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THE RELATIONSHIP BETWEEN BILINGUALISMAND CREATIVITY IN PRESCHOOL CHILDREN

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THE RELATIONSHIP BETWEEN BILINGUALISMAND CREATIVITY IN PRESCHOOL CHILDREN

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APPROVAL

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DECLARATION ON RESEARCH ETHICS AND PUBLISHING METHODS

I, PINAR KARATAŞ; hereby declare

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In addition, I acknowledge that any claim of irregularity that may arise in relation to this work will result in a disciplinary action in accordance with the university legislation.

Pınar Karataş

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Date (14/06/2022)

To My Dearest Family...

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THE RELATIONSHIP BETWEEN BILINGUALISM AND CREATIVITY IN PRESCHOOL CHILDREN

ABSTRACT

Creativity is producing novel ideas and combining unrelated concepts to generate an original product (Guilford, 1967). Association between bilingualism and creativity can differ depending on the types of creativity (e.g., verbal and figural creativity). Earlier research agrees on a positive relationship between bilingualism and figural creativity; however, there are some discrepancies in the relationship between bilingualism and verbal creativity. Some suggest that bilingual individuals have poorer achievement on verbal creativity tasks; others discuss that bilingual individuals who have high L2 proficiency (second language proficiency) have better performance on verbal creativity tasks. Another aspect of creativity research examines the relationship between executive functions and creativity. Research findings vary on the association between verbal and figural creativity and three core executive functions. Moreover, studies show that bilingualism and executive functions are related. The present study intends to investigate the relationship between bilingualism and creativity taking into account the associations with the executive functions in preschool children. Fifty-six preschool children aged 4-6 (Mage= 65 months) participated in the study. Story Completion Task, Verbal Fluency Task, and Test of Creative Imaginary Abilities were administered to children to measure verbal and figural creativity. Children completed inhibitory control, cognitive flexibility, working memory tasks, and language measures. The results suggest that verbal creativity and L2 proficiency are positively related. However, there was no significant association between Verbal Fluency Task and L2 proficiency. Figural creativity was positively related to bilingualism, and highly L2 proficient participants showed better performance on the Test of Creative Imaginary Abilities. Moreover, there was no significant relationship between cognitive flexibility and inhibitory control with any creativity task. On the other hand, working memory capacity was positively related to figural creativity performance while it was negatively associated with verbal creativity. Overall, L2 proficiency was positively related to verbal and figural creativity; on the other hand, working memory was positively associated with figural creativity.

Keywords: Creativity, Bilingualism, Verbal Creativity, Figural Creativity, Executive Functions.

YARATICILIK VE İKİ DİLLİLİK ARASINDAKİ İLİŞKİNİN OKUL ÖNCESİ ÇAĞI ÇOCUKLARINDA İNCELENMESİ

ÖZET

Yaratıcılık kavramsal olarak hali hazırda var olan kavramların ve fikirlerin yeni ve orijinal bir biçimde bir araya getirilerek bir ürün oluşturulmasına verilen addır. (Guilford, 1967). İki dillilik ve yaratıcılık arasındaki ilişki, yaratıcılığın türlerine (örneğin, sözlü ve figüral yaratıcılık) bağlı olarak farklılık gösterebilir. Daha önceki araştırmalar, iki dillilik ve figüral yaratıcılık arasında olumlu bir ilişki olduğu konusunda hemfikirdir, ancak iki dillilik ve sözel yaratıcılık arasındaki ilişkide bazı farklı bulgular vardır. Bazı çalışmalar iki dilli bireylerin sözel yaratıcılık görevlerinde daha düşük başarıya sahip olduklarını, diğer çalışmalar ise yüksek ikinci dil yeterliliğine sahip iki dilli bireylerin sözel yaratıcılık görevlerinde daha iyi olduklarını ileri sürmektedir. Yaratıcılık araştırmasının bir başka yönü de yürütücü işlevler ve yaratıcılık arasındaki ilişkiyi inceler. Önceki araştırma bulguları, sözel ve figüral yaratıcılık ile üç temel yürütücü işlev arasındaki ilişkiye göre değişmektedir. Bunun yanında daha önce yapılan çalışmalar yürütücü işlevler ve yaratıcılık arasında bir ilişki olduğunu göstermektedir. Bu çalışma, okul öncesi çocuklarda yürütücü işlevleri de dikkate alarak iki dillilik ve yaratıcılık arasındaki ilişkiyi araştırmayı amaçlamaktadır. Çalışmaya 4-6 yaşları arasındaki 56 okul öncesi çocuk (ortalama 65 ay) katılmıştır. Sözel ve figüral yaratıcılığı ölçmek için çocuklara Hikaye Tamamlama Görevi, Sözel Akıcılık Görevi ve Yaratıcı Hayali Yeteneklerin Testi uygulandı. Çocuklar ket vurma, bilişsel esneklik ve çalışan bellek görevlerini ve dil ölçümlerini tamamladılar. Sonuçlar, sözel yaratıcılığın ve ikinci dil yeterliliğinin pozitif ilişkili olduğunu göstermektedir. Bununla birlikte, Sözel Akıcılık Görevi ile ikinci dil yeterliliği arasında anlamlı bir ilişki yoktur. Figüral yaratıcılık iki dillilik ile pozitif ilişkili bulunmuştur ve ikinci dilde yetkin olan katılımcılar Yaratıcı Hayali Yetenekler Testinde daha iyi performans gösterdiler. Bilişsel esneklik ve ket vurma ile herhangi bir yaratıcılık görevi arasında anlamlı bir ilişki bulunamamıştır. Öte yandan, çalışan bellek kapasitesi figüral yaratıcılık performansı ile pozitif ilişkiliyken, sözel yaratıcılık ile negatif ilişkiliydi. Genel olarak, ikinci dil yeterliliği sözel ve figüral yaratıcılıkla ilişkili bulunmuştur, ancak çalışan bellek sadece figüral yaratıcılıkla ilişkili bulunmuştur.

Anahtar Sözcükler: Yaratıcılık, İki dillilik, sözel yaratıcılık, figüral yaratıcılık, yürütücü işlevler

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EF: Executive Functions

SES: Socio-economic Status

TCIA: Test of Creative Imaginary Abilities

1. INTRODUCTION

Creativity is defined as producing novel ideas or making new combinations out of pre-existing concepts or ideas (Simonton, 2008; Sternberg, 2001). Creativity is a concept that comes across in many areas. The importance of creativity in every field, from education to business life, is emphasized. Besides, creativity is fundamental for development and progress in society. Moreover, creativity predicts academic and other schooling outcomes for young children (Sternberg, 2018). In the psychology literature, divergent thinking is used interchangeably with creativity, which refers to original and alternative responses to problems (Guilford, 1967). According to Guilford, divergent thinking has four subcategories: fluency, flexibility, originality, and elaboration. Fluency means the number of different answers produced toward the specific problem. Flexibility refers to categories of given solutions; how many other categories are produced by individuals. Originality indicates the diversity of given answers to a particular problem between given responses; how the number of given different solutions is divergent from each other. The more unusual ideas would be estimated as the original. Elaboration refers to how detailly participants respond to questions; the answers include many details, and illustrations are elaborated responses.

