Test (described above)

Data collection procedure

Fifteen schools in Santiago de Chile were selected. We used the database of the National System of Measurement of Quality of Education by the Minister of Education. The inclusion criteria were schools in the province of (Santiago within the urban radius, with a medium or high school vulnerability index, and publicly funded. Once these schools had been filtered, they were contacted by e-mail or telephone and invited to participate in the study. Those that expressed interest were recruited.

The children's assessment in the study was conducted by administrators who were trained by the research team before the study began. All of them had a degree in psychology or education. The surveys were sent to parents via an online link to SurveyMonkey.

The assessment instruments were divided into three sessions, each lasting no more than 30 minutes, to prevent fatigue from affecting the children's performance. Before the assessment, informed assent was obtained from each child, and only those who wanted to participate were assessed.

Ethics

The present research study was approved by the Ethic committee of Social Sciences of the Pontificia Universidad Católica de Chile). School principals signed research authorization forms, while teachers and parents provided informed consent. An assent procedure was also implemented for young children.

Analyses

Descriptive analyses and bivariate associations (i.e., Spearman correlations) were conducted to examine central tendencies and correlations among study variables. To identify distinct developmental trajectories of synthetic creativity from the beginning of pre-kindergarten to the start of first grade (first research question), we employed a person-centered approach using group-based trajectory modeling (GBTM; Nagin, 2005). GBTM is a form of finite mixture modeling that identifies subgroups of individuals who follow similar patterns of change over time. In contrast to variable-centered techniques that estimate a single average trajectory, person-centered approaches allow the identification of qualitatively distinct developmental pathways, offering a more detailed understanding of developmental heterogeneity (Laursen & Hoff, 2006; Magnusson, 2003).

Model estimation followed the two-step procedure recommended by Nagin (2005). In the first step, a series of models assuming a censored normal distribution and including quadratic growth terms were estimated, testing solutions with two to six trajectory groups. Model fit was evaluated using the Bayesian Information Criterion (BIC), with higher (i.e., less negative) values indicating better model fit. A three-group solution was selected based on both BIC values and interpretability, balancing statistical criteria and parsimony (Table 4). In the second step, polynomial terms (i.e., constant, linear, quadratic) were adjusted to retain only statistically significant parameters within each trajectory. Model acceptability was further assessed through posterior classification diagnostics, including the average posterior probability of group assignment (APP; >.70) and the odds of correct

Table 4. Model fit: bayesian information criterion.

	BIC ($N = 962$)	BIC ($N = 230$)	AIC
2-group	−1585.79	−1580.06	−1566.31
3-group	**−1579.74**	**−1571.15**	**−1550.52**
4-group	−1582.60	−1571.15	−1543.65
5-group	−1587.71	−1573.41	−1539.02
6-group	−1599.24	−1582.07	−1540.81

Note. The sample size in the first BIC column represents the total number of assessments used in the model estimation across time and participants. Sample size in the second BIC column denotes the actual sample size used in the trajectories. The theoretically correct BIC score lies in between these two indices (Nagin, 2005).

Table 5. Model fit: posterior classification diagnostics.

Trajectory Group	*n*	Average Posterior Probability of Group Membership	Odds of Correct Classification
1	50	84.84	20.15
2	169	95.33	7.36
3	11	86.32	125.65

Note. Membership probability greater than 70 and OCC greater than 5 represent good model fit.

classification (OCC; >5), both of which met recommended thresholds. Final model fit statistics are reported in Table 5.

To address our second research question, we estimated a new model incorporating time-stable predictors measured at Wave 1, when children were at the beginning of pre-kindergarten, to examine factors associated with trajectory group membership. These predictors were included directly in the model, preserving the treatment of trajectory groups as latent constructs. The predictors included child gender, school-level socioeconomic vulnerability, receptive and expressive language skills, quality of fantasy play, working memory, and narrative abilities.

Finally, to answer our third research question, we examined the unique associations between each trajectory group and developmental outcomes assessed at Wave 5, when children were at the start of first grade. These outcomes included verbal skills (receptive and expressive language), divergent creativity (fluency, flexibility, originality), and socioemotional functioning (behavioral and emotional problems, prosocial behaviors). We compared the means and 95% confidence intervals for each outcome across trajectory groups and inferred significant differences when the confidence intervals did not overlap. All analyses were conducted using Stata 18.0, with statistical significance set at $p < .05$.

Results

Descriptive analyses and bivariate associations

Descriptive analyses (Table 6) revealed a steady increase in creativity scores from Wave 1 ($M = 2.23$, $SD = 1.18$) to Wave 5 ($M = 3.43$, $SD = 1.51$), suggesting overall developmental growth. Additionally, bivariate Spearman correlations showed that several baseline characteristics (beginning of pre-kindergarten) were significantly correlated with synthetic creativity across the five waves. Higher levels of school socioeconomic vulnerability were negatively correlated with creativity at Wave 3 ($rs = -.67$). Conversely, higher expressive language and the quality of fantasy in pretend play showed a positive correlation with synthetic creativity at Wave 2 ($rs = .48$) and 4 ($rs = .43$), respectively. In addition, synthetic creativity scores at each wave were correlated with developmental outcomes assessed at the beginning of first grade (Wave 5). Also, synthetic creativity was positively correlated with receptive language ($rs = .45$ for Wave 2 creativity) and expressive language ($rs = .43$ to $.67$ for creativity at Waves 2, 3 and 4). Finally, higher synthetic creativity scores were correlated with fewer emotional problems ($rs = -.45$ and $-.72$ for creativity at Waves 1 and 5, respectively) and peer problems ($rs = -.50$ and $-.44$ for creativity at Waves 1 and 4, respectively). As a general reference, in wave 5, 71.6% of children were in the "normal" range, 16.47% in the "borderline" range, and 11.76% in the "high-needs" range of difficulties.

Synthetic creativity trajectories

A group-based trajectory analysis identified three distinct developmental pathways of creativity from the beginning of pre-kindergarten to the start of first grade (see Figure 1). These included: (1) an "*Accelerated Growth*" group (22.3% of the sample), (2) a "*Gradual Growth*" group (72.6% of the sample), and (3) an "*Early Peak and Recovery*" group (5.1% of the sample).

Growth parameters indicated that creativity changed significantly over time in all trajectory groups (see Table 7). The first two groups followed linear growth patterns, while the third exhibited a quadratic trajectory. Children in the *Gradual Growth* group (G2) showed consistently low levels of synthetic creativity with a steady but modest increase over time. In contrast, the *Accelerated Growth* group (G1) began at lower levels but displayed a steeper upward trend. The *Early Peak and Recovery* group (G3) started with the highest synthetic creativity scores, then declined during pre-kindergarten and rebounded through kindergarten. Notably, by Waves 3 to 5, the *Accelerated Growth* and *Early Peak and Recovery* groups reached similarly high levels of synthetic creativity, reflecting convergence in developmental outcomes despite their distinct starting points and patterns of change. Figure 1 shows the trajectories of each group and Figure 2 illustrates and

Table 6. Descriptive statistics and bivariate Spearman correlations.

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Creativity																										
1. Wave 1	2.23	1.18	–																							
2. Wave 2	2.33	1.21	.41	–																						
3. Wave 3	2.57	1.29	.17	.30	–																					
4. Wave 4	3.10	1.45	.42	.59**	.34	–																				
5. Wave 5	3.43	1.51	.45*	.49*	.17	.34	–																			
Predictors																										
6. Sex (male)	–	–	−.17	.30	.26	.23	.00	–																		
7. School vulnerability	64.51	17.34	−.32	−.25	−.67**	−.17	−.19	−.33	–																	
8. Receptive language	51.69	16.91	.12	.33	.08	.17	.21	.35	−.35	–																
9. Expressive language	6.64	3.20	.10	.48*	.16	.21	.29	.42	−.37	.86***	–															
10. Fantasy play quality	2.79	0.97	.02	.24	.03	.43*	.38	−.02	.19	−.04	−.01	–														
11. Working memory	3.03	2.57	−.06	−.26	.07	.02	−.07	.19	−.11	.24	−.01	−.18	–													
12. Narrative skills	6.88	3.34	.35	.41	−.15	.36	.44	.30	−.04	.51*	.58**	.40	−.14	–												
Outcomes																										
13. Receptive language	78.69	17.11	.36	.45*	.21	.20	.37	.41	−.33	.62**	.54*	−.15	.31	.50*	–											
14. Expressive language	10.59	4.12	.39	.58**	.26	.67**	.43*	.40	−.13	.43*	.47*	.32	.15	.53*	.46*	–										
15. DC fluency (noise)	6.76	3.45	.13	−.05	−.29	.07	.25	−.04	.15	.32	.15	.31	.50*	.38	.20	.22	–									
16. DC flexibility (noise)	4.48	2.23	−.05	−.09	−.30	.03	.25	.05	.01	.32	.17	.16	.57**	.24	.20	.01	.86***	–								
17. DC originality (noise)	2.61	0.89	.11	.13	−.22	.08	.27	.38	.01	.44*	.44*	.02	.38	.43*	.55*	.31	.61**	.63**	–							
18. DC fluency (hand)	11.11	5.61	−.26	−.23	−.31	−.24	−.39	.29	.13	.37	.24	−.18	.44*	.19	.23	.03	.34	.40	.40	–						
19. DC flexibility (hand)	7.77	3.82	−.20	.19	−.07	−.01	−.26	.39	−.04	.53*	.49*	−.15	.25	.25	.42	.22	.25	.30	.47*	.83***	–					
20. DC originality (hand)	2.83	0.74	−.38	.00	.12	.08	−.29	.37	−.19	.49*	.38	.12	.15	.27	.21	−.03	.00	.20	.11	.59**	.63**	–				
21. Emotional problems	2.16	2.05	−.45*	−.24	−.31	−.28	−.72**	.10	.26	−.33	−.27	−.26	−.18	−.28	−.50*	−.26	−.35	−.38	−.44*	.03	−.09	−.04	–			
22. Peer problems	1.87	1.82	−.50*	−.38	−.33	−.44*	−.26	.25	.36	−.27	−.19	−.06	−.26	−.05	−.36	−.18	−.18	−.24	−.23	.02	−.20	−.11	.60**	–		
23. Hypact. problems	4.5	2.19	−.21	−.22	−.20	−.09	−.32	−.04	.58*	−.23	−.27	.05	−.14	−.17	−.32	−.11	−.15	−.29	−.04	−.11	−.27	−.08	.33	.36	–	
24. Conduct problems	2.02	1.88	−.31	−.03	−.13	−.03	−.00	.05	.35	−.34	−.11	.26	−.34	.03	−.48*	−.01	−.29	−.29	−.36	−.17	−.25	−.08	.44*	.49*	.18	–
25. Prosocial skills	8.5	1.87	.04	−.00	.29	.08	−.23	−.39	−.09	−.16	−.26	−.05	.08	−.48*	−.08	−.23	−.13	−.05	−.23	.05	.11	.10	−.26	−.53*	−.08	−.53*

Note. DC = Divergent creativity; *M* = Mean; SD = Standard Deviation. Predictors were measured at Wave 1; outcomes were assessed at Wave 5. $p < .05$*, $p < .01$**, $p < .001$***.

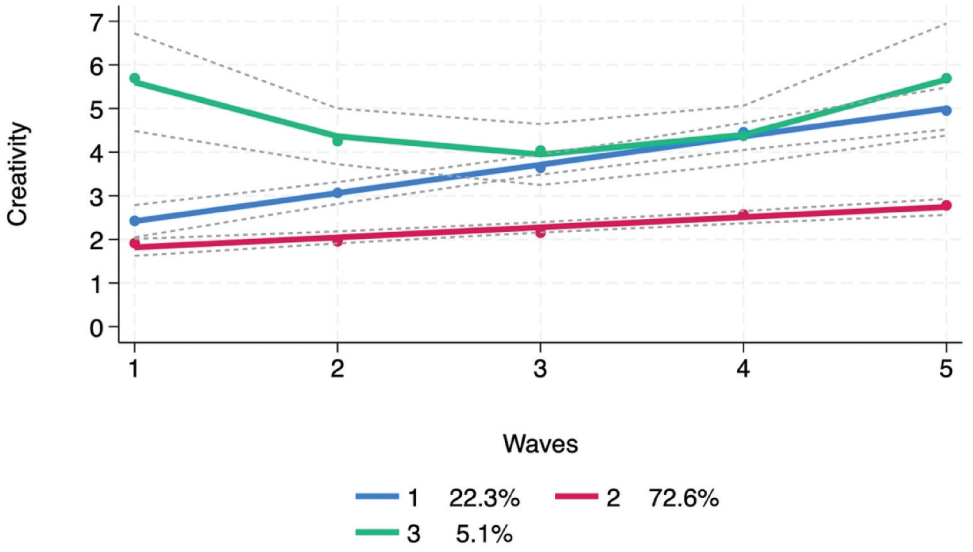

Figure 1. Developmental trajectories of creativity from the beginning of pre-kindergarten to the start of first grade ($n = 230$).

Table 7. Trajectory parameter estimates for the 3-group model.

Group	Parameter	Estimate	SE	*T*	*p*
Accelerated Growth	Intercept	1.76	0.23	7.77	<.001
	Linear	0.65	0.07	8.93	<.001
Gradual Growth	Intercept	1.56	0.10	15.06	<.001
	Linear	0.24	0.03	7.35	<.001
Early Peak and Recovery	Intercept	7.81	0.96	8.16	<.001
	Linear	−2.60	0.74	−3.49	.001
	Quadratic	0.44	0.12	3.51	.001

	Wave 1 (Pre-K, Semester 1)	**Wave 2 (Pre-K, Semester 2)**	**Wave 3 (Kinder, Semester 1)**	**Wave 4 (Kinder, Semester 2)**	**Wave 5 (First grade, Semester 1)**
Drawing					
Name	*A city, a dog*	*Pig that has a tale*	*Aisoraptu*	*Long-neck Kitten*	*Camel-Caterpillar*
Story	It's sitting in a tree. They went to the forest and saw puppies and rabbits. They also saw a duck. There were also mountains. It comes out to eat during the day. It's white, has a long tail, small paws, and barks twice. It has three legs and wakes me up at night.	He has a little tail, a hat, and clothes (a blue square). He's over there eating from his plate. He's eating some peanuts. He lives in my house, and he's outside because he can't be controlled.	It walks fast, has fangs, and lives in the jungle. It destroys animals, cares for its young, and feeds its young.	It has a long neck, runs very fast, and also has a pouch that collects sweat because it sweats a lot. It also has long, rectangular, cone-shaped ears, and it hears very well. It has one eye, and the ear covers the other. And the sweat pouch is for storing water and collecting water from rivers. It has big ears because it hears very well.	It cleans the water. It creates more plants that are important. It's very clean. It lives in Colombia and is also found in Chile and Argentina. These circles are its hump, and this yellow part is its head.
Score	2,4	3,2	5	5,4	6

Figure 2. Examples of a child's drawings from the "Accelerated growth group".

example of creations from a child belonging to the "Accelerated growth" group.

Time-stable predictors of group membership

Subsequently, a second model was estimated to examine whether time-stable predictors measured at the beginning of pre-kindergarten (Wave 1) were associated with children's likelihood of membership in each trajectory group, using the *Gradual Growth* group (G2) as the reference (Table 8). This group was selected as the reference because it represents the largest developmental pattern within the sample.

Higher quality of fantasy in pretend play significantly predicted membership in the *Accelerated Growth* group ($b = 1.59$, $p < .05$, OR = 4.91), indicating that each one-point increase in fantasy play quality in pretend play was associated with a 391% increase in the odds of being in the *Accelerated Growth* group relative to the *Gradual Growth* group. Additionally, higher receptive language scores significantly predicted membership in the *Early Peak and Recovery* group ($b = 0.16$, $p < .05$, OR = 1.17), such that each additional point in receptive language increased the odds of belonging to this group by 17%. No other predictors (i.e., child gender, school socioeconomic vulnerability, expressive language, working memory, and narrative skills) were significantly associated with group membership.

Outcomes associated with trajectory groups

We next examined whether membership in each synthetic creativity trajectory group was associated with developmental outcomes assessed at Wave 5 (see Table 9), when children entered first grade. Outcomes included verbal skills (receptive and expressive language), divergent creativity (fluency, flexibility, originality), and socioemotional functioning (emotional, hyperactivity, and conduct problems, peer problems, and prosocial behaviors).

In the verbal domain, children in the *Gradual Growth* group scored significantly lower in expressive language than those in both the *Accelerated Growth* and the *Early Peak and Recovery* groups. Moreover, children in the *Early Peak and Recovery* group outperformed the *Gradual Growth* group in receptive language.

In the divergent creativity domain, results differed by task. On the noise test, children in the *Accelerated*

Table 8. Multivariable analysis of time-stable predictors by group membership.

	Accelerated Growth Group			Early Peak and Recovery Group		
	b	SE	*p*	b	SE	*p*
Child gender (male)	1.98	1.07	.066	0.65	1.38	.642
School socioeconomic vulnerability	−0.05	0.03	.074	−0.04	0.04	.227
Receptive language	0.03	0.04	.537	0.16	0.07	.019
Expressive language	0.10	0.16	.553	−0.22	0.22	.333
Fantasy play quality	1.59	0.64	.013	1.05	0.76	.168
Working memory	−0.05	0.18	.777	−0.37	0.26	.148
Narrative skills	0.02	0.17	.905	0.33	0.27	.227

Note. The comparison group was *Gradual Growth* group. Table includes b coefficient, standard error, and significant value.

Table 9. Outcomes associated with trajectory groups.

	Gradual Growth		Accelerated Growth		Early Peak and Recovery	
	M	95% CI	M	95% CI	M	95% CI
Verbal domain						
Expressive language	9.13	8.46–9.79	13.04	11.76–14.32	15.88	13.44–18.32
Receptive language	73.53	60.98–86.08	73.53	58.49–88.57	92.17	87.55–96.79
Divergent creativity domain						
Fluency (noise)	6.13	5.46–6.79	7.93	6.79–9.08	7.93	5.66–10.20
Flexibility (noise)	3.98	3.56–4.40	5.48	4.73–6.23	5.15	3.56–6.74
Originality (noise)	2.40	2.23–2.57	2.99	2.71–3.26	2.94	2.35–3.53
Fluency (hand)	10.34	9.26–11.41	12.48	10.56–14.40	13.40	9.79–17.01
Flexibility (hand)	7.02	6.31–7.73	9.25	7.99–10.51	9.49	7.11–11.86
Originality (hand)	2.66	2.53–2.80	3.13	2.89–3.37	3.34	2.86–3.83
Socioemotional domain						
Emotional problems	2.53	2.01–3.06	1.48	0.52–2.43	0.41	−1.48 - 2.31
Peer problems	2.36	1.91–2.83	0.69	−0.13 - 1.52	0.72	−0.84 - 2.28
Hyperactivity problems	4.58	3.98–5.18	4.38	3.14–5.63	3.99	1.70–6.28
Conduct problems	2.17	1.68–2.67	1.62	0.72–2.52	1.84	0.07–3.61
Prosocial behavior	8.33	7.84–8.82	8.88	7.98–9.78	9.05	7.33–10.78

Note. All outcome variables were measured at T5 (beginning of first grade). *M* = mean; CI = Confidence interval.

Growth group scored higher in flexibility and originality than those in the *Gradual Growth* group. In contrast, no significant differences emerged for the *Early Peak and Recovery* group relative to the others. On the hand test, children in the *Accelerated Growth* group outperformed the *Gradual Growth* group across all three divergent indices (fluency, flexibility, originality). Additionally, the *Early Peak and Recovery* group obtained higher originality scores than the *Gradual Growth* group.

Finally, in the socioemotional domain, Children in the *Gradual Growth* group exhibited more peer problems than those in the *Accelerated Growth* group. No significant group differences were observed for emotional problems, hyperactivity, conduct problems, and prosocial behaviors.

Discussion

This longitudinal study provides novel insights into the developmental trajectories of synthetic creativity in early childhood, highlighting patterns often overlooked in cross-sectional research. Overall, most children improved their creativity scores during the preschool years, consistent with the findings of Bai et al. (2023). However, synthetic creativity did not follow a uniform developmental path; instead, children exhibited heterogeneous growth patterns, including accelerated gains, gradual increases, and early peaks followed by recovery. These results underscore the value of person-centered approaches for capturing developmental variability.

Interestingly, the patterns identified in this study align with those reported by Jankowska and Karwowski (2025), who, using latent growth curve models, found three similar trajectories of synthetic creativity among Polish children of comparable age. In both studies, most children belonged to the low-beginning/moderate-growth group. However, while Jankowska and Karwowski observed similar representation of rapid-growth and stable-high trajectories, our sample included a greater proportion of children in the Accelerated-Growth group. In both studies, the majority of children followed trajectories characterized by low creativity levels – a finding that is concerning but not surprising given that early childhood education in Chile tends to emphasize over-schooling and offers limited opportunities for imaginative activities and play (Grau et al., 2018; Pardo et al., 2021; Rupin et al., 2023; Strasser et al., 2024).

Now, relying on the aforementioned four-C model as a framework to understand the development of creativity, these trajectories can be interpreted as reflecting primarily mini-c forms of creativity, that is, personally meaningful visual-narrative productions rather than a high-quality creative products. Some children, however, may have engaged in emerging little-c creativity, particularly those who adopted a more metacognitive approach to the task and demonstrated greater awareness of its creative demands (Preiss, 2022), thereby showing a more advanced stage of creativity development. This metacognitive understanding is also expected to become more sophisticated with age, which may help explain the observed increases in the quality, coherence, and appropriateness of children's products across waves (Kaufman & Beghetto, 2009; Runco et al., 2005).

Despite the general trend of modest early creativity levels, the presence of an accelerated-growth group suggests that some children may be particularly susceptible to positive change. Moreover, the existence of multiple pathways toward similar creative outcomes, despite different starting points, highlights the dynamic and non-linear nature of creativity development in early childhood.

A key contribution of this study is the identification of fantasy play quality and receptive language as significant predictors of growth in synthetic creativity. Children who engaged in more complex and imaginative play at pre-kindergarten were more likely to follow trajectories characterized by accelerated growth. Similarly, children with stronger receptive language skills were more likely to belong to the early-peak /recovery group, which achieved higher creativity scores across the five waves. In contrast, demographic factors such as gender and school-level socioeconomic vulnerability did not predict trajectory membership, suggesting that structural factors may play a limited role in creativity development. Likewise, expressive language, working memory, and narrative skills did not predict group membership, thereby precluding confirmation of the claims made by Bauer and Gilpin (2025) regarding the role of executive functions (EF) in the play – creativity relationship. However, given that this study measured only working memory as an EF component, these findings are consistent with Pasarín-Lavín's et al. (2023) review, which concluded that evidence for a link between working memory and creativity remains inconclusive. Future research should incorporate a broader range of EF measures.

Further, if we consider a developmental systems perspective to interpret these findings (Lerner, 2006), the association between early fantasy play quality and membership in the Accelerated Growth trajectory may reflect *differential developmental responsiveness*—that is, heterogeneity in children's sensitivity to change as they engage with subsequent learning environments (Belsky & Pluess, 2009). High-quality fantasy play may index the richness and flexibility of symbolic representation (e.g., elaboration, organization, and imaginative transformation), which could enable some children to benefit more strongly on later educational or interactional opportunities,

thereby showing a clear growth in synthetic creativity across transition to school. Importantly, this interpretation does not imply that fantasy play is simply "creativity measured twice"; rather, fantasy quality in pretend play reflects the organization and elaboration of symbolic play processes (a developmental context/capacity), whereas our creativity task captures children's production of coherent, novel visual – narrative products over time. Future work should test mediating pathways (e.g., changes in symbolic flexibility, classroom opportunity structures, or language-related scaffolding) that could account for differential growth.

Following this argument, the association between receptive language and the Early Peak and Recovery trajectory may be consistent with the idea that receptive language supports early expressive richness in developmentally embedded creativity tasks that require understanding a prompt and constructing a coherent narrative around a visual product. At the same time, the non-linear pattern observed in this group may plausibly reflect sensitivity to changing educational constraints and opportunities during the transition from pre-kindergarten to kindergarten and first grade. In contexts where early schooling becomes more structured and play opportunities narrow, creative expression may temporarily diminish and later rebound as children adapt to new demands. However, given the small size of this trajectory group, we present this interpretation as a hypothesis to be examined in larger samples and with direct measures of classroom opportunity structures and peer play.

Trajectory membership was also associated with meaningful developmental outcomes. Children in the accelerated-growth group demonstrated superior performance on divergent thinking tasks. They exhibited stronger expressive and receptive language skills by first grade, suggesting a potential bidirectional relationship between creativity and language development. This interpretation aligns with Whitebread and Whitebread and O'Sullivan (2020) assertion that play and creativity are mediated by language development, while also contributing reciprocally to language growth. Additionally, children in the accelerated-growth group experienced fewer peer-related difficulties in first grade, pointing to possible socioemotional benefits of creative engagement (e.g., interpersonal problem-solving). However, no significant differences emerged in emotional problems, hyperactivity, or prosocial behaviors. Although evidence on the link between mental health and creativity in early childhood remains scarce, the observed association between creativity, language development, and complex play suggests that cognitive flexibility – central to synthetic creativity – may support social competence. It is plausible that children who engage effectively in pretend play from an early age also demonstrate stronger peer interaction skills.

Practical Implications

From an applied perspective, the findings underscore the importance of promoting high-quality fantasy play and language development in early childhood education and home environments. Interventions that enrich imaginative play and verbal interaction can be effective strategies for fostering creativity. Although this study does not establish causality, its predictive findings are consistent with theoretical and empirical literature on the relationship between pretend play and creativity (Fehr & Russ, 2016; Mottweiler & Taylor, 2014; Russ, 2020).

Limitations of the study

Despite these contributions, several limitations should be acknowledged. One limitation that warrants careful consideration concerns the relatively small size of the Early Peak and Recovery trajectory group. Although this pattern was theoretically interpretable and consistent with prior trajectory-based studies of creativity development, the small number of children in this group constrains statistical power and limits the generalizability of inferences drawn from it. Consequently, findings related to this trajectory should be regarded as exploratory. Rather than representing a distinct developmental "type," this pattern may reflect transitional or context-sensitive expressions of creativity that warrant further investigation in larger samples. Replication with broader cohorts will be essential to determine the robustness and prevalence of this developmental pathway.

The present findings also call for a nuanced interpretation of the roles of executive functioning and socioeconomic context in creativity development. Although working memory did not predict trajectory membership, this result should not be taken as evidence that executive functions are unrelated to early creativity. Executive functioning is a multidimensional construct, and prior research suggests that components such as cognitive flexibility may be more strongly implicated in creative processes than working memory alone. Similarly, while school-level socioeconomic vulnerability did not predict trajectory membership within this sample, socioeconomic factors were associated with creativity at specific time points, and the sample did not include the most socioeconomically advantaged schools. Thus, structural factors may still shape creative development in more subtle or context-dependent ways. Future studies incorporating more diverse samples

and a broader set of executive function measures are needed to clarify these relationships.

It is important to interpret these findings in light of the specific form of creativity assessed in this study. Creativity was operationalized through a visual – narrative production task designed to capture children's ability to synthesize elements into novel and coherent representations. This measure aligns closely with theoretical accounts of *synthetic creativity* and mini-c creativity in early childhood, emphasizing meaning-making, imagination, and narrative integration rather than ideational fluency alone. Indeed, one contribution of this study was the development of a creativity task that flexibly integrates figural and verbal elements within a playful, meaningful narrative for children. This task is designed to be independent of fine motor development on the one hand, and not entirely dependent on language development on the other. Therefore, the trajectories identified here should be understood as reflecting developmental pathways of this particular dimension of creative thinking

Directions for future research

Future research would benefit from examining whether similar trajectory patterns emerge when creativity is assessed across multiple domains and modalities, including verbal, motor, and social forms of creative expression. It should incorporate multidimensional measures of creativity, examine executive functions longitudinally, and consider diverse forms of play beyond solitary pretend play (i.e. collaborative pretend play/play with peers). Also, future work should explore mediating environmental factors, such as classroom opportunities to play, or scaffolding of language development that could account for differential growth.

Expanding studies to include more populations from the Global South and other underrepresented cultures will also be critical for building a more inclusive understanding of creativity development. Overall, replication with broader sample will be fundamental to determine the robustness of these developmental pathways.

Conclusion

In sum, this longitudinal study highlights that synthetic creativity in early childhood follows heterogeneous developmental pathways rather than a uniform progression. Also, the findings underscore the potential role of pretend play and language development in predicting creative development. Moreover, associations between higher-growth trajectories and later advantages in divergent thinking, expressive and receptive language, and peer functioning point to the broad developmental relevance of early creativity. Taken together, this work contributes novel evidence on the dynamic nature of creativity in the preschool years and reinforces the value of educational practices that intentionally cultivate rich pretend play and language-supportive environments. Future research incorporating more diverse samples, multidimensional assessments of creativity, and broader measures of executive functioning will be essential to deepen our understanding of how creativity emerges and evolves in early childhood.

Acknowledgements

We thank all the schools, parents, and children who participated in this study. Also, the committed research assistants who worked on ensuring a rigorous and child-friendly data collection process.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The work was funded by the Agencia Nacional de Investigación y Desarrollo, ANID, through their FONDECYT (Fondo Nacional de Desarrollo Científico y Tecnológico) Regular programme, Nº1201606, and FONDECYT Exploración programme Nº 13220200.

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References

Acar, S., Tadık, H., Uysal, R., Myers, D., & Inetas, B. (2022). Socio-economic status and creativity: A meta-analysis. *Journal of Creative Behavior*, *57*(1), 138–172. https://doi.org/10.1002/jocb.568

Alves-Oliveira, P., Arriaga, P., Xavier, C., Hoffman, G., & Paiva, A. (2022). Creativity landscapes: Systematic review spanning 70 years of creativity interventions for children. *Journal of Creative Behavior*, *56*(1), 16–40. https://doi.org/10.1002/jocb.514

Amabile, T. M., & Gitomer, J. (1984). Children's artistic creativity: Effects of choice in task materials: Effects of choice in task materials. *Personality & Social Psychology Bulletin*, *10*(2), 209–215. https://doi.org/10.1177/0146167284102006

Bai, H., Mulder, H., Moerbeek, M., Leseman, P. P. M., & Kroesbergen, E. H. (2023). The development of divergent thinking in 4- to 6-year-old children. *Creativity Research Journal*, *36*(4), 656–674. https://doi.org/10.1080/10400419.2023.2182492

Bauer, R. H., & Gilpin, A. T. (2025). Creativity in early childhood: How do imagination and self-regulation predict creativity in a story-stem task? *Psychology of Aesthetics, Creativity, and the Arts*, *19*(6), 1402–1411. https://doi.org/10.1037/aca0000620

Beaty, R., Benedek, M., Silvia, P., & Schacter, D. (2016). Creative cognition and brain network dynamics. *Trends in Cognitive Sciences*, *20*(2), 87–95. https://doi.org/10.1016/j.tics.2015.10.004

Beghetto, R. A., & Kaufman, J. C. (2013). Fundamentals of creativity. *Educational Leadership*, *70*(5), 10–15.

Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: Differential susceptibility to environmental influences. *Psychological Bulletin*, *135*(6), 885–908. https://doi.org/10.1037/a0017376

Bijvoet van den Berg, S., & Hoicka, E. (2014). Individual differences and age-related changes in divergent thinking in toddlers and preschoolers. *Developmental Psychology*, *50*(6), 1629–1639. https://doi.org/10.1037/a0036131

Brunner, J. (2006). Play as a mode of constructing the real. In. En J. Bruner (Ed.), *Search of pedagogy volume II: The Selected Works of Jerome S. Bruner, 1979-2006* (pp. 57–64). Routledge.

Brussoni, M., Ishikawa, T., Brunelle, S., & Herrington, S. (2017). Landscapes for play: Effects of an intervention to promote nature-based risky play in early childhood centres. *Journal of Environmental Psychology*, *54*, 139–150. https://doi.org/10.1016/j.jenvp.2017.11.001

Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network: Anatomy, function, and relevance to disease. *Annals of the New York Academy of Sciences*, *1124*(1), 1–38. https://doi.org/10.1196/annals.1440.011

Cankaya, O., Rohatyn-Martin, N., Leach, J., Taylor, K., & Bulut, O. (2023). Preschool children's loose parts play and the relationship to cognitive development: A review of the literature. *Journal of Intelligence*, *11*(8), 151. https://doi.org/10.3390/jintelligence11080151

Christie, J. F. (1983). The effects of play tutoring on young children's cognitive performance. *Journal of Educational Research*, *76*(6), 326–330. https://doi.org/10.1080/00220671.1983.10885477

Dahlberg, A., Ghaderi, A., Sarkadi, A., & Salari, R. (2019). Sdq in the hands of fathers and preschool teachers-psychometric properties in a non-clinical sample of 3-5-year-olds. *Child Psychiatry & Human Development*, *50*(1), 132–141. https://doi.org/10.1007/s10578-018-0826-4

Dodd, H. F., & Lester, K. J. (2021). Adventurous play as a mechanism for reducing risk for childhood anxiety: A conceptual model. *Clinical Child & Family Psychology Review*, *24*(1), 164–181. https://doi.org/10.1007/s10567-020-00338-w

Evans, N., Schlesinger, M., Hopkins, E., Jaeger, G., Golinkoff, R., & Hirsh-Pasek, K. (2021). Are preschoolers creative? A review of the literature. In S. W. Russ, J. D. Hoffman, & J. C. Kaufman (Eds.), *The Cambridge handbook of lifespan development of creativity* (pp. 101–125). Cambridge University Press. https://doi.org/10.1017/9781108755726.008

Evans, N. S., Hopkins, E. J., Schlesinger, M. A., Golinkoff, R. M., & Hirsh-Pasek, K. (2018). *The development of creativity: A review and critique* [Unpublished master's thesis]. Temple University.

Fehr, K. K., & Russ, S. W. (2016). Pretend play and creativity in preschool-age children: Associations and brief intervention. *Psychology of Aesthetics, Creativity, and the Arts*, *10*(3), 296–308. https://doi.org/10.1037/aca0000054

Francis, G. A., & Gibson, J. L. (2023). A plausible role of imagination in pretend play, counterfactual reasoning, and executive functions. *British Journal of Psychology*, *114*(3), 749–779. https://doi.org/10.1111/bjop.12650

Ghanamah, R. (2025). From play to creativity: The mediating role of self-regulation in kindergarteners. *Early Childhood Education Journal*. *54*(2), 741–756. Advance online publication. https://doi.org/10.1007/s10643-025-01867-1

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *38*(5), 581–586. https://doi.org/10.1111/j.1469-7610.1997.tb01545.x

Grau, V., Lorca, A., Preiss, D., Strasser, K., Jadue, D., Lopez, V., & Whitebread, D. (2018). *Role of play in early childhood education: Beliefs and practices of preschool educators*. Center for Studies MINEDUC.

Gray, P. (2011). The decline of play and the rise of psychopathology in children and adolescents. *American Journal of Play*, *3*(4), 443–463.

Guilford, J. P. (1967). *The nature of human intelligence*. McGraw-Hill.

Holmes, R. M., Kohm, K., Genise, S., Koolidge, L., Mendelson, D., Romeo, L., & Bant, C. (2022). Is there a connection between children's language skills, creativity, and play?. *Early Child Development & Care*, *192*(8), 1178–1189. https://doi.org/10.1080/03004430.2020.1853115

Jaarsveld, S., & van Leeuwen, C. (2005). Sketches from a design process: Creative cognition inferred from intermediate products. *Cognitive Science*, *29*, 79–101. https://doi.org/10.1207/s15516709cog2901_4

Jankowska, D. M., & Karwowski, M. (2025). The trajectories of creativity development in childhood. *Learning and Individual Differences*, *119*, 102644. https://doi.org/10.1016/j.lindif.2025.102644

Kaufman, J. C., & Beghetto, R. A. (2009). Más allá de lo grande y lo pequeño: El modelo de las cuatro C de la creatividad. *Revista de Psicología General*, *13*(1), 1–12. https://doi.org/10.1037/a0013688

Kaugars, A., & Russ, S. W. (2009). Assessing preschool children's play: Preliminary validation of the affect in play scale-preschool version. *Early Education and Development*, *20*(5), 733–755. https://doi.org/10.1080/10409280802545388

Kupczyszyn, K. H., Arán Filippetti, V., & Oros, L. B. (2024). Socioeconomic status effects on children's creativity: The mediating role of executive functions. *Thinking Skills and Creativity*, *51*, 1–15. https://doi.org/10.1016/j.tsc.2023.101437

Laursen, B., & Hoff, E. (2006). Person-centred and variable-centred approaches to longitudinal data. *Merrill-Palmer Quarterly*, *52*(3), 377–389. https://doi.org/10.1353/mpq.2006.0029

Leong, D. J., & Bodrova, E. (2012). Assessing and scaffolding make-believe play. *Young Child*, *67*(1), 28–34.

Lerner, R. M. (2006). Developmental science, developmental systems, and contemporary theories of human development. In R. M. Lerner (Ed.), *Theoretical models of human development. The handbook of child psychology* (6th ed., Vol. 1, pp. 1–17). Editors in-chief: W. Damon & R.M. Lerner. Wiley.

Lillard, A. S., Lerner, M. D., Hopkins, E. J., Dore, R. A., Smith, E. D., & Palmquist, C. M. (2013). The impact of pretend play on children's development: A review of the evidence. *Psychological Bulletin*, *139*(1), 1–34. https://doi.org/10.1037/a0029321

Lloyd, B., & Howe, N. (2003). Solitary play and convergent and divergent thinking skills in preschool children. *Early Childhood Research Quarterly*, *18*(1), 22–41. https://doi.org/10.1016/S0885-2006(03)00004-8

Magnusson, D. (2003). The person approach: Concepts, measurement models, and research strategy. *New Directions for Child and Adolescent Development*, *101*(101), 3–23. https://doi.org/10.1002/cd.79

Mottweiler, C. M., & Taylor, M. (2014). Elaborated role play and creativity in preschool age children. *Psychology of Aesthetics, Creativity, and the Arts*, *8*(3), 277–286. https://doi.org/10.1037/a0036083

Nagin, D. (2005). *Group-based modelling of development*. Harvard University Press.

Olabarrieta-Landa, L., Rivera, D., Ibáñez-Alfonso, J. A., Albaladejo-Blázquez, N., Martín-Lobo, P., Delgado-Mejía, I. D., Lara, L., Rabago Barajas, B. V., Rodriguez Salgado, A. M., Paredes Quispe, L. A., Romero-García, I., Velázquez-Cardoso, J., García de la Cadena, C., Fernandez-Agis, I., Padilla-López, A., Hernández Agurcia, G. P., Marín-Morales, A., Corral San José, A., & Arango-Lasprilla, J. C. (2017). Peabody picture vocabulary test-iii: Normative data for Spanish-speaking pediatric population. *NeuroRehabilitation*, *41*(3), 687–694. https://doi.org/10.3233/NRE-172239

Pardo, M., Opazo, M. J., & Rupín, P. (2021). Escolarización de la educación parvularia en (country anonymised for peer review): Consensos entre actores del campo sobre su definición, causas y proposiciones. *Calidad En La Educación*, *54*(54), 143–172. https://doi.org/10.31619/caledu.n54.953

Paris, A. H., & Paris, S. G. (2003). Assessing narrative comprehension in young children. *Reading Research Quarterly*, *38*(1), 36–76. https://doi.org/10.1598/RRQ.38.1.3

Pasarín-Lavín, T., Abín, A., García, T., & Rodríguez, C. (2023). Relationship between executive functions and creativity in children and adolescents: A systematic review. *Children*, *10*(6). https://doi.org/10.3390/children10061002

Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, *39*(2), 83–96. https://doi.org/10.1207/s15326985ep3902_1

Preiss, D. D. (2022). Metacognition, mind wandering, and cognitive flexibility: Understanding creativity. *Journal of Intelligence*, *10*(3), 69. https://doi.org/10.3390/jintelligence10030069

Raichle, M. E., MacLeod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode of brain function. *Proceedings of the National Academy of Sciences*, *98*(2), 676–682. https://doi.org/10.1073/pnas.98.2.676

Raichle, M. E., & Snyder, A. Z. (2007). A default mode of brain function: A brief history of an evolving idea. *NeuroImage*, *37*(4), 1083–1090. https://doi.org/10.1016/j.neuroimage.2007.02.041

Rodríguez-Hernández, P. J., et al. (2012). Psychometric properties of the parent and teacher versions of the strengths and difficulties questionnaire (SDQ) in a Spanish sample. *International Journal of Clinical and Health Psychology*, *12*(2), 265–279.

Rosas, R., Espinoza, V., Martínez, C., & Santa Cruz, C. (2022). Playful testing of executive functions with yellow-red: Tablet-based battery for children between 6 and 11. *Journal of Intelligence*, *10*(4), 125. https://doi.org/10.3390/jintelligence10040125

Runco, M. A., Illies, J. J., & Eisenman, R. (2005). Creativity, originality, and appropriateness: What do explicit instructions tell us about their relationships? *Journal of Creative Behavior*, *39*(2), 137–148. https://doi.org/10.1002/j.2162-6057.2005.tb01255.x

Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal*, *24*(1), 92–96. https://doi.org/10.1080/10400419.2012.650092

Rupin, P., Muñoz, C., & Jadue-Roa, D. (2023). "So, we can't play": Limitations to play at school in periods of educational transition in Chile. *Education Sciences*, *13*(3), 1–24. https://doi.org/10.3390/educsci1303031

Russ, S. W. (2014). *Pretend play in childhood: Foundation of adult creativity*. American Psychological Association. https://doi.org/10.1037/14282-000

Russ, S. W. (2020). Mind wandering, fantasy, and pretend play: A natural combination. In D. D. Preiss, D. Cosmelli, & J. C. Kaufman (Eds.), *Creativity and the wandering mind: Spontaneous and controlled cognition* (pp. 231–248). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-816400-6.00010-9

Said-Metwaly, S., Fernandez-Castilla, B., Kyndt, E., Van den Noortgate, W., & Barbot, B. (2020). Does the fourth-grade slump in creativity actually exist? A meta-analysis of the development of divergent thinking in school-age children and adolescents. *Educational Psychology Review*, *33*(1), 275–298. https://doi.org/10.1007/s10648-020-09547-9

Smallwood, J. (2013). Distinguishing how from why the mind wanders: A processe occurrence framework for self-generated mental activity. *Psychological Bulletin*, *139*(3), 519–535. https://doi.org/10.1037/a0030010

Spencer, R. A., Joshi, N., Branje, K., McIsaac, J.-L. D., Cawley, J., Rehman, L., Kirk, S. F. L., & Stone, M. (2019). Educator perceptions on the benefits and challenges of loose parts play in the outdoor environments of childcare centres. *AIMS Public Health*, *6*(4), 461–476. https://doi.org/10.3934/publichealth.2019.4.461

Strasser, K., Balladares, J., Grau, V., Marín, A., Preiss, D., & Jadue, D. (2024). Playfulness and the quality of classroom interactions in preschool. *Learning & Instruction*, *93*(1). https://doi.org/10.1016/j.learninstruc.2024.101941

Urban, K. K. (1991). On the development of creativity in children. *Creativity Research Journal*, *4*(2), 177–191. https://doi.org/10.1080/10400419109534384

Urban, K. K. (2004). Assessing creativity: The test for creative thinking - drawing production (TCT-DP). The concept,

application, evaluation, and international studies. *Psychology Science*, *46*(3), 387–397.

Urban, K. K., & Jellen, H. G. (1996). *Test for creative thinking-drawing production (TCTDP)*. Swets and Zeitlinger.

Vygotsky, L. S. (1967). Play and its role in the mental development of the child. *Soviet Psychology*, *5*(3), 6–18. https://doi.org/10.2753/RPO1061-040505036

Vygotsky, L. S. (2004). Imagination and creativity in childhood. *Journal of Russian and East European Psychology*, *42*(1), 7–97. https://doi.org/10.1080/10610405.2004.11059210 (Original work published 1967)

Vygotsky, L. S. (2015). Play and its role in the mental development of the child. *Voprosy Psikhologii [Problems of Psychology]*, *12*(6), 62–76. (Original work published 1966).

Wallach, M. A., & Kogan, N. (1965). *Modes of thinking in young children*. Holt, Rinehart, & Winston.

White, R. E., Thibodeau-Nielsen, R. B., Palermo, F., & Mikulski, A. M. (2021). Engagement in social pretend play predicts preschoolers' executive function gains across the school year. *Early Childhood Research Quarterly*, *56*(1), 103–113. https://doi.org/10.1016/j.ecresq.2021.03.005

Whitebread, D., & O'Sullivan, L. (2020). Pretend play in young children and the emergence of creativity. In D. Preiss, D. Cosmelli, & J. C. Kaufman (Eds.), *Creativity and the wandering mind* (pp. 205–230). Academic Press.

Zhao, Y. V., & Gibson, J. L. (2023). Evidence for protective effects of peer play in the early years: Better peer play ability at age 3 years predicts lower risks of externalising and internalising problems at age 7 years in a longitudinal cohort analysis. *Child Psychiatry & Human Development*, *54*(1), 1807–1822.