**Abstract**

This study examined the bidirectional relationship between children’s playfulness and creative potential and how these factors were longitudinally related to overexcitabilities. The participants were parents and teachers of 139 Hong Kong kindergarten children (52.1% boys, mean age = 4.4 years, age range = 3.4 to 5.9 years). At Time 1, the parents reported their children’s overexcitabilities (imaginational, psychomotor, sensual, intellectual, and emotional), and the teachers rated children’s playfulness (physical spontaneity, social spontaneity, cognitive spontaneity, manifest joy, and sense of humor) and creative potential (creative personality traits). Six months later, at Time 2, the teachers’ ratings of playfulness and creative potential were obtained. The results from the cross-lagged model revealed that the path from playfulness at Time 1 to creative potential at Time 2 and the path from creative potential at Time 1 to playfulness at Time 2 were both significant when the children’s age, gender, and their parent’s education were controlled. The indirect relationship between intellectual overexcitability at Time 1 and creative potential at Time 2, mediating through playfulness at Time 1, was also significant. These findings suggest that children who are overexcitable about manipulating concepts and ideas tend to be more playful and exhibit higher creative potential. At the same time, their creative potential may drive them to act playfully and engage in future kindergarten play. Practically, the results highlight the utility of promoting children’s playfulness and creative potential through increased participation in kindergarten group play activities such as sociodramatic play.

**Keywords:** overexcitabilities, playfulness, creative potential, kindergarten children, bidirectionality

Overexcitabilities and Bidirectional Development in Playfulness and Creative Potential among Kindergarten Children

**Introduction**

Overexcitabilities represent people’s inherited levels of responsiveness when exposed to different categories of external or internal stimulation (Dabrowski, 1964; He et al., 2017). A growing body of evidence has revealed the interrelationships among kindergarten children’s overexcitabilities, playfulness, and creative potential (e.g., Fung & Chung, 2021, 2022a; Fung et al., 2021). Conceptually, overexcitabilities may directly foster children’s creative potential by amplifying their perceptual processes (He et al., 2017). Given that playfulness is a potential contributor to creative potential (e.g., Bateson & Nettle, 2014; Luria et al., 2018; Trevlas et al., 2003), overexcitabilities may also promote children’s creative potential indirectly by prompting them to display certain styles of play (Fung & Chung, 2021; Fung et al., 2021). Nonetheless, previous studies were cross-sectional and, therefore, unable to inform the direction of relationships. Apart from a unidirectional relationship, a separate line of research has proposed that children's and adults' creative potential may positively predict their future playfulness (e.g., Bateson, 2015; Bundy et al., 2008; Keisari et al., 2020). Together, the extant literature suggests a potential bidirectional relationship between playfulness and creative potential, but no prior study has examined their co-development. The present study filled these gaps by investigating the reciprocal relationship between playfulness and creative potential. It also examined how overexcitabilities are longitudinally related to these two outcomes in a sample of Hong Kong Chinese kindergarten children.

**Overexcitabilities and Creative Potential**

Creativity is regarded as one’s competency in generating original and useful ideas across different domains (Amabile, 1996). Nevertheless, the aspect of usefulness may be less emphasized in examining creativity in early childhood since children are more likely to reintegrate existing knowledge and resources for fun and enjoyment without considering functionality (Fung & Chung, 2022; Runco & Jaeger, 2012). Children tend to express their novel and appropriate creative ideations in everyday situations (e.g., play, arts; Richards, 2007, 2019), and they can demonstrate varying potentials for creative expression (i.e., creative potential; Runco, 2014).

Rhodes (1961) conceptualized that creativity could be defined in four “strands” (p. 307): *press* (i.e., perception of and relationship with the environment), *person* (i.e., personality traits, temperament), *process* (i.e., stages of thinking processes), and *product* (i.e., the embodiment of ideas into tangible outcomes). In previous research, different approaches have been used to access children’s creative potential. For example, Hui et al. (2015) assessed kindergarten children’s creative potential using a drawing production task, which corresponded to the *product* strand of creativity. Lloyd and Howe (2003) evaluated children’s divergent and convergent thinking skills to indicate their creative potential, drawing on the *process* strand of creativity. The present study focused on the *person* strand and operationalized children’s creative potential as their creative personality traits. This approach has been adopted in creativity research on children from Hong Kong (e.g., Fung & Chung, 2022a; Fung et al., 2021), India, and the United States (e.g., Runco et al., 1993; Runco & Johnson, 2002). Evidence has consistently revealed positive relationships between children’s creative personality traits and their divergent thinking skills, such as fluency and originality (e.g., Butcher & Niec, 2005; Runco, 1984).

Creative potential is vital for children to grow and thrive in the 21st century (Van Laar et al., 2022), and research has investigated the antecedents of its development. For example, overexcitabilities are considered a class of inborn predictors of children’s creative potential (Fung et al., 2021; He et al., 2017). Dabrowski (1964) defined overexcitabilities as one’s inborn disposition to be aroused at exceptional levels by stimuli in five different domains: imaginational (vivid fantasies and widespread associations), psychomotor (active, energetic, and agitation), sensual (exceptional sensory and artistic perception), intellectual (curious inquisition and mental manipulation of ideas), and emotional (extraordinary emotional experience). Overexcitabilities augment one’s physiological experiences as a result of exceptional neural sensitivity (Mendaglio & Tillier, 2006). Any aligning stimuli can induce intense internal arousal and exaggerated emotional/behavioral responses, leading to augmented physiological experiences (De Bondt et al., 2021; Piechowski & Cunningham, 1985).

Overexcitabilities also filter one’s sensory inputs (Chang & Kuo, 2013) and may lead to enhanced information processing (Daniels & Piechowski, 2009). Specifically, overexcitable children take in more information based on the domain of their overexcitability (He et al., 2017). For example, imaginational overexcitable children might perceive and process more fantasy-related information when they are watching a magical cartoon. Therefore, overexcitabilities may give children vigorous and unconventional experiences and ideas (Fung et al., 2021). These incomparable physiological experiences and advanced information processing may explain how overexcitabilities enhance children’s creative potential (He et al., 2017). Indeed, Rhodes (1961) argued that creative production depends on children’s individual characteristics governing how they sense and perceive internal and external stimuli.

Among the five domains, Dabrowski (1972) highlighted that imaginational, intellectual, and emotional overexcitabilities are particularly important for determining children’s creative potential. Recent research has revealed consistent findings (e.g., Fung & Chung, 2021; He et al., 2017). For instance, Fung and Chung (2021) demonstrated that kindergarten children’s imaginational and intellectual overexcitabilities are predictive of their flexible use of play materials and originality in play. Likewise, He et al. (2017) reported that imaginational, intellectual, and emotional overexcitabilities are stronger predictors of children’s and adolescents’ creative drawing production than their sensual and psychomotor overexcitabilities.

Although there is theoretical and empirical support for the interlinks between overexcitabilities and creative potential (i.e., Dabrowski, 1972; Fung & Chung, 2021; He et al., 2017), alternative research has proposed that the personality trait of openness should be used in studying giftedness and creativity development (e.g., Vuyk, Kerr, & Krieshok, 2016; Vuyk, Krieshok, Kerr, 2016 ). Openness indicates the degree to which one embraces new experiences (e.g., fantastic, aesthetic, intellectual) (Vuyk, Kerr, & Krieshok, 2016). Specifically, Vuyk and colleagues (2016) argued that overexcitabilities and openness are overlapping concepts, although the latter is a more robust and generalizable way of describing individual characteristics and has better empirical support. Nevertheless, De Bondt et al. (2021) reported that overexcitabilities are weakly to moderately associated with openness and concluded that these two constructs are not conceptually equivalent or interchangeable. Grant (2021) also indicated that Vuyk, Krieshok, and Kerr’s (2016) findings did not support the argument that overexcitabilities can be wholly represented by openness. Although there is continuing debate on conceptual similarity (Grant, 2021; Vuyk & Kerr, 2021), openness is not closely linked with temperament, is difficult to assess in early childhood, and may be developmentally irrelevant until middle childhood or early adolescence (Donnellan & Robins, 2009). A further study could examine the temporal relationships between overexcitabilities and openness to disentangle their conceptual links and the way in which these constructs predict creativity development. In this study, we focused on kindergarten children’s creative potential and considered overexcitabilities as the antecedents.

**Overexcitabilities, Playfulness, and Creative Potential**

Although overexcitabilities may impact children’s creative potential, the predictive relationships between overexcitabilities and creative potential are not necessarily positive (Chang & Kuo, 2013). According to the Theory of Positive Disintegration (Dabrowski, 1964), overexcitabilities, regardless of the specific domain, can be linked with emotional vulnerability since exceptional physiological experiences often induce a great intensity of feeling (i.e., emotional tensions). If these emotional tensions are not relieved appropriately, they may reach an unbearable level, cause inner turmoil, and bring adverse psychological or behavioral consequences (Piechowski & Cunningham, 1985). For example, an extreme level of emotional tension might cause inner conflict and the misuse of self-torment or self-injury to relieve unbearable stress, as revealed in case studies of gifted creators, such as Michelangelo and Tolstoy (Piechowski, 1999). Therefore, the intense emotional tensions accompanying the augmented perceptual experiences among overexcitable children require a proper release channel (Piechowski & Cunningham, 1985) such that overexcitabilities can positively influence creativity development.

Play offers children a safe, age-appropriate, and socially acceptable environment (Ayling et al., 2019) in which to satisfy their unrealizable desires (Vygotsky, 1967) without having to consider practical needs or consequences. Overexcitable children can release their emotional arousal and impulse through play activities after exposure to contextual or internal stimulation. For instance, after reading a fantasy story describing how a giant senselessly destroyed the forest and animals, an imaginational overexcitable child may find the scene especially fascinating. The intense physiological arousal and vivid mental images relevant to the scene of destruction may lead to emotional tensions and urge the child to perform aggressive acts. To release these emotional tensions and impulses, the child can set up a pretend play situation by putting various objects on the floor and walking through them like a giant. This type of pretend play, involving object substitution (i.e., toys as trees and animals) and symbolic behaviors (i.e., giant steps and attacks), encourages alternative uses of play materials and creative ideations and is beneficial to children’s creative potential (Russ, 2003; Russ & Wallace, 2013). Therefore, the positive link between kindergarten children’s overexcitabilities and creative potential may be mediated through their likelihood of engaging in playful circumstances. Playfulness indicates one’s propensity to create and participate in playful situations (Pinchover, 2017), and this construct governs children’s play patterns in multiple contexts (Barnett, 1991; Lieberman, 1977). Five indicators can reflect children’s playfulness; include physical spontaneity (activity level and motor control), social spontaneity (initiate, gain access to, and coordinate peer play), cognitive spontaneity (proneness to fantasy, imagination, and original ideas), manifest joy (expressing positive emotions and passion), and sense of humor (teasing and joke-telling) (Barnett, 2018). To examine children’s playfulness further, empirical evidence has shown positive relationships between kindergarten children’s overexcitabilities (imaginational, intellectual, and psychomotor) and playfulness (social, cognitive, and physical spontaneity) as perceived by their parents (Fung & Chung, 2021).

As playful children are likelier to explore and link up different concepts and materials (Chávez-Eakle et al., 2012), playfulness is predictive of creative potential (e.g., Bateson & Nettle, 2014; Luria et al., 2018; Trevlas et al., 2003). Specifically, cognitive spontaneity indicates children’s tendency to assume different characters and integrate unusual objects or ideas into play. In contrast, social spontaneity reflects their likelihood to lead, engage, and cooperate with peers in play (Barnett, 1991). Social spontaneity enables children to propose, negotiate, and incorporate imaginative ideas into group play constructively (Fung & Chung, 2022a). These two aspects of playfulness are particularly important in shaping children’s participation in kindergarten group pretend play (Fung & Chung, 2022a), which may, in turn, promote their creative potential (Russ, 2003; Russ & Wallace, 2013). Recent research examining the relationships among children’s overexcitabilities, playfulness, and creative potential has highlighted social and cognitive spontaneity as the potential mediators (e.g., Fung & Chung, 2022a; Fung et al., 2021). For example, children’s imaginational overexcitability was shown to be indirectly related to their creative potential via cognitive spontaneity in the home setting (Fung et al., 2021). Relatedly, the indirect relationship between children’s parent-reported intellectual overexcitability and teacher-reported creative potential was shown to be mediated through teachers’ ratings of children’s social and cognitive spontaneity (Fung & Chung, 2022a). These cross-sectional studies demonstrated the possible mediating role of playfulness in the relationship between overexcitabilities and creative potential. Nonetheless, a further investigation using a longitudinal design is warranted to better examine their directional relationships.

**Bidirectional Development in Playfulness and Creative Potential**

Theories (e.g., Bateson & Nettle, 2014; Luria et al., 2018) and empirical evidence (e.g., Fung & Chung, 2022a; Fung et al., 2021) support the predictive role of playfulness in creative potential. However, anecdotes (Bateson, 2015) and alternative findings (Bundy et al., 2008; Keisari et al., 2020) have suggested that creative people could show higher playfulness levels than others. Bateson (2015) recounted that many creative composers, artists, or scientists (e.g., Wolfgang Mozart, Pablo Picasso, Richard Feynman) were well known for their playfulness in their respective areas of expertise. This proposed suggestion is partly because they treated work as a game, enabling them to play with different possibilities during which new ideas emerged effortlessly. Keisari and colleagues (2020) reported that adults who participated in a creative group intervention of dramatic playback theatre experienced particular evolution in their playfulness. Similarly, Bundy and colleagues (2008) reported that creative children showed higher levels of leadership and engagement in playful activities than their peers. The narratives and evidence (Bateson, 2015; Bundy et al., 2008; Keisari et al., 2020) support the argument that children’s playfulness and creative potential may co-develop over time instead of having a unidirectional relationship.

On the one hand, playful children tend more to engage in kindergarten group pretense to exercise their social and cognitive spontaneity and develop their creative potential (Fung & Chung, 2022a; Russ & Wallace, 2013). On the other hand, creative children may see kindergarten group play as a prominent situation to actualize or test their novel ideas, leading to higher levels of playfulness. This suggestion is analogous to how creative composers and scientists perceive their daily work as a playing field to explore possibilities, extend boundaries, and have fun (Batson, 2015), resulting in higher engagement in composition or experimentation. Successful engagement in group play activities is one of the primary social goals for kindergarten children (Beaty, 2014); creativity and playfulness may be the factors supporting their participation in and, at the same time, benefiting from the group play processes. Despite the sound theoretical and empirical basis (e.g., Bateson, 2015; Bateson & Nettle; Bundy et al., 2008; Fung & Chung, 2022a), research examining the bidirectional relationship between playfulness and creative potential among kindergarten children is sparse. The present study aimed to fill this gap by investigating their reciprocal relationship using a cross-lagged panel model.

**The Present Study**

This study investigated the longitudinal relationships between parent-reported overexcitabilities and teacher-reported playfulness and creative potential among kindergarten children. It also examined the reciprocal association between children’s playfulness and creative potential across Time 1 (in the middle of the school year) and Time 2 (six months later, at the end of the school year). Based on the literature review and studies (e.g., Bateson, 2015; Bateson & Nettle; Bundy et al., 2008; Fung & Chung, 2022a; Fung et al., 2021; Luria et al., 2018), it was hypothesized that children’s imaginational and intellectual overexcitabilities at Time 1 would be indirectly related to their creative potential at Time 2 via their social and cognitive spontaneity (i.e., playfulness) at Time 1. It was also expected that teacher-reported playfulness and creative potential would predict each other across Times 1 and 2.

**Method**

**Participants**

Theparticipants were the parents and teachers of 139 Hong Kong kindergarten children (52.1% boys, mean age = 4.4 years, age range = 3.4 to 5.9 years). All of the participants were recruited from a local kindergarten situated in a middle-socioeconomic district. In Hong Kong, most children aged 3.5 years attend three years from kindergarten 1 (K1) to kindergarten 3 (K3). At Time 1, 55 children were studying at K1, 44 were at K2, and 40 were at K3 across 14 classrooms. Kindergarten has been encouraged to promote different types of play-based learning, mainly free play activities, since 2017 (Curriculum Development Council of HKSARG, 2017). Twenty-two teachers participated in this study; each rated seven children in their class on average. More than 90% of the teachers held a bachelor’s degree in early childhood education, and they had been teaching for at least a year. Thus, the participating teachers had adequate knowledge and experience in observing children’s play patterns and personal characteristics. The parents reported demographic information including their children’s age, and gender, and their own education level: (1) primary, (2) secondary, (3) college, (4) university, and (5) postgraduate. Forty-four percent of the parents had a university or postgraduate degree, 26% finished college, and 30% finished secondary school. Seventy percent of the mothers were equally or better educated than their spouses, and mothers completed 90% of the questionnaires.

**Procedure**

Ethical approval was granted by the university (blinded for review). The principal of the kindergarten also consented to participate. Informed consent and questionnaire forms were distributed to the parents and teachers as an invitation. At Time 1, the parents reported demographic information and rated children’s overexcitabilities by completing a questionnaire that took approximately 20 minutes. Based on children’s daily behaviors in the kindergarten context, the class teachers reported children’s playfulness and creative potential at both Time 1 and Time 2 (six months apart) through a questionnaire, which took 10 minutes to complete.

**Measures**

***Parent-reported Overexcitabilities at Time 1***

Overexcitabilities were measured by the Chinese version of Overexcitability Questionnaire–Two (OEQII; Falk et al., 1999). The OEQII has been employed in research locally and internationally (Chang & Kuo, 2013; Fung & Chung, 2021). Previous results also revealed the reliability of its test scores (Cronbach’s alphas > .80; De Bondt et al., 2021) and the validity of test score interpretations (factorial validity; De Bondt & Van Petegem, 2015). This instrument consists of five subscales, and each of them has 10 items: imaginational (e.g., “When the child gets bored, s/he begins to daydream”), psychomotor (e.g., “The longer that the child has to sit still, the more restless s/he gets”), sensual (e.g., “My child enjoys the sensations of colors, shapes, and designs”), intellectual (e.g., “My child loves to solve problems and develop new concepts”), and emotional (e.g., “My child's strong emotions move him or her to tears”). The parents rated the items on a 5-point scale ranging from 1 (*not like*) to 5 (*exactly like*). The mean scores of the subscales corresponded with children’s imaginational, psychomotor, sensual, intellectual, and emotional overexcitabilities. In this study, the Cronbach’s alphas of the test scores under the imaginational, psychomotor, sensual, intellectual, and emotional subscales were .84, .81, .74, .84, and .71, respectively.

***Teacher-reported Playfulness at Times 1 and 2***

Playfulness was measured with the Children’s Playfulness Scale (CPS; Barnett, 1991), an instrument that has been widely employed in research on kindergarten children (e.g., Fung & Chung, 2022a, 2022b; Trevlas et al., 2003). Previous results have demonstrated the good reliability of its test scores (internal consistency > .80) and the validity of its test score interpretations (factorial validity; Barnett, 2018). The CPS has 23 items categorized into five subscales: physical spontaneity (e.g., “The child prefers to be active rather than quiet in play”), cognitive spontaneity (e.g., “The child assumes different character roles in play”), social spontaneity (e.g., “The child plays cooperatively with other children”), manifest joy (e.g., “The child sings and talks while playing”), and sense of humor (e.g., “The child gently teases others while at play”). The teachers rated individual items on a 5-point scale ranging from 1 (*not like*) to 5 (*exactly like*). The mean scores of the subscales represented children’s playfulness in the kindergarten context correspondingly. At Time 1, the Cronbach’s alphas of the test scores under the physical spontaneity, social spontaneity, cognitive spontaneity, manifest joy, and sense of humor subscales were .84, .84, .75, .90, and .82, respectively. By comparison, those at Time 2 were .82, .86, .81, .87, and .87, respectively.

***Teacher-reported Creative Potential at Times 1 and 2***

Children’s creative potential was measured with the Common Creative Attribute (Chan & Chan, 1999). This measure was employed in a recent local study, and the test scores showed good reliability (Cronbach’s alpha > .90; Fung & Chung, 2022a). This instrument includes 11 characteristics that the teachers attributed to students when considering their creativity (e.g., nonconforming, curious, and original), and the test scores were locally validated (Chan & Chan, 1999). The teachers rated each item on a 7-point scale ranging from 1 (*rarely*) to 7 (*extremely*). The mean score represented children’s creative potential in the kindergarten context. In this study, the Cronbach’s alphas of the test scores at Times 1 and 2 were both .92.

**Data Analysis Plan**

Correlation and hierarchical regression analyses were conducted to examine the specific aspects of overexcitability and playfulness significantly related to the creative potential at Times 1 and 2. The identified correlates were then subjected to a cross-lagged path model to examine their indirect relationships with creative potential and how playfulness and creative potential would bidirectionally develop over time. The cross-lagged model was estimated using the lavaan package in R (version 4.2.0; R Core Team, 2023). Intraclass correlations (ICCs) were reviewed to estimate the potential influences of the nested structure on playfulness and creative potential (i.e., teachers’ ratings of children in the same class), with ICCs ranging from .04 (social spontaneity at Time 2) to .29 (creative potential at Time 1). To account for the clustered sampling structure, the lavaan.survey package (Oberski, 2014) was used to adjust the parameter estimates, standard errors, and chi-square-derived fit indices. This statistical method has been employed in prior studies (e.g., Jackson & Cunningham, 2017; Stühmann et al., 2020). Model fit was evaluated by referring to Hu and Bentler’s suggestions (1999): nonsignificant Chi-square index (*χ2*), comparative fit index (CFI) over .95, root mean square error of approximation (RMSEA) below .06, and standardized root mean square residual (SRMR) below .08.

**Results**

**Preliminary Analyses**

Table 1 shows the descriptive statistics, Cronbach’s alphas, and bivariate correlations of the study variables at Times 1 and 2. There were no missing values in the data. The normality of the variables, as reflected by their skewness and kurtosis, was acceptable. At Time 1, teacher-reported playfulness was positively related to psychomotor and intellectual overexcitabilities as reported by parents (*r* = .20 to .39, *p* < .01), and a similar pattern of relationships was obtained at Time 2 (*r* = .18 to .25, *p* < .05). Teacher-reported creative potential at both Time 1 (*r* = .18 to .22, *p* < .05) and Time 2 (*r* = .20 to .26, *p* < .05) was positively correlated with psychomotor and intellectual overexcitabilities. Furthermore, children’s creative potential was positively associated with all five aspects of playfulness at both Time 1 (*r* = .48 to .72, *p* < .001) and Time 2 (*r* = .59 to .73, *p* < .001). Hierarchical regression analyses were conducted to identify the aspects of playfulness that specifically predicted creative potential with children’s overexcitabilities and demographic variables (i.e., child age, gender, and parental education) statistically controlled (He, 2018; He et al., 2017).

**Hierarchical Regression Models Predicting Creative Potential**

Table 2 shows the results of hierarchical regression analyses, which examined how children’s overexcitabilities and playfulness jointly predicted their creative potential at Time 1 (model 1) and Time 2 (model 2). In both models, demographic variables were entered in step 1, children’s overexcitabilities were entered in step 2, and various aspects of playfulness were included in step 3. Standardized regression coefficients of the predictors in the final model with all three steps considered are displayed in Table 2. In regression Model 1, child age and gender significantly predicted 8% of the variance in creative potential at Time 1. In step 2, overexcitabilities collectively explained an additional 8% of the variance of creative potential, but none of them turned out to be a significant predictor in the final model. In step 3, playfulness further explained 45% of the variance of creative potential, while social (*β* = .28, *SE* = .14, *p* < .01) and cognitive spontaneity (*β* = .49, *SE* = .14, *p* < .001) were the significant predictors.

In regression Model 2, child age and gender significantly predicted 7% of the variance in creative potential at Time 2. Overexcitabilities jointly explained an extra 9% of the variance in step 2, but they were not a significant predictor in the final model. Playfulness collectively explained 47% of the variance of creative potential in step 3. Cognitive spontaneity at Time 2 emerged as a significant predictor (*β* = .42, *SE* = .13, *p* < .001), whereas social spontaneity was only a marginally significant predictor ((*β* = .23, *SE* = .15, *p* = .06). Considering the positive correlations of psychomotor and intellectual overexcitabilities with playfulness and creative potential at both Times 1 and 2 (Table 1), these two aspects of overexcitability were regarded as the antecedents in the cross-lagged model. The results from the hierarchical regression analyses also revealed social and cognitive spontaneity as the two specific aspects of playfulness that predicted creative potential (Table 2). Therefore, the average of children’s social and cognitive spontaneity was used to represent their playfulness in the cross-lagged model to examine its co-development with creative potential over time.

**Cross-lagged Model Predicting Playfulness and Creative Potential**

Figure 1 shows the parameter estimates and model fit statistics for the cross-lagged model of teacher-reported playfulness (social spontaneity and cognitive spontaneity) and creative potential across Times 1 and 2, with parent-reported psychomotor and intellectual overexcitabilities at Time 1 as antecedents. The cross-lagged model reveals an adequate fit to the data *χ2* (*df* = 21, *N* = 139) = 31.19, *p* = .07, CFI = .96, RMSEA = .06 (90% CI: .00, .10), SRMR = .07, *R2 Time 2 Teacher-reported Creative Potential* = .52, *R2 Time 2 Teacher-reported Playfulness* = .51.

Children’s parent-reported psychomotor and intellectual overexcitabilities at Time 1 were positively associated (*r* = .42, *p* < .001). Their teacher-reported playfulness and creative potential were positively related at both Time 1 (*r* = .73, *p* < .001) and Time 2 (*r* = .55, *p* < .001). For the concurrent associations of overexcitabilities with playfulness and creative potential at Time 1, only the path between parent-reported intellectual overexcitability and teacher-reported playfulness was significant (*β* = .26, *SE* = .15, *p* < .05), whereas the others were nonsignificant. The autoregressive paths of teacher-reported playfulness (*β* = .42, *SE* = .12, *p* < .001) and creative potential (*β* = .50, *SE* = .11, *p* < .001) across Times 1 and 2 were both significant. The cross-lagged path from playfulness at Time 1 to creative potential at Time 2 was significant (*β* = .24, *SE* = .12, *p* < .05). The cross-lagged path from creative potential at Time 1 to playfulness at Time 2 was also significant (*β* = .33, *SE* = .09, *p* < .01). The indirect relationship between intellectual overexcitability at Time 1 and creative potential at Time 2 mediated through playfulness at Time 1 was positive and significant (indirect effect: *β* = .06, *SE* = .05, *p* < .05, 90% CI: .01, .21).

**Discussion**

This study examined the bidirectionality of kindergarten children’s playfulness and creative potential with their overexcitabilities as antecedents. The results reveal the reciprocal relationship between playfulness and creative potential across time. Moreover, the findings highlight the indirect relationship among intellectual overexcitability, playfulness, and creative potential. Importantly, the findings from this longitudinal study have expanded the existing evidence (e.g., Fung & Chung, 2021, 2022; Fung et al., 2021) by demonstrating how the innate characteristics of overexcitabilities might be the antecedents that predicted children’s co-development of playfulness and creative potential.

**Overexcitabilities as the Antecedents of Playfulness and Creative Potential**

As expected, children’s intellectual overexcitability was positively related to their playfulness in the cross-lagged model but not their concurrent creative potential. Although psychomotor overexcitability was significantly correlated with children’s playfulness and creative potential (Table 1), its relationships with playfulness and creative potential were nonsignificant in the cross-lagged model. The association between intellectual overexcitability at Time 1 and creative potential at Time 2 was mediated through playfulness at Time 1. This pattern of relationships highlights that overexcitabilities may predispose children to a specific daily experience and, in turn, shape their creative potential. With recent evidence demonstrating the nonsignificant direct link between overexcitabilities and creative potential (Fung & Chung, 2022a; Fung et al., 2021), playfulness may be the underlying process accounting for their indirect relationship. In the cross-lagged model, playfulness was represented by children’s social and cognitive spontaneity. Therefore, it is possible that children who were overexcited to mental manipulation of concepts and ideas were participating in higher levels of kindergarten sociodramatic play (Fung & Chung, 2022a), which involved effective communication and collaboration with peers (as reflected by social spontaneity) as well as the contribution of imaginative and original play ideas (as reflected by cognitive spontaneity). Sociodramatic play is a mature play type (Bodrova & Leong, 2018) that requires the activation of symbolic representation and broad association, while these cognitive processes are conducive to kindergarten children’s creative potential (Fung et al., 2021; Russ, 2003; Russ & Wallace, 2013). In contrast, children’s psychomotor overexcitability and the corresponding aspect of playfulness (e.g., physical spontaneity) may be less important in determining children’s engagement in sociodramatic play. The present results further supported the contention that children’s playfulness, particularly their social and cognitive spontaneity, can mediate the predictive link between overexcitabilities and creative potential.

Unexpectedly, imaginational overexcitability was unrelated to playfulness and creative potential in the present findings. Although it has been suggested that imaginational overexcitability may be linked with children’s imaginative pretense (Fung et al., 2021), its relationship may be readily observed in a home environment through solitary pretend play (Fung & Chung, 2022a). In kindergarten, playmates and group play opportunities are more available. Teachers may also encourage and support children in group activities such as sociodramatic play. As sociodramatic play activities often resemble real-life situations (e.g., restaurants, train stations, clinics), the level of imagination may be lower than solitary pretense. Therefore, intellectual overexcitability might emerge as a stronger correlate of children’s social and cognitive spontaneity in kindergarten than imaginational overexcitability.

**Bidirectionality Between Playfulness and Creative Potential**

Notably, the path model (Figure 1) revealed that both cross-lagged relationships were statistically significant, with their autoregressive effects controlled. Within the kindergarten context, more playful children tended to develop higher levels of creative potential. Similarly, children who displayed higher creative potential were more likely to exhibit increased levels of playfulness. Taken together, these findings highlighted that kindergarten children’s playfulness and creative potential might predict each other over time. To the best of our knowledge, this is the first evidence demonstrating the reciprocal relationship between kindergarten children’s playfulness and creative potential. This pattern of co-development aligns with the propositions that playfulness contributes to one’s creative potential (e.g., Bateson & Nettle, 2014; Fung et al., 2021; Luria et al., 2018) and that more creative people tend to express increased playfulness (Bateson, 2015).

Children with elevated playfulness levels were possibly engaging in more kindergarten sociodramatic play, and the cognitive processes promoted their creative potential. Children with higher creative potential were also likely to view the day-to-day group play activities as favorable situations that allowed them to break the rules and generate novel ideas (Bateson, 2015). These children may be more eager to engage in future group play activities, as reflected by their increased social and cognitive spontaneity that was reported by their teachers. Together, the results point to the potential self-perpetuation of kindergarten children’s creative potential through the provision of group play opportunities such as sociodramatic play, especially among those with a heightened level of intellectual overexcitability. Kindergarten group play may enable children to manifest their social and cognitive spontaneity and expand their creative potential, promoting their future engagement in these activities and exhibition of playfulness.

**Limitations**

The present study has at least three limitations. First, although data were obtained from multiple informants, the parents’ and teachers’ ratings may be biased due to social desirability (Krumpal, 2013). Both outcome measures (i.e., playfulness and creative potential) were reported by teachers, and, therefore, common method variance may also bias the results (Podsakoff et al., 2003). Relatedly, this study operationalized children’s creative potential as their creative personality traits. Although prior research has revealed the positive relationships between children’s creative personality traits and divergent thinking skills (e.g., Butcher & Niec, 2005; Runco, 1984), the lack of a direct assessment of children’s creative potential limits the generalizability of the present results. Future research may employ independent measures of playfulness (e.g., the Test of Playfulness scale; Bundy et al., 2001) and alternative assessments of kindergarten children’s creative potential (e.g., the Test for Creative Thinking – Drawing Production; Urban & Jellen, 1996) to validate the present findings. Second, the number of participants was adequate but small (post hoc analysis of power = 0.79; Moshagen & Erdfelder, 2016), all of them were recruited from a single kindergarten. The sample size precluded the use of a more sophisticated statistical approach (e.g., structural equation modeling) to analyse the data. Moreover, the time lag between the two data collection points was short (i.e., six months). Further studies with a larger and more diverse sample and data collected at multiple time points can better inform the long-term directional relationships among the variables. Lastly, although the present findings were based on longitudinal data, this study was correlational, and no causal inference can be made. Experimental studies are needed to promote a better understanding of the causal links between children’s playfulness and creative potential.

**Conclusions and Implications**

Despite its limitations, the present study contributed to the literature by demonstrating the co-development of children’s playfulness and creative potential and how these factors were longitudinally related to children’s overexcitabilities. It is possible that children who are fond of manipulating concepts and ideas tend to be more playful in the kindergarten context. These playful children may develop their creative potential through increased participation in group play activities such as sociodramatic play. In contrast, their creative potential might further motivate them to display higher levels of playfulness, mainly social and cognitive spontaneity, and engagement in future kindergarten group play situations. Practically, the results underscore the utility of promoting kindergarten children’s social and cognitive spontaneity. Teachers may support daily play time by endorsing and extending children’s play choices and ideas to encourage playfulness (Fung & Chung, 2022b). Practitioners may also provide unstructured play materials (Canning, 2010) such that children can frequently use board scanning and symbolic representation to advance their cognitive spontaneity. Furthermore, more group play opportunities may be incorporated into daily schedules to nurture children’s social spontaneity (Fung & Chung, 2022a). Recent research has also suggested a positive link between children’s and practitioners’ playfulness (Pinchover, 2017) and how online interventions can promote adults’ playfulness (Proyer et al., 2021). By shaping more playful practitioners and better-implementing kindergarten group play activities, these approaches may stimulate children’s playfulness and support their co-development with creative potential naturally and joyfully.

**References**

Amabile, T. M. (1996). *Creativity in Context: Update to The Social Psychology of Creativity* (1st ed.). Routledge. https://doi.org/10.4324/9780429501234

Ayling, P., Armstrong, H., & Gordon, C. L. (2019). *Becoming and being a play therapist : Play therapy in practice*. Taylor & Francis Group. https://doi.org/10.4324/9780203711224

Barnett, L. A. (1991). The playful child: Measurement of a disposition to play. *Play & Culture, 4*(1), 51–74.

Barnett, L. A. (2018). The education of playful boys: Class clowns in the classroom. *Frontiers in Psychology, 9*, 232–232. https://doi.org/10.3389/fpsyg.2018.00232

Bateson, P. (2015). Playfulness and creativity. *Current Biology, 25*(1), R12–R16. https://doi.org/10.1016/j.cub.2014.09.009

Bateson, P., & Nettle, D. (2014). Playfulness, ideas, and creativity: A survey. *Creativity Research Journal, 26*(2), 219-222. https://doi.org/10.1080/10400419.2014.901091

Beaty, J. J. (2014). *Observing development of the young child* (8th edition). Prentice Hall.

Bodrova, E., & Leong, D. J. (2018). Tools of the Mind: The Vygotskian-based early childhood program. *Journal of Cognitive Education and Psychology, 17*(3), 223-237. https://doi.org/10.1891/1945-8959.17.3.223

Bundy, A. C., Luckett, T., Naughton, G. A., Tranter, P. J., Wyver, S. R., Ragen, J., Singleton, E., & Spies, G. (2008). Playful interaction: occupational therapy for all children on the school playground. *The American Journal of Occupational Therapy, 62*(5), 522–527. https://doi.org/10.5014/ajot.62.5.522

Bundy, A. C., Nelson, L., Metzger, M., & Bingaman, K. (2001). Validity and reliability of a test of playfulness. *OTJR (Thorofare, N.J.), 21*(4), 276–292. https://doi.org/10.1177/153944920102100405

Butcher, J. L., & Niec, L. N. (2005). Disruptive behaviors and creativity in childhood: The importance of affect regulation. *Creativity Research Journal, 17*(2), 181-193. https://doi.org/10.1080/10400419.2005.9651478

Canning, N. (2010). The influence of the outdoor environment: den-making in three different contexts. *European Early Childhood Education Research Journal, 18*(4), 555–566. https://doi.org/10.1080/1350293X.2010.525961

Chan, D. W., & Chan, L. K. (1999). Implicit theories of creativity: Teachers' perception of student characteristics in Hong Kong. *Creativity Research Journal, 12*(3), 185–195. https://doi.org/10.1207/s15326934crj1203\_3

Chang, H., & Kuo, C. (2013). Overexcitabilities: Empirical studies and application. *Learning and Individual Differences, 23*, 53-63. https://doi.org/10.1016/j.lindif.2012.10.010

Chávez-Eakle, R. A., Eakle, A. J., & Cruz-Fuentes, C. (2012). The multiple relations between creativity and personality. *Creativity Research Journal, 24*(1), 76–82. https://doi.org/10.1080/10400419.2012.649233

Curriculum Development Council of HKSARG (2017). Kindergarten Education Curriculum Guide. https://www.edb.gov.hk/attachment/en/curriculum-development/major-level-of-edu/preprimary/ENG\_KGECG\_2017.pdf

Dabrowski, K. (1964). *Positive disintegration*. Little Brown.

Dabrowski, K. (1972). *Psychoneurosis is not an illness*. Gryf.

Daniels, S., & Piechowski, M. M. (2009). Embracing intensity: overexcitability, sensitivity, and the developmental potential of the gifted. In S. Daniels & M. M. Piechowski (Eds.), *Living with intensity: Understanding the sensitivity, excitability, and emotional development of gifted children, adolescents, and adults* (pp. 3–17). Great Potential Press.

De Bondt, N., De Maeyer, S., Donche, V., & Van Petegem, P. (2021). A rationale for including overexcitability in talent research beyond the FFM-personality dimensions. *High Ability Studies, 32*(1), 1–26. https://doi.org/10.1080/13598139.2019.1668753

De Bondt, N., & Van Petegem, P. (2015). Psychometric evaluation of the Overexcitability Questionnaire-Two applying Bayesian structural equation modeling (BSEM) and multiple-group BSEM-based alignment with approximate measurement invariance. *Frontiers in Psychology, 6*, 1963–1963. https://doi.org/10.3389/fpsyg.2015.01963

Donnellan, M. B., & Robins, R. W. (2009). The development of personality across the lifespan. In P. J. Corr & G. Matthews (Eds.), *Cambridge handbook of personality psychology* (pp. 191-204). Cambridge University Press.

Falk, R. F., Lind, S., Miller, N. B., Piechowski, M. M., & Silverman, L. K. (1999). *The overexcitability Questionnaire–Two (OEQ II): Manual, scoring system, and questionnaire*. Institute for the Study of Advanced Development.

Fung, W. K., & Chung, K. K. H. (2021). Associations between overexcitabilities and playfulness of kindergarten children. *Thinking Skills and Creativity, 40*, 100834. https://doi.org/10.1016/j.tsc.2021.100834

Fung, W. K., & Chung, K. K. H. (2022a). Overexcitabilities and creative potential in the kindergarten context: The mediating role of children’s playfulness. *Thinking Skills and Creativity, 46*, 101197. https://doi.org/10.1016/j.tsc.2022.101197

Fung, W. K., & Chung, K. K. H. (2022b). Parental play supportiveness and kindergartners’ peer problems: Children’s playfulness as a potential mediator. *Social Development, 31*(4), 1126–1137. https://doi.org/10.1111/sode.12603

Fung, W. K., Chung, K. K. H., & He, M. W. (2021). Association between children’s imaginational overexcitability and parent‐reported creative potential: Cognitive and affective play processes as potential mediators. *The Journal of Creative Behavior, 55*(4), 962–969. https://doi.org/10.1002/jocb.501

Grant, B. (2021). Overexcitabilities and openness to experience are not the same: A critique of a study and reflections on theory, ethics, and truth. *Roeper Review, 43*(2), 128–138. https://doi.org/10.1080/02783193.2021.1881852

He, W. (2018). A 4-year longitudinal study of the sex-creativity relationship in childhood, adolescence, and emerging adulthood: Findings of mean and variability analyses. *Frontiers in Psychology, 9*, 2331–2331. https://doi.org/10.3389/fpsyg.2018.02331

He, W., Wong, W., & Chan, M. (2017). Overexcitabilities as important psychological attributes of creativity: A Dabrowskian perspective. *Thinking Skills and Creativity, 25*, 27-35. https://doi.org/10.1016/j.tsc.2017.06.006

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Hui, A. N. N., Chow, B. W. Y., Chan, A. Y. T., Chui, B. H. T., & Sam, C. T. (2015). Creativity in Hong Kong classrooms: transition from a seriously formal pedagogy to informally playful learning. *Education 3-13, 43*(4), 393–403. https://doi.org/10.1080/03004279.2015.1020652

Jackson, S. L., & Cunningham, S. A. (2017). The stability of children's weight status over time, and the role of television, physical activity, and diet in elementary school. *Preventive Medicine, 100*, 229-234. https://doi.org/10.1016/j.ypmed.2017.04.026

Keisari, S., Gesser-Edelsburg, A., Yaniv, D., & Palgi, Y. (2020). Playback theatre in adult day centers: A creative group intervention for community-dwelling older adults. *PloS One, 15*(10), e0239812–e0239812. https://doi.org/10.1371/journal.pone.0239812

Krumpal, I. (2013). Determinants of social desirability bias in sensitive surveys: a literature review. *Quality & Quantity, 47*(4), 2025–2047. https://doi.org/10.1007/s11135-011-9640-9

Lieberman, J. N. (1977). *Playfulness: Its relationship to imagination and creativity.* Academic Press.

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

Luria, S. R., Baer, J., & Kaufman, J. C. (2018). *Creativity and Humor*. Elsevier Science & Technology.

Mendaglio, S., & Tillier, W. (2006). Dabrowski’s theory of positive disintegration and giftedness: Overexcitability research findings. *Journal for the Education of the Gifted, 30*(1), 68–87. https://doi.org/10.1177/016235320603000104

Moshagen, M., & Erdfelder, E. (2016). A new strategy for testing structural equation models. *Structural Equation Modeling, 23*, 54–60. https://doi.org/10.1080/10705511.2014.950896

Oberski, D. (2014). lavaan.survey: An R package for complex survey analysis of structural equation models. *Journal of Statistical Software, 57*, 1-27. https://doi.org/10.18637/jss.v057.i01

Piechowski, M. (1999). Overexcitabilities. *Encyclopedia of creativity* (pp. 325–334). Academic Press.

Piechowski, M. M., & Cunningham, K. (1985). Patterns of overexcitability in a group of artists. *The Journal of Creative Behavior, 19*(3), 153–174. https://doi.org/10.1002/j.2162-6057.1985.tb00655.x

Pinchover, S. (2017). The relation between teachers’ and children’s playfulness: A pilot study. *Frontiers in Psychology, 8*, 2214–2214. https://doi.org/10.3389/fpsyg.2017.02214

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Proyer, R. T., Gander, F., Brauer, K., & Chick, G. (2021). Can playfulness be stimulated? A randomised placebo‐controlled online playfulness intervention study on effects on trait playfulness, well‐being, and depression. *Applied Psychology : Health and Well-Being, 13*(1), 129–151. https://doi.org/10.1111/aphw.12220

R Core Team (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. 2022. <https://www.R-project.org/> Assessed 2 March 2023.

Rhodes, M. (1961). An analysis of creativity. *The Phi Delta Kappan, 42*, 305–310.

Richards, R. (2007). Everyday creativity: Our hidden potential. In R. Richards (Ed.), *Everyday creativity and new views of human nature: Psychological, social, and spiritual perspectives* (pp. 25–54). American Psychological Association. https://doi.org/10.1037/11595-000

Richards, R. (2019). Everyday creativity: Process and way of life - Four key issues. In J. Kaufman & R. Sternberg (Eds.), *The Cambridge handbook of Creativity* (pp. 189-215). Cambridge University Press. https://doi.org/10.1017/9781316979839

Runco, M. A. (1984). Teacher's judgments of creativity and social validity of divergent thinking tests. *Perceptual and Motor Skills, 59*(3), 711-717. http://dx.doi.org/10.2466/pms.1984.59.3.711

Runco, M. A. (2014). “Big C, Little c” Creativity as a false dichotomy: Reality is not categorical. *Creativity Research Journal, 26*(1), 131–132. https://doi.org/10.1080/10400419.2014.873676

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

Runco, M. A., & Johnson, D. J. (2002). Parents’ and teachers’ implicit theories of children’s creativity: A cross-cultural perspective. *Creativity Research Journal, 14*(3-4), 427–438. https://doi.org/10.1207/S15326934CRJ1434\_12

Runco, M. A., Johnson, D. J., & Bear, P. K. (1993). Parents’ and teachers’ implicit theories of children’s creativity. *Child Study Journal, 23*, 91–113.

Russ, S. W. (2003). Play and creativity: Developmental issues. *Scandinavian Journal of Educational Research, 47*(3), 291–303. https://doi.org/10.1080/00313830308594

Russ, S. W., & Wallace, C. E. (2013). Pretend play and creative processes. *American Journal of Play, 6*(1), 136-148.

Stühmann, L. M., Paprott, R., Heidemann, C., Ziese, T., Hansen, S., Zahn, D., . . . Gellert, P. (2020). Psychometric properties of a nationwide survey for adults with and without diabetes: The "disease knowledge and information needs - diabetes mellitus (2017)" survey. *BMC Public Health, 20*(1), 192. https://doi.org/10.1186/s12889-020-8296-6

Trevlas, E., Matsouka, O., & Zachopoulou, E. (2003). Relationship between playfulness and motor creativity in preschool children. *Early Child Development and Care, 173*(5), 535-543. https://doi.org/10.1080/0300443032000070482

Urban, K. K., & Jellen, H. G. (1996). *Test for Creative Thinking – Drawing Production (TCT-DP)*. Swets & Zeitlinger.

Van Laar, E., Van Deursen, J. A. M., & Van Dijk, A.G.M. (2022) Developing policy aimed at 21st-century digital skills for the creative industries: an interview study with founders and managing directors, *Journal of Education and Work, 35*(2), 195-209. https://doi.org/10.1080/13639080.2022.2036710

Vuyk, M. A., & Kerr, B. (2021). Openness to experience and overexcitabilities, a jangle fallacy with ethical implications: A response to Barry Grant. *Roeper Review, 43*(2), 139–141. https://doi.org/10.1080/02783193.2021.1881749

Vuyk, M. A., Kerr, B. A., & Krieshok, T. S. (2016). From overexcitabilities to openness: Informing gifted education with psychological science. *Gifted and Talented International, 31*(1), 59–71. https://doi.org/10.1080/15332276.2016.1220796

Vuyk, M. A., Krieshok, T. S., & Kerr, B. A. (2016). Openness to experience rather than overexcitabilities: Call it like it ss. *The Gifted Child Quarterly, 60*(3), 192–211. https://doi.org/10.1177/0016986216645407

Vygotsky, L. (1967). Play and its role in the mental development of the child. *Soviet Psychology, 5*(3), 6–18.

Table 1

*Descriptive statistics, reliabilities, and bivariate correlations of study variables.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | Correlations | | | | | | | | | |  |
| Variables | |  | (1) a | (2) a | (3) a | (4) a | (5) a | (6) c | (7) c | (8) c | (9) c | (10) c | (11) c |
| 1. Imaginational OE a | |  | -- | .35\*\*\* | .44\*\*\* | .42\*\*\* | .40\*\*\* | -.06 | -.04 | .06 | .04 | .09 | .10 |
| 2. Psychomotor OE a | |  | .35\*\*\* | -- | .16 | .41\*\*\* | .47\*\*\* | .24\*\* | .23\*\* | .25\*\* | .24\*\* | .25\*\* | .26\*\* |
| 3. Sensual OE a | |  | .44\*\*\* | .16 | -- | .52\*\*\* | .36\*\*\* | -.05 | -.02 | -.02 | .02 | .07 | .07 |
| 4. Intellectual OE a | |  | .42\*\*\* | .41\*\*\* | .52\*\*\* | -- | .57\*\*\* | .17 | .16 | .18\* | .20\* | .23\*\* | .20\* |
| 5. Emotional OE a | |  | .40\*\*\* | .47\*\*\* | .36\*\*\* | .57\*\*\* | -- | .04 | .08 | .06 | .06 | .03 | .11 |
| 6. Physical spontaneity b | |  | .16 | .30\*\*\* | .10 | .34\*\*\* | .08 | -- | .78\*\*\* | .66\*\*\* | .73\*\*\* | .70\*\*\* | .61\*\*\* |
| 7. Social spontaneity b | |  | .01 | .12 | .05 | .24\*\* | .14 | .63\*\*\* | -- | .79\*\*\* | .82\*\*\* | .72\*\*\* | .69\*\*\* |
| 8. Cognitive spontaneity b | |  | .06 | .13 | .07 | .29\*\*\* | .10 | .63\*\*\* | .80\*\*\* | -- | .75\*\*\* | .71\*\*\* | .73\*\*\* |
| 9. Manifest joy b | |  | .11 | .29\*\*\* | .10 | .32\*\*\* | .11 | .73\*\*\* | .75\*\*\* | .74\*\*\* | -- | .71\*\*\* | .59\*\*\* |
| 10. Sense of humor b | |  | .15 | .20\*\* | .14 | .39\*\*\* | .12 | .66\*\*\* | .63\*\*\* | .67\*\*\* | .65\*\*\* | -- | .63\*\*\* |
| 11. Creative potential b | |  | .08 | .18\* | .04 | .22\*\* | .13 | .54\*\*\* | .70\*\*\* | .72\*\*\* | .60\*\*\* | .48\*\*\* | -- |
| Descriptive statistics | Mean |  | 3.17 a | 3.53 a | 3.39 a | 3.27 a | 3.32 a | 3.51 b / 3.70 c | 3.48 b / 3.67 c | 3.19 b / 3.24 c | 3.79 b / 3.77 c | 2.81 b / 3.01 c | 4.41 b / 4.63 c |
| *SD* |  | 0.68 a | 0.63 a | 0.50 a | 0.59 a | 0.51 a | 0.89 b / 0.84 | 0.86 b / 0.80 c | 0.80 b / 0.80 c | 0.87 b / 0.78 c | 0.87 b / 0.89 c | 1.08 b / 1.00 c |
| Skewness |  | 0.05 a | -0.35 a | 0.07 a | -0.11 a | 0.06 a | -0.19 b / -0.54 c | -0.44 b / -0.72 c | -0.28 b / -0.41 c | -0.66 b / -0.80 c | 0.05 b / -0.34 c | -0.60 b / -0.56 c |
| Kurtosis |  | 0.01 a | 0.82 a | 0.07 a | -0.02 a | -0.37 a | -0.82 b / -0.02 c | 0.03 b / 0.73 c | -0.25 b / -0.04 c | -0.13 b / 0.85 c | -0.37 b / -0.50 c | -0.05 b / 0.23 c |
| Minimum |  | 1.40 a | 1.50 a | 2.00 a | 1.50 a | 2.00 a | 1.50 b / 1.00 c | 1.20 b / 1.20 c | 1.00 b / 1.00 c | 1.40 b / 1.00 c | 1.00 b / 1.00 c | 1.27 b / 1.36 c |
| Maximum |  | 4.80 a | 5.00 a | 4.80 a | 4.80 a | 4.60 a | 5.00 b / 5.00 c | 5.00 b / 5.00 c | 4.75 b / 5.00 c | 5.00 b / 5.00 c | 5.00 b / 5.00 c | 6.36 b / 6.55 c |
| Reliability |  | 0.84 a | 0.81 a | 0.74 a | 0.84 a | 0.71 a | 0.84 b / 0.82 c | 0.84 b / 0.86 c | 0.75 b / 0.81 c | 0.90 b / 0.87 c | 0.82 b / 0.87 c | 0.92 b / 0.92 c |
| *Note:* \* *p* < .05; \*\* *p* < .01; \*\*\* p < .001; OE – overexcitability; SD – standard deviation; Reliability – Cronbach’s alpha. Correlations under the diagonal are between overexcitabilities, playfulness, and  creative potential at Time 1, whereas those above the diagonal are between overexcitabilities at Time 1 and playfulness and creative potential at Time 2.  a Reported by parents at Time 1.  b Reported by teachers at Time 1.  c Reported by teachers at Time 2. | | | | | | | | | | | | | |

Table 2

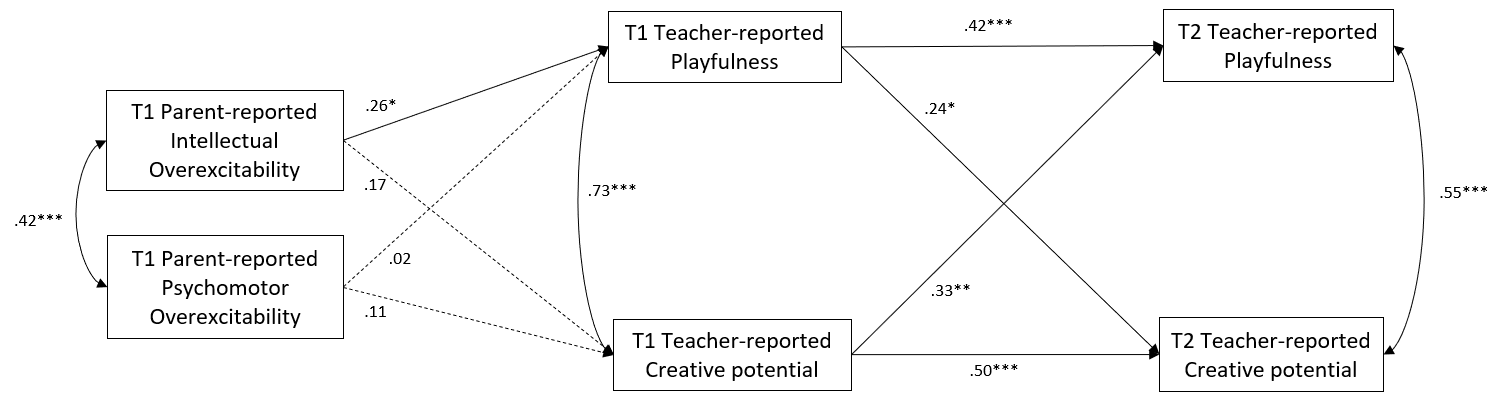
*Hierarchical regressions predicting creative potential from child age and gender, parental education, overexcitabilities, and playfulness.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | (Model 1) Creative potential at Time 1 | | | | | |  | (Model 2) Creative potential at Time 2 | | | | | |
| Steps/independent variables |  | Final *β* | *SE* | Total *R*2 | Δ*R*2 | Δ*F* | *p* |  | Final *β* | *SE* | Total *R*2 | Δ*R*2 | Δ*F* | *p* |
| Step 1 |  | -- | -- | .08 | .08 | 2.93 | .02 |  | -- | -- | .07 | .07 | 2.61 | .04 |
| Child gender (boy = 0, girl = 1) |  | .12 | .13 |  |  |  | .05 |  | .15 | .12 |  |  |  | .01 |
| Child age |  | .13 | .01 |  |  |  | .03 |  | .13 | .01 |  |  |  | .02 |
| Maternal education |  | .10 | .07 |  |  |  | .12 |  | .05 | .06 |  |  |  | .42 |
| Paternal education |  | -.12 | .07 |  |  |  | .07 |  | -.02 | .06 |  |  |  | .70 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Step 2 |  | -- | -- | .16 | .08 | 2.30 | .05 |  | -- | -- | .16 | .09 | 2.73 | .02 |
| Imaginational overexcitability a |  | -.01 | .11 |  |  |  | .93 |  | .01 | .10 |  |  |  | .96 |
| Psychomotor overexcitability a |  | .09 | .12 |  |  |  | .19 |  | .07 | .11 |  |  |  | .31 |
| Sensual overexcitability a |  | -.04 | .15 |  |  |  | .55 |  | .04 | .14 |  |  |  | .55 |
| Intellectual overexcitability a |  | .01 | .16 |  |  |  | .97 |  | .01 | .14 |  |  |  | .93 |
| Emotional overexcitability a |  | .01 | .16 |  |  |  | .89 |  | -.01 | .15 |  |  |  | .91 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Step 3 |  | -- | -- | .61 | .45 | 29.26 | <.001 |  | -- | -- | .63 | .47 | 31.73 | <.001 |
| Physical spontaneity b |  | .11 | .11 |  |  |  | .24 |  | .16 | .12 |  |  |  | .10 |
| Social spontaneity b |  | .28 | .14 |  |  |  | .01 |  | .23 | .15 |  |  |  | .06 |
| Cognitive spontaneity b |  | .49 | .14 |  |  |  | <.001 |  | .42 | .13 |  |  |  | <.001 |
| Manifest joy b |  | -.04 | .13 |  |  |  | .74 |  | -.12 | .14 |  |  |  | .26 |
| Sense of humor b |  | -.09 | .11 |  |  |  | .29 |  | .11 | .10 |  |  |  | .21 |
| *Note:* a Children’s overexcitabilities were reported by parents at Time 1.  b Children’s playfulness was reported by teachers at both time points. The playfulness scores at Time 1 and Time 2 were used to predict creative  potential in regression models 1 and 2, respectively. | | | | | | | | | | | | | | |

Figure Legend

**Figure 1.** A cross-lagged model of teacher-reported playfulness (social spontaneity and cognitive spontaneity) and creative potential across Time 1 and Time 2 with children’s parent-reported intellectual and psychomotor overexcitabilities at Time 1 as antecedents. Control variables include children’s age, gender, and parental education level. Standardized coefficients are reported. Solid paths are statistically significant. Dashed paths are non-significant. T1 = time 1 and T2 = time 2. \* *p* < .05; \*\* *p* < .01; \*\*\* *p* < .001. Fit indices: *χ2* (*df* = 21, *N* = 139) = 31.19, *p* = .07, CFI = .96, RMSEA = .06 (90% CI: .00, .10), SRMR = .07, *R2 Time 2 Teacher-reported Creative Potential* = .52, *R2 Time 2 Teacher-reported Playfulness* = .51.

**Figure 1**

****