Furthermore, there are other ways to categorize types of creativity, such as the novelty of problem/task and solution: Proactive creativity and reactive creativity (Kaufmann, 2003). Proactive creativity refers to finding novel solutions to familiar tasks (e.g., problem-solving tasks), and reactive creativity occurs in a novel problem situation and novel solution production, which is the category that needs more creativity (Kaufmann, 2004). Besides these two creativity categories, creativity types are mostly categorized as verbal and figural (Kharkhurin, 2009; Benedek et al., 2012; Dijk et al., 2019). Verbal creativity abilities include originality, novelty, and fluency in the generated narrations. Figural creativity is a form of non-verbal creativity which does not interpreted with linguistic and verbal capacities, figural creativity is also called non-verbal creativity (Kharkhurin, 2010a). There is an increase in research investigating the relationship between creativity

(verbal and figural) and other cognitive factors such as bilingualism (Leikin & Tovli, 2014; Lee& Kim, 2011; Madhav & Anand, 2012).

The prevalence of bilingualism has increased in all age groups due to environmental, educational, and familial factors; therefore, studying the effects of bilingualism has an essential value for understanding relationship between being bilingual and the developmental processes. Several studies have investigated whether there is any relationship between creativity and bilingualism; most studies found a positive relationship (Kharkhurin, 2010a; Madhav & Anand, 2012; Ricciardelli, 1992a). Some studies show that bilingual individuals have better control of language processes and are better at selecting and conveying linguistic information than monolinguals (Bialystok, 2005). These skills allow bilinguals to perform better on creativity tasks because creativity tasks need to combine different ideas and solutions to generate an original output (Kim, 2016). Furthermore, Leikin and Tovli (2014) state that bilinguals operate in two languages and two cultures most of the time; this is an explanation for why bilinguals might be more creative. Another explanation is that bilinguals switch between languages (Sampedro & Pena, 2019b). This might make their way of thinking more flexible and original.

Previous studies also show that bilingualism is related to other cognitive domains than creativity, such as executive functions (Bialystok & DePape, 2009; Carlson & Meltzoff, 2008; Klein, 2015). Executive functions refer to processes that control reflexive thoughts, behaviors, and attention (Diamond, 2013). Inhibitory control, working memory, and cognitive flexibility are three subcomponents of executive functions (Garon et al., 2008). Previous studies have examined the relationship between bilingualism and executive functions, and they found various results on the relationship between bilingualism working memory, inhibitory control, and cognitive flexibility. Although some studies did not report significant relations between executive functions and bilingualism (Lethonen et al., 2018; Nichols et al., 2020), there are studies demonstrating a positive relationship (e.g., Benedek et al., 2014; De Drue et al., 2012; Zabelina et al., 2019). These studies show an association between bilingualism and better performance on executive functions

tasks with different types of tasks representing three core executive functions in diverse age groups from childhood to adulthood (Carlson & Meltzoff, 2008; Zelazo et al., 2003). Studies argue that inhibitory control, working memory, and cognitive flexibility are necessary to produce and generate an original, creative product (Krumm et al., 2018). People who switch between the two languages in their daily lives may practice their working memory, cognitive flexibility, and inhibitory control skills on a daily basis. For instance, when using one language, suppressing the other language requires inhibitory control (Carlson & Meltzoff, 2008). Inhibitory control is required to produce a creative idea or concept because something a person should do when creating something new is to suppress the first common idea that comes to mind and try to produce a more original output. We can also suggest that to combine concepts or ideas that have not been combined before, she or he should call them from working memory. Therefore, the relationship between bilingualism, creativity, and components of executive functions, namely, working memory, cognitive flexibility, and inhibitory control, should be investigated. Nevertheless, the relationship between working memory, inhibitory control, cognitive flexibility, and verbal and figural creativity remains understudied in the present literature. This study intended to shed light on this gap in the literature. With consideration of these common connections between creativity and bilingualism, the present study focused on examining the relationship between verbal and figural creativity and bilingualism in preschool children while taking into account the associations with executive functions.

2. LITERATURE REVIEW

2.1 Bilingualism and Creativity

There is extensive literature on whether bilingualism has cognitive advantages (for review, Adesope et al., 2010). Many studies have been conducted to investigate the relation of bilingualism to different cognitive functions such as creativity (Hommel et al., 2011; Kostandyan & Ledovaya, 2013; Madhav & Anand, 2012), problem-solving (Bialystok, 2006; Cushen & Wiley, 2011; Leikin et al., 2020), and executive functions (Bialystok & DePape, 2009; Carlson & Meltzoff, 2008; Klein, 2015). There are controversial findings on bilingual advantages on cognitive functions. In terms of creativity, some studies found a positive association to bilingualism (Wang & Cheng, 2016). With university students, Kharkhurin (2010a) showed that bilingualism and higher creativity performance are positively associated. The first comparison included L1-Russian and L2-English bilinguals and L1- English monolinguals living in the US, while the other group comprises L1-Farsi and L2-English monolingual and L1-Farsi monolinguals residing in the UAE. They used the biographical questionnaire to determine the acquisition of L1 -Farsi or Russian and L2- English. Participants have received a standard picture naming task to measure L2- English proficiency. Participants, who had higher proficiency in both languages, had taken divergent thinking tasks (the Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002). ATTA included verbal and figural creativity tasks that assess creativity through four subcomponents: flexibility, fluency, originality, and elaboration (Goff & Torrance, 2002). This study was a very convenient example for testing whether there was a contextual difference between being bilingual among different cultures. It was essential to mention that results indicated the positive relationship between bilingualism and creativity regardless of different language groups and cultural backgrounds. All bilingual groups were better than monolinguals on creativity tasks but comparing L2- English speaking adult participants in the US and UAE showed that bilinguals who have lived in the L2 dominant society had slightly higher scores than bilinguals who have lived in the L1 dominant society. The researchers suggested that the differences may not yield from bilingualism but the cultural background.

Most of the studies in this field use verbal and figural creativity and related tasks to compare bilinguals' and monolinguals' creativity to investigate whether bilinguals have an advantage in creativity (Kharkhurin & Altarriba, 2016; Kostandyan & Ledovaya, 2013). In a meta-analysis, Dijk et al. (2019) reviewed 13 studies about bilingualism and creativity; those studies mainly included university students and children aged between 4 and 11. These studies measured creativity with verbal and figural creativity types, and problem-solving tasks. The findings on figural creativity and bilingualism advocated previous literature. Both adult and children studies show that bilingual participants had better performance on figural creativity. Likewise, reviewed studies demonstrate that bilinguals performed better on verbal creativity than monolingual participants. The studies examined in this meta-analysis state that bilinguals had better verbal and figural creativity scores. The results of meta-analysis indicated that bilingual adults and children have higher creativity scores on related tasks than monolingual peers. These findings supported the positive relationship between bilingualism and creativity.

Previous findings show a relation between bilingualism and different types of creativity (Kharkhurin, 2010a). Previous research builds consensus about bilingual advantages on figural creativity (Kharkhurin & Wei, 2015; Leikin, 2013). For example, Leikin (2013) examined bilingual advantage on figural creativity by comparing L1-Hebrew L2-Russian bilingual and L1-Hebrew monolingual preschoolers from bilingual and monolingual preschools. The participants completed pictural solution tasks and equal numbers of tasks that needed creative problem-solving skills. Results indicated that bilingual children had better performance on figural creativity. Also, early bilingual education seems advantageous for creativity. The bilingual children from the bilingual preschools show slightly better creativity performance than bilingual children from monolingual preschools. The study is a good reminder of the importance of considering preschool education, whether bilingual or monolingual while studying a young bilingual sample.

An early study claims verbal and figural advantages of bilingualism; bilingual individuals reveal more creative (original and fluent) outcomes in figural and verbal creativity domains than monolinguals (Simonton, 2008). However, although most researchers agree on bilingual advantages in different creative types, both verbal and figural creativity (Lee

& Kim, 2011; Madhav & Anand, 2012), some studies show a monolingual advantage in verbal creativity instead of a bilingual advantage (Kharkhurin 2010b). Studies suggest that bilingual individuals have better performance on verbal creativity and figural creativity tasks (Leiken & Tovli, 2014, Sampedro & Pena, 2019b). For example, Ricciardelli (1992b) demonstrates that bilinguals have more outstanding creativity scores on both verbal and figural task domains. She reviewed 24 separate studies: 14 of them show bilingual superiority on verbal creativity tasks, and 12 of the studies exhibit bilingual advantages on figural divergent thinking tasks. Moreover, recent research conveys that being L2 proficient bilingual is advantaged in verbal and figural creativity domains; in other words, there is a positive association between L2 proficiency and figural and verbal creativity (Sampedro & Peña, 2019a). Authors found that L1-Basque and L2-Spanish speaking bilinguals in early adolescence (age ranged 9-to 12) performed better at verbal and figural creativity tasks. L2 proficiency was an essential factor in predicting creativity performance in that experiment. As such, high proficient bilinguals display better performance in both figural and verbal creativity than moderate bilinguals. Participants with low and moderate L2 proficiency succeed less in verbal creativity tasks than monolingual and balanced bilinguals. The relationship between bilingualism and creativity is closely related to L2 proficiency. The degree of bilingualism or proficiency at L2 is a crucial predictor of the bilingual advantage of creativity domains; research shows positive relation between L2 proficiency and creativity (Lee & Kim, 2011; Wang & Cheng, 2016). To accurately investigate the relationship between bilingualism and verbal creativity, it is crucial to obtain the level of bilingualism. There might be a positive relationship between L2 proficiency and verbal creativity instead of the self-reported level of bilingualism. Even though studies mentioned above instantiated bilingual advantage in verbal creativity, specific research findings disagree with that idea (e.g., Kharkhurin, 2010b). Some reasonable explanations attribute that monolinguals have better verbal abilities than bilinguals due to bilingual disadvantages in speech production. Ivanova and Costa (2008) showed that monolinguals are faster in the verbal naming task than bilinguals. In that study, bilinguals were tested in their dominant L1 and proficient L2, but monolingual participants outperformed both trials of bilinguals. Hence, some expectations that bilingual individuals will have lower performance on verbal creativity tasks due to poorer bilingual performance on language tasks. In a study, Kharkhurin

(2010b) tested that hypothesis; they recruited bilingual (L1- Russian; L2-English) and monolingual (L2 -English) adult participants. All participants get the Picture Naming task as a productive vocabulary test and the Abbreviated Torrance Test for Adults, including verbal and figural creativity tasks. The findings indicate that monolinguals get higher scores on the vocabulary task. In parallel, they perform better at verbal creativity tasks than bilingual participants. On the other hand, the same study replicates previous research findings that bilingualism is positively related to figural creativity. In that study, bilingual participants show higher performance on figural creativity tasks than monolinguals (Kharkhurin, 2010b). Moreover, some studies show monolingual children have better narrative skills than bilingual children; for example, a recent study conducted in Turkey exhibited that children who enroll in L1 preschool perform better at narrative competence than students who attend L2 speaking preschools (Aktan-Erciyes, 2020).

Overall, it should be noted that when studying the relationship between bilingualism and creativity: L2 proficiency highly matters. Not taking L2 proficiency into account can be considered as a gap in the literature. Studies have found a relationship between bilingualism and creativity, but this relationship can vary according to the type of creativity (verbal or figural) and L2 proficiency of individuals. Specifically, bilinguals are found to be more successful than monolinguals in figural creativity tasks, while their performance in verbal creativity is associated with their L2 competence.

2.2 Bilingualism and Executive Functions

Several research investigated the association between bilingualism and executive functions and the specific relationship between specific core executive functions (inhibitory control, cognitive flexibility, and working memory) and bilingualism. Studies exhibit two different results; some argue that bilingualism is positively related to executive functions; on the other hand, some results showed a negative relation between bilingualism and executive functions. A meta-analysis study investigated bilingual advantages in executive functions in children with bilingual and monolingual language status aged from 3 to 17, examining 145 studies with published and unpublished data sets (Lowe et al., 2021). The results of the meta-analysis show that there is no coherent evidence of bilingual advantages in executive functions across reviewed studies.

However, some studies demonstrated bilingual advantages in executive functions depending on specific tasks and L2 proficiency. For example, use of verbal tasks moderate relationship between bilingualism and executive functions. Further, L2 proficiency had small but significant positive moderation between bilingualism and executive functions. Even though there was a small association between bilingual language status and executive functions of children the overall results of the meta-analysis study exhibited that language status (being monolingual or bilingual) and executive functions are not significantly related (Lowe et al., 2021). There is another meta-analysis study reviewing the relationship between bilingualism and executive functions in adults. The study reviewed 152 studies to examine the relationship between bilingualism and executive functions in adults. (Lethonen et al., 2018). The results of the meta-analysis indicated that there was no consensus on whether bilingualism had an advantage on executive functions. However, studies that used Wisconsin Card Sorting Task show a positive relationship between bilingualism and cognitive flexibility, results showed a small to medium effect on bilingual advantage on cognitive flexibility. There was no significant association reported with other cognitive flexibility tasks. Also, they found a small but significant bilingual advantage in figural tasks; bilinguals perform better in figural tasks than monolinguals in all executive function domains (Lethonen et al., 2018). Grundy et al. (2017) suggested that finding bilingual advantages with adult samples is challenging because most adults perform adequately in executive function measures. Furthermore, there were studies that exhibit a relationship between bilingualism and executive functions in children (e.g., Carlson & Meltzoff, 2008; Zelazo et al., 2003). For example, a study compared Spanish-English bilingual preschoolers' executive functions with monolingual English children found that bilingual children outperformed on executive function tasks when SES and parental education were controlled (Carlson & Meltzoff, 2008). Another early study decelerated better performance on the Dimensional Change Card Sorting (DCCS) task for bilingual children, a cognitive flexibility task for preschool children (Bialystok, 1999). Children who correctly sort the cards both in a way instructed and after the instruction switches successfully pass the task (Zelazo et al., 2003); in other words, they should apply inhibitory control and cognitive flexibility. Bialystok (2001) states that bilingual people practice inhibitory control when choosing

the appropriate language and inhibiting non-relevant ones. This daily practice might cause an advantage in inhibitory control.

A recent study with a large sample including 11,041 adult participants found no significant association between bilingualism and better executive function scores. They used 12 different executive function measures with monolingual and bilingual participants, including Double Trouble, Spatial Planning, Odd One Out, Grammatical Reasoning, Feature Match, Polygons, Digit Span, Rotations, Token Search, Paired Associates, Spatial Span, Monkey Ladder. The results showed that bilinguals did not score better on 11 different EF tasks (Nichols et al., 2020). In this large-sampled study, researchers only used detailed demographic questionnaires to determine bilingual participants; there were no standardized language tests. Self-report surveys to determine level of bilingualism is not a reliable source. Because participants would overestimate or underestimate their L2 proficiency. Using standardized tasks to determine level ol bilingualism/L2 proficiency give reliable results for bilingualism studies.

Cognitive processes, executive function, and creativity development are sensitive to social/environmental factors such as socio-economic status (SES). Previous research has demonstrated that SES affects children's executive function development; a meta-analysis including 8760 children from 25 independent studies showed a significant relationship between executive function and SES across all studies (Lawson et al., 2018). Distinguishing the effects of SES and bilingualism on executive functions could be complicated. Calvo and Bialystok (2013) consider the effects of bilingualism and SES separately. They found that low SES monolingual children perform worse on nonverbal reasoning and visual search tasks than mid-SES monolingual children. However, bilingual children only outperform monolingual children on executive function tasks. The study claimed that both SES and bilingualism impact cognitive functioning; however, there was no specific interaction between SES and bilingualism. Carlson and Meltzoff (2008) demonstrated that low SES bilingual children who speak Spanish-L1 and English-L2 had better performance on inhibitory control tasks than monolingual peers.

Overall, there are different findings in the literature on bilingual advantage in executive functions. The results could be differed due to aging (adult or child sample), task types (verbal or figural), and specific executive function tasks (e.g., Wisconsin Change Card Sorting Task).

2.3 Creativity and Executive Functions

Generating creative ideas is suggested to be related to inhibitory control, working memory, and cognitive flexibility. Most of the studies investigating executive functions and creativity focus on inhibitory control (e.g., Edl et al. 2014). Studies showed a positive association between divergent thinking and inhibitory control tasks (Groborz & Necka, 2003; Zabelina et al., 2019). For instance, Zmigrod et al. (2015) investigated the relationship between inhibitory control and verbal creativity tasks; they used Alternate Uses Task (AUT) as a divergent thinking/creativity measure in university students. In this task, they asked for alternative usage of an everyday object. The findings suggested that inhibitory control and verbal creativity were positively associated. Also, a study using brain imaging techniques to investigate the relationship between verbal creativity and inhibitory control showed that greater performance in verbal creativity was related to the activation of brain areas that are responsible for the semantic representation and inhibitory control (Zhu et al., 2013).

On the other hand, some research showed that creativity and inhibitory control are negatively related; increased performance on creativity task (Alternate Uses Task) was related to decreased inhibitory control. Researchers suggested that depleted inhibitory control might benefit idea generation in Alternate Uses Task (Radel et al., 2015). Low inhibitory control may be associated with creative idea generation. Disinhibiting the active search for concepts and knowledge might cause releasing of uncommon and irrelevant concepts from working memory that helps creative idea generation. On the other hand, a lack of inhibitory control can be dysfunctional, leading to meaningless outputs instead of generating creative ideas (Benedek et al., 2012). To generate more creative outputs, standard and most apparent thoughts need to be effectively suppressed, which is possible with high inhibitory control (Edl et al., 2014).

Few studies investigated the relationship between creativity and working memory (Palmiero et al., 2022). De Dreu et al. (2012) reported a positive correlation between working memory and creativity in fluency and originality subcategories. Benedek et al. (2014) showed that working memory and inhibitory control predicted creativity but were not related to cognitive flexibility. A more recent study replicated these findings: Zabelina et al. (2019) conducted a study with an adult sample (age range from 19 to 47). They administered a standardized verbal and figural creativity task and executive function tasks for working memory, inhibition, and cognitive flexibility. Results showed that executive functions were significantly related to creativity scores, especially working memory capacity, which predicted higher creativity in the fluency category (Zabelina et al., 2019). Krumm et al. (2018) study found that cognitive flexibility was related to creativity tasks. Pan and Yu (2018) show that cognitive flexibility was related to fluency and flexibility scores of creativity; they found a mediator effect of cognitive flexibility between creativity and intelligence. Moreover, Palmiero et al. (2010) demonstrated that adult participants who had high performance on cognitive flexibility tasks had higher scores on ambiguous figure tests, which required reinterpreting the given figures. Also, they found a positive correlation between cognitive flexibility and reaction time of ambiguous figures. Also, there was a relationship between cognitive flexibility and language processes. Individuals who had higher cognitive flexibility successfully integrated and chose meanings and linguistic forms appropriately. Children with high cognitive flexibility were more successful at verbal tasks due to better selecting and constructing meaning and conceptual representation (Deak, 2003). Therefore, cognitive flexibility and flexible language use were related. More novel narratives were created with flexible language use. People need to convey and combine to generate a creative narration. So, there might be a relationship between cognitive flexibility and verbal creativity.

On the other hand, researchers did not investigate the specific effects of executive function components on different types of creativity scores (verbal and figural). Most studies used only a dimension of the executive functions, which was generally, an inhibitory control component (Benedek et al., 2012; Cassotti et al., 2016; Edl et al., 2014). The contribution of working memory to creativity was understudied, but few research findings have shown that working memory significantly predicted creativity scores.

(Benedek et al., 2014; De Drue et al., 2012). It is essential to investigate the impact of working memory on verbal and figural creativity types differently. Because there are different processes in the types of figural and verbal creativity, while language is involved in verbal creativity but not in figural creativity, so the relationship between working memory and figural creativity might be different than verbal creativity. Studies that found a positive relationship between creativity and working memory capacity used measures including a composite creativity score including verbal and figural creativity (Benedek et al., 2014; Hao et al., 2015). Previous studies had a composite score of creativity (coming from figural and verbal creativity). Studies that included figural creativity measure found a positive association between creativity and working memory, while studies that only used verbal creativity measure had found no association between creativity and working memory. Thus, it was necessary to study the relationship between figural creativity and working memory capacity. For example, Zabelina et al. (2019) used figural creativity tasks in their research design, and they found a significant relationship between working memory and creativity. However, Leikin et al. (2020) study did not find any effect of working memory on creativity when using verbal creativity tasks. Starting from the point of view, differences in the effects of working memory on figural creativity might result from using different tasks. Because verbal skills were not associated with performance on figural creativity tasks (Khukhrain, 2010a). In order to be better at figural creativity performance, it is necessary to combine different concepts and different features, and for this, it is necessary to make a creative and original combination by calling the features of objects from memory to different objects, so it was thought that working memory capacity and figural creativity are related. Working memory plays an important role in creativity because temporary information is stored in working memory, and thought processes are supported by recalling it (Lu et al., 2022). Working memory enables active and controlled research in memory (Unsworth & Engle, 2007). More creative outputs are expected to be obtained by combining unrelated concepts in the creativity tasks, which is possible with a controlled and focused memory search. The high working memory capacity makes it easier to active research and hold more unrelated concepts in the memory (Benedek et al., 2014). Furthermore, high working memory capacity increases persistence. Individuals with higher working memory capacity can perform creativity tasks in a more persistent and focused way, leading to more creative outputs (De Drue et al.,2012).

2.4 Present Study

In the literature, there are some studies investigating the relationship between bilingualism, creativity, and executive functions. Various findings have been reported on the association between bilingualism and creativity. Previous studies suggest that the relationship between bilingualism and creativity varies depending on the L2 proficiency of the participants and creativity tasks, whether figural or verbal creativity tasks. Even though there are robust findings on the association between figural creativity and bilingualism (Dijk et al., 2019; Lee & Kim, 2011), there are inconsistent results on verbal creativity and bilingualism (Kharhrumin, 2010b; Madhav & Anand, 2012; Sampedro & Pena, 2019b). Previous studies used only one type of verbal creativity measure, and there is no study investigating the relationship between different verbal creativity tasks and bilingualism. The present study included two different verbal creativity tasks. In the first verbal creativity task (Story Completion Task), participants were asked to narrate a story, and in the second verbal creativity task (verbal fluency task), participants were asked to produce a list of words in different categories. The present study investigated associations between different verbal creativity tasks and bilingualism and executive functions to fill the gap in the literature.

Furthermore, there are some studies that examine the relationship between working memory and creativity however these studies do not focus on different types of creativity such as verbal and figural. They used a composite creativity score; studies found a positive relationship between working memory and creativity tasks, including both figural and verbal creativity tasks, but they had a composite creativity score from figural and verbal creativity (Benedek et al., 2014; Zabelina et al., 2019). However, studies that include only verbal creativity do not find any significant association (e.g., Palmiero et al., 2010). Thus, this study aimed to investigate the relationship between figural creativity and working memory capacity. Participants had to search and bring imaginary figural concepts from their memory to combine unrelated images and objects to make creative figural outcomes. We expected that children with higher working memory capacity could call several irrelevant objects's features from their memory to create an original figural output.

Finally, this study investigated the contribution of L2 proficiency as a continuous variable instead of using categorical monolingual / bilingual distinction. Some studies measure participants' language proficiency by self-report measures; however, this method would not be the best way to investigate bilingual advantage on cognitive function tasks such as creativity tasks. Thus, we considered L2 proficiency in the present study, and we hypothesized that higher L2 proficiency would be associated with better figural and verbal creativity performance. Moreover, it is important to investigate the relationship between L1 proficiency and verbal creativity. In the present study, participants were tested in their L1. However, in those studies, the association of L1 proficiency was not controlled. The present study also aimed to control for L1 proficiency.

The present study aims to investigate the relationship between verbal and figural creative abilities with executive functioning, and bilingualism (reflected in L2 proficiency) in preschool children, controlling for L1 proficiency and SES. The specific research questions are as follows:

1. How do bilingualism (L2 proficiency) and preschool children's verbal and figural creativity associate?
2. What is the relationship between three core executive functions (inhibitory control, working memory, and cognitive flexibility) and verbal and figural creativity?

Hypotheses

1. There will be a positive link between bilingualism and creativity.

Children who have higher L2 proficiency will show better performance on creativity tasks than children who have lower L2 proficiency.

2. There will be an association between bilingualism (L2 proficiency) and inhibitory control, cognitive flexibility, and working memory.

3. There will be a positive relationship between verbal creativity and inhibitory control.

4. There will be a positive relationship between verbal creativity and cognitive flexibility.

5. Working memory capacity will be specifically positively associated with figural creativity.

3. METHOD

3.1 Participants

The sample consisted of 56 preschool children aged between 4 and to 6-years (Mage=65 months, SD=7.7). In this study, participants were attending a preschool, all children had English lessons at their preschools, and some of them were attending English immersion schools. Due to the pandemic, some children could not regularly attend school. We considered L2 proficiency a continuous variable instead of categorizing two language groups like bilinguals and monolinguals. PPVT-IV measured participants' L2 proficiency. Children's overall performance in PPVT-IV indicated that they could be considered bilinguals (see Figure 3.1 for distribution of standard scores). We calculated their standard scores for PPVT-IV; their mean, standard score was 44.8, with an SD of 19.2. The mean PPVT-IV standard score for the high bilingual group was 61.9, with an SD of 8.2. Participants were from middle to high SES families. Therefore, SES was used as a control variable. We used both mother's education and income as indicators of SES and derived a composite SES score using these two variables.

We had participants from 18 different cities. 32.1% of the participants were from Muğla, 30.3% were from Istanbul, and 9% were from Adana (for distribution of the cities, see Appendix H). All children's and their mothers' L1 were Turkish. Only two participants had a babysitter speaking L1: Turkish.

To recruit participants, the study was announced on social media accounts of Studies in Language and Bilingualism Lab, scientific study advertisement websites, and volunteer private kindergartens.

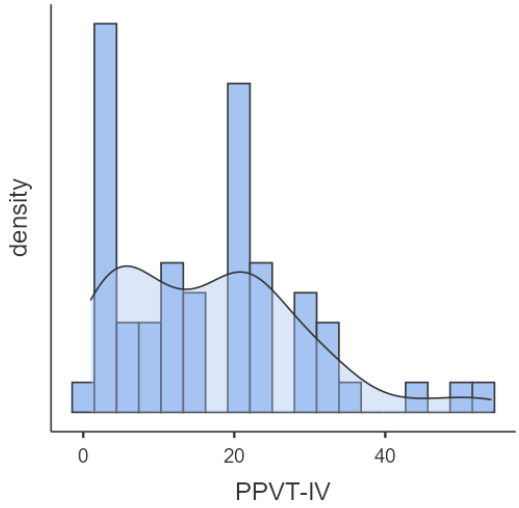

Figure 3.1. Distribution of PPVT-IV Standard Scores

3.1 Materials

3.1.1 Demographic information form

In this form, parents answered questions about the home environment and their demographic information. The form included the education and income level of both mother and father (to determine SES level), L2 input at home, mothers' native language, number of children they had, the age that child started to learn L2, which city they live in, and the academic language of the preschool. Mothers completed this online survey to report familial demographic information on Google Forms.

Parents reported their monthly household income on a 5-point Likert-type scale (1= less than 3.000 TL; 2= 3000-5000 TL; 3= 5000-7000 TL; 4= 7000-10000TL; 5= 10000 TL
and above). The income variable was taken as a categorical variable. Parents report maternal and paternal education levels on a five-point Likert scale. They were asked to report the last education level they graduated (1= primary school;

2= secondary school; 3= high school; 4= university; 5= graduate studies. Only maternal education level was used in the analysis; this variable was a categorical variable. One of the demographic questions asked the preschool's education language if the child attended one. Mothers chose one of the five answers (1= only Turkish; 2= mostly Turkish but have some English; 3= equal English and Turkish; 4= only English; 5= not attending). Parents reported L2 intake at home on a 5point Likert scale (1= Never; 2= less than 30 minutes; 3=30 minutes to 1 hour; 4= 2 to 3 hours; 5= more than 3 hours). Also, they reported their children's L2 screen time (1= Never; 2= less than 30 minutes; 3= 30 minutes to 1 hour; 4= 2 to 3 hours; 5= more than 3 hours). (See Appendix A for demographic form questions).

3.1.2 Creativity tasks

Test of creative imaginary abilities (TCIA)

This measure included seven subtasks that present seven unfinished drawings on separate pages. In the original study, participants received the task as a seven-page booklet (Jankowska & Karwowski, 2015). In the remote version of the study, participants received seven separate A4 sheets, including each unfinished drawing. Participants were asked to think about what given unfinished lines and shapes remind them of. The

participants were informed that they could change and add any way they wished to do it; more creative, original, and unusual ideas are even better. The given time to solve this test was not limited. The TCIA measures imaginary and figural creativity and relied on three conjunctional characteristics: vividness, originality, and transformative ability. Vividness was the ability to generate clear and complex, specific, elaborated imaginary characters. Originality was the ability to generate novel ideas and characters. Transformative ability was modifying and transforming generated images into new forms. The highest score that one participant could reach was 42, and the lowest score was 0.

Two undergraduate assistants from the Studies in Language and Bilingualism Laboratory scored the task. A high degree of reliability was found between the scores of two independent coders. The Intraclass Correlation Coefficient (ICC) was .86 with a 95% confidence interval from .80 to .91, $F(55, 110)= 20.213$, $p<.001$. The coding scheme is presented in Table 3.1.

Table 3.1. Coding Scheme for Test of Creative Imaginary Abilities

Score	Vividness	Originality	Transformativeness
0	Not drawing was interpreted, just given title.	Drawing figure as in its typical features/shapes	Stating original figure.
1	Simple and schematic completion of the titled figure.	A simple modification of the shape and function of the typical objects.	Simple recreation of the original figure, adds few modifications, objects.
2	Complex and detailed complementation of the figure.	Significant changes in the functions and shape of the figure do not represent reality.	A complex modification changes the figure in multiple aspects.

Story completion task

In this task, participants were asked to complete a story. They received two stories, and the first one is the warm-up story for starting (Birthday Party Story). In the original task, the experimenter showed the child two girl doll figures for female participants and a boy figure for male participants. However, in this data collection session, we used Power-Point slides to introduce the characters in the story. Instead of playing with dolls to reenact the scene, the experimenter presented Power-Point slides to the children, and each child received the same familiar birthday story that was easily perceived by most of the children. After the warm-up story, children were asked to complete another study called the "Key Story" as a narrative creativity task. The experimenter showed two children on a path, and the children found a key. After the experimenter said, "They found a key," then she asked what would happen next. The participant then started to tell her/his story. Children's narratives were transcribed and coded by three independent coders to score participants' creativity. Coders read all transcribed narrative completion twice. In the first turn, they read all stories to see all the different responses, which were presented in random order. The second time, they started to rate transcriptions for narrative creativity on a range from 1 (less creativity) to 5 (high creativity; Amabile; 1982). After the coders read all the stories, they scored these narratives independently. The coders compared stories that narrated by children to decide which story was more or less creative. Talkativeness and willingness to tell a story did not count as indicators of narrative creativity. The final score is calculated by taking the average of three scores from independent coders for each participant.

We used intraclass correlations to measure reliability. The Intraclass Correlation Coefficient (ICC) was .815 with a 95% confidence interval from .730 to .880 ($F(55, 110)= 14.212$, $p<.001$).

Verbal (semantic) fluency task

In this study, the Semantic Fluency Task was used as a verbal creativity task. In this task, there were three different categories, and participants had been asked to tell words related to these categories. Participants have been asked to say as many words as possible they

can produce in three categories (animal, food, and picnic) in 60 seconds. The verbal fluency task was coded through three sub-scores: fluency, flexibility, and originality scores, and three categories: animal, food, and picnic. First, the experimenter asked the participants to list all words that came to their minds when she called out the animal's name. Then, experimenter gave the same instructions for food and finally for the picnic category. This task was used to measure participants' verbal creativity performance. The procedure of the task was the same as the original, but the coding scheme was different. To have a verbal creativity score, we used fluency, flexibility, and originality sub-scores of divergent thinking/creativity.

Two independent coders coded the task results. We used a coding schema from Leikin and Tovli (2014). There are three sub-scores: fluency, flexibility, and originality. Each score has a unique scoring schema. First of all, we calculated the fluency score. For each category (animal, food, and picnic), the total number of given answers made a fluency score. Participants got 1 point for each word they came up with. They have three fluency scores: animal fluency, food fluency, and picnic fluency. Second, flexibility referred to the number of categories of a given answer. To calculate the flexibility score, we grouped listed words. The first word of a specific category was 10 points, and other words belonging to the same category received 0.10 points. Unique answers were worth 1 point. For example, in the animal category, participants could produce words belonging to farm animals, wild animals, and pets such as cow, ship, lion, zebra, tiger, dog, and cat. From this example, zebra, tiger, and lion belonged to the group of wild animals; zebra is worth 10 points because it was the first produced word in the wild animal group, and others (zebra and tiger) had .10 points. Unique words such as alligator or sea otter have received 1 point. Summing up given points for each word gives the total score for flexibility. All three categories have flexibility scores: animal, food, and picnic flexibility scores.
Last, to compute the originality score, each individual answer is evaluated and compared to all answers of the population. An answer gets 10 points if the given answer was produced by less than 15% of total participants; 1 point if the given answer was produced by more than 15% but less than 40% of all participants; 0.1 points if a given answer produced by more than 40% of all participants. Total creativity score came from the sum of fluency, flexibility, and originality scores.

All three verbal fluency categories (animal, food, and picnic) had their creativity scores by summing fluency, flexibility, and originality sub-scores of related categories. Thus, each participant had creativity scores for the animal, food, and picnic category.
Leikin and Tovli (2014) created seven scores: animal category score, food category score, picnic category score, fluency score, flexibility score, originality score, and total verbal fluency score. We tested all seven scores as outcome variables.

We used intraclass correlations to measure reliability. The ICC was .843 with a 95% confidence interval from .441 to .960 ($F(9, 9)= 15.446$, $p<.001$).

Table 3.2. Coding Scheme for Verbal Fluency Task

Fluency	**Flexibility**	**Originality**	**Creativity**
Number of total answers	10 points for the first answer of each category	10 points for the answers given less than 15% of participants	Sum of fluency, flexibility, and originality scores
	0.1 points for each following answers in the same category	1 point for the answer given at range 15% and 40% of the participants	
	1 point for the unique answers	0.1 points for the answer given by more than 40% participants	

3.1.3 Executive function measures

Dimensional change card sort task (DCCS task)

The DCCS task is designed to measure executive functioning skills, especially cognitive flexibility (Zelazo, 2006). In this study, an online version of the game was used. In the original task, the experimenter presented the child with two trays (one tray included a blue ship and the other included a red rabbit), then asked them to sort cards by pointing

due to their characteristics (i.e., blue ship, red rabbit). There were two conditions to sort cards: shape and color. When the child was asked to sort cards according to shape, the child pointed to the ship tray to sort the ship card and pointed to the rabbit tray to sort the rabbit card. The first two trials were warm-up trials. After then, test trials started. The experimenter showed five cards to the child consecutively. The child pointed rabbit or ship tray after the experimenter asked where the target card would go. The experimenter did not give any feedback or remind rules during the test trials. The child was asked to show which card belonged to which tray due in the shape game. After the shape game, the experimenter switched to the color game. In the color game, the child was asked to place target cards according to their colors; the blue card went to the blue card tray, and the red card went to the red card tray. After two warm-up questions, the child received five cards sequentially. The experimenter did not give any feedback, but she reminded the rules beginning of each trial. After four correct trials out of five trials in the color game, the child received the border version of the DCCS. In the border version, the experimenter showed a card framed with black borders and asked the child whenever she saw a card with a black border to play the color game and whenever she saw a card without black borders, play the shape game. After each trial, the experimenter reminded of the rules of the border versions. After five trials, the game ended, and all successful points the child made gave the final score.

Bear dragon task

Bear Dragon task aimed to measure inhibitory control. The original task involved the experimenter introducing two puppets: a bear (the cow is used instead of bear in the present study) and a dragon (the lion is used instead of the dragon in the present study), to the child. The bear puppet is kind, and the experimenter introduced the bear puppet as a friend, and she stated that whatever the nice bear puppet told the child to do, the child should follow and perform (e.g., touch your head). The dragon puppet was mean, and the experimenter introduced the dragon puppet as not a friend, and she said that whatever the naughty dragon puppet asked the child to do, the child should not do it (e.g., touch your nose). The experimenter explained the game to the participants. There were two practice trials that used a bear puppet and a dragon puppet once. If the participant could not understand and successfully perform at practice trials, the experimenter provided the

instructions again. If participants completed practice trials, 14 test trials were given with bear and dragon puppets in alternating orders.

This task was an inhibitory control task, and dragon (lion in this study) trials provide an index of inhibition. Children were expected not to move at all in inhibition trials. They must not do what the lion puppet said, and they must not move at all. If the child did or attempted to do the movement that the lion puppet said in inhibition trials, she or he got 0 points from this attempt. But children who did not move in inhibition trials got 1 point for that trial. So, the movement scored 0, and no movement scored 1 in the inhibition trials. Behaviors of the children in inhibition trials (no moves) give the total score out of 7.

Forward and backward digit span task

Forward and Backward Digit Span Task was a standard test for measuring working memory. We used forward and backward digit span task from the standardized Turkish version of WISC-IV (Uluç et al., 2011). In the forward trial, participants were asked to remember and repeat numbers that the experimenter said. Task started with the two-digit span series and continued until the nine-digit span series. When the participant failed to repeat two sets of digits correctly, the experimenter ended forward to trial and switched to the backward digit span task. The experimenter demonstrated the game (she instructed, "You will hear a sequence of numbers, and I want you to repeat the sequence in a backward order"). There are two warm-up trials with two-digit-spans. After the participants successfully passed the warm-up trial, the experimenter started the test. If children could not successfully repeat digits in a backward manner, the experimenter could provide extra four warm-up trials until children understood and passed the warm-up series. If participants could not repeat the series after the additional warm-up series, the experimenter did not start the actual test. For those who successfully passed the warm-up trial, the experimenter finished the test after participants made two mistakes in repeating digit series backward. Every set had two series of digit spans.

Each digit series are worth as 1-point, highest point participants could reach is 16. The total score does not indicate the number of digits repeated; total scores are equal to the

successfully completed amount of the series. In this study, we only use the Backward Digit Span Task score.

3.1.4 Language measures

Turkish expressive and receptive language test- receptive subtest (TİFALDİ-R)

This language test was designed to measure children's receptive vocabulary abilities at age 2-to- 12 for Turkish. (Kazak Berument & Güven, 2013) The task included 104 items consisting of four pictures. One of the pictures representing the target word and stimuli was said by the experimenter. Participants were asked to point to the target word out of four pictures. The sum of all correct responses of the child is calculated as the total score of the task. In this study, we used a remote version of the TİFALDİ-R. Each page of the TİFALDİ-R booklet was transformed into Power-Point slides and represented to children screen via Zoom. Child was asked to point corresponding word on her screen. If the experimenter could not identify the pointed picture, asked the mother to identify the number of pointed pictures.

Peabody picture vocabulary test iv (PPVT-IV)

The Peabody Picture Vocabulary Test-IV is used for measuring receptive language skills in English. PPVT-IV is designed for norm-referenced receptive language assessment for a large age range (2 years-to adulthood) (Dunn and Dunn, 2007). The task included training items and 228 test items that each item consisting of four colored pictures on each page. Experimenter read a word for each item, and the child needed to point to the corresponding correct picture (each situated four corners of the screen), which reflected the word's meaning. The task last 15-20 minutes. The scores ranged from 0 to 96, higher scores represented high L2 receptive ability.

In the present study, we used a remote version of PPVT-IV, we made a Power-Point slide with using pages of the original task and added audio records for each word. All participants heard the same recordings.

3.2 Procedure

We collected entire data via an online meeting platform. Before data collection started, all parents were asked to sign a consent form and demographic information forms. Mother and child dyads joined the study, and mothers helped the experimenter with certain tasks. First, the experimenter introduced them to creative tasks. The first creativity task was Story Completion Task; the experimenter asked them to complete a story that she began. The second creativity task was the Test of Creative Imaginary Abilities (TCIA) to measure figural creativity. Children had completed unfinished line drawings. We sent an e-mail including the TCIA booklet to parents and asked them to print it before the data collection session started; we asked parents to give the booklet during the online meeting. Parents and children heard the instructions for the task and what to do with the booklet for the first-time during data collection. In the session, the experimenter asked the parent to present the booklet to the child. End of the session, the parent sent us photos of the child's completed drawings. The last creativity task was Semantic Verbal Fluency Task to measure verbal creativity. Then we passed to the executive function tasks. The first one was the Dimensional Change Card Sorting Task (DCCS). The experimenter asked the child to sit in front of the screen in the distance to see her upper body and hand movements. The child pointed to the tray in the DCCS task. In case of experimenter could not identify the answer of the child, the mother helped to experimenter by saying what the child pointed out. The second executive function task was the Forward and Backward Digit Span Task to measure working memory capacity. Next, the experimenter administered The Bear Dragon task. The experimenter introduced them to a nice bear and mean dragon puppet and told them commends to assess their inhibitory control. The last two tasks were language tasks and these tasks completed in another online session. All participants received TİFALDİ (for L1-Turkish) and PPVT IV (for L2-English) task to measure their L1 and L2 proficiency. The second data collection session was completed one week later the first data session. Only three children received the language measurement session two weeks later than the first session due to their availability.

4. RESULTS

4.1 Data Preparation

In order to compute a composite score for SES, we took maternal education level and monthly household income level. We first created standardized z-scores of maternal education and income, then we ran zero-order Pearson's correlation analysis, which showed a positive correlation between maternal education and income (r=.272, p=.042). After finding a positive correlational relationship, we took the average z-scores of maternal education and income, which reflected our final SES score.

We took L2 proficiency as a continuous predictor variable in the last step and thus did not add language group as a categorical variable as monolingual vs. bilingual. We decided to do this since, in our sample, we found out that all of our participants have been exposed to some form of L2 in varying amounts of time at school and/or at home. Thus, we took L2 proficiency as a continuous variable.

We created box plots to check whether there were outliers in the data, and none of the participants was excluded from the sample.

4.2 Creativity Measures

We had one outcome variable from Story Completion Task, and we called it verbal creativity in the regression model. The second creativity measure was the Test of Creative Imaginary Abilities to assess figural creativity. We computed one outcome variable through a figural creativity measure. We administered Semantic Verbal Fluency Task as our third creativity measure. We calculated seven different scores from the verbal fluency task as outcome variables. First, we calculated a creativity score from each sub-category: animal, food, and picnic by summing fluency, flexibility, and originality sub-scores. We had three creativity scores from the animal category of verbal fluency, food category of verbal fluency, and picnic category of verbal fluency. We created the fourth outcome variable from verbal creativity by summing fluency scores in the animal, food, and picnic

sub-categories. We named this variable as fluency sub-score of verbal fluency. Likewise, we created a flexibility score of verbal fluency outcome variable by summing flexibility sub-scores in the animal, food, and picnic sub-categories and originality score of verbal fluency by calculating originality sub-scores in the animal, food, and picnic sub-categories. The last score derived from the verbal fluency task was the overall verbal fluency score, which was made by summing the scores animal, food, and picnic sub-categories. In short, there were seven creativity scores derived from the verbal fluency task, which are creativity scores for animal, food, picnic categories, fluency, flexibility, originality, and overall verbal fluency scores.

4.3 Descriptive Statistics for Creativity, Executive Functions and Demographic Measures

Descriptive data for creativity, executive function measures, and demographics can be found in Table 4.1.

Table 4.1. Descriptive Statistics

	Mean	SD	Min	Max
Age	65.1	7.7	42	78
SES	-0.00018	0.8	-2.5	1.4
Maternal Education	2.9	0.5	2.0	4.0
Income	3.7	1.2	1.0	5.0
L2 Intake	1.5	0.7	1.0	3.0
L2 Screen Time	2.1	0.9	1.0	4.0
AoA	4.0	0.9	2.0	5.0
Num. of Child.	1.8	0.7	1.0	4.0
Preschool Ed.	3.4	0.9	1.0	4.0
PPVT-IV	16.9	12.5	1.0	54.0
PPVT-IV Std	44.8	19.2	20.0	80.0
TİFALDİ-R raw	76.7	11.5	34.0	95.0
Bear Dragon	6.2	1.2	4.0	7.0
Digit Span	3.0	2.1	1.0	6.0
DCCS	5.4	1.5	1.0	7.0

Verbal Creativity	2.4	1.2	1.0	5.0
Verbal Fluency	193	76	44.2	342
Figural Creativity	14.5	3.7	7.3	25.3

Note: L2 Intake: L2 intake at home, time for speaking L2 with children; L2 Screen Time: Time for exposing L2 on screen; AoA: Age of acquisition, when participants started to learn L2; Num. of Child.: how many children parents have; Preschool Ed: Education language of the preschools; PPVT-IV: Peabody Picture Vocabulary Test; PPVT-IV Std: Standard scores of Peabody Picture Vocabulary Test; TİFALDİ-R; Turkish Receptive and Expressive Language Test; Bear Dragon: inhibitory control task; Digit Span: Backward Digit Span Task for working memory; DCCS: Dimensional Change Card Sorting Task; Verbal Creativity: Story Completion Task; Verbal Fluency; Semantic Verbal Fluency Task; Figural Creativity: Test of Creative Imaginary Abilities

4.4 Associations Between Language Measures, Executive Functions, and Creativity Measures

We ran normality test and results showed variables that verbal creativity (Story Completion Task), PPVT-IV, Digit Span, and Bear Dragon were not normally distributed. Because of that, instead of Pearson's correlation test, we ran Spearman's correlation test to investigate the relationship between verbal creativity, language measures (PPVT-IV for L2 and TİFALDİ-R for L1), and executive functions. TİFALDİ-R (r= .315, p= .018) was positively correlated with verbal creativity. However, PPVT-IV and verbal creativity were not correlated. Also, there is no significant correlation between verbal creativity and executive function measures (DCCS, Digit Span, and Bear Dragon Tasks). TİFALDİ-R (r= .334, p= .012) and PPVT-IV (r= .304, p= .023) positively correlated with verbal fluency score. There is no significant relationship between executive function measures (DCCS, Digit Span, and Bear Dragon Tasks) and verbal fluency. Figural creativity positively correlated with PPVT-IV (r= .680, p < .001) and Digit Span Task (r= .412, p= .002); in other words, L2 proficiency and working memory positively correlated with figural creativity. DCCS (r= .446, p < .001) and Digit Span (r= .384, p= .004) significantly correlated with PPVT-IV.

No significant association was found between figural creativity TİFALDİ-R, Bear Dragon, and DCCS (See Table 4.2 for details of correlation analyses)

Table 4.2 Spearman Correlation Test Between Creativity, Language Measures and Executive Function Measures

		1	2	3	4	5	6	7	8	9
1	Age (month)									
2	SES	.014								
3	PPVT-IV	.258	.014							
4	TİFALDİ-R	.192	.258	.199						
5	Digit Span	.421**	.192	.384**	.218					
6	DCCS	.086	.421**	.446***	.424**	.283*				
7	Bear Dragon	.124	.086	.251	.099	.078	.147			
8	Verbal Creativity	.022	.124	.263	.315*	-.161	.227	.046		
9	Verbal Fluency	.109	.022	.304*	.334*	.192	.128	.149	.307*	
10	Figural Creativity	.227	.109	.680***	.080	.412**	.299*	.088	.263*	.381**

Note. * p < .05, ** p < .01, *** p<.001

4.5 Relationship between Creativity and L2 Proficiency

To investigate the relationship between bilingualism, executive functions, and different types of creativity, we tested nine models using hierarchical linear regression analyses. We used the following predictors in four steps: Age and SES were added in the first step as control variables. TİFALDİ-R was added in the second step. In the third step, Bear Dragon, Digit Span, and DCCS task scores were added. Finally, PPVT-IV was added as a predictor in the last step. These predictor variables are used for all models in the same steps and order.

In Model 1, verbal creativity (assessed by the Story Completion task) was the outcome variable. In the second Model, figural creativity was taken as an outcome variable. We tested seven Models using different verbal fluency task measures as the outcome variable. Verbal fluency was assessed by Semantic Verbal Fluency Task, which produced one overall and six sub-scores, including three subcategories (animal, food, and picnic) and sub-scores of creativity (fluency, flexibility, and originality). In Model 3, we used the animal category of verbal fluency as the outcome variable, the food category of verbal fluency in Model 4, and the picnic category of verbal fluency in Model 5 as an outcome variable. After we ran the analysis for separately each verbal fluency category, we created an overall score by summing all scores of verbal fluency subcategories. The outcome variable was the overall verbal fluency score in Model 6. We then arranged three new outcome variables from the verbal fluency task: we summed fluency, flexibility, and originality scores across three categories (i.e., animal, food, picnic) and thus computed verbal fluency-fluency, verbal fluency-flexibility, and verbal fluency-originality sub-scores. In Model 7, the verbal fluency-fluency was the outcome variable. Verbal fluency-flexibility score was used outcome variable in Model 8. In the last model, Model 9, we took the verbal fluency-originality score as the outcome variable.

4.6 Predicting Verbal Creativity from L2 Proficiency and Executive Function Measures

In Hypothesis 1, we expected there is a positive relationship between verbal creativity and L2 proficiency. To test Hypothesis 1, we conducted the regression model to examine the association between bilingualism, executive function, and verbal creativity (*Story Completion Task*). The model shows that higher L2 proficiency was associated with better verbal creativity (see Table 4.3). We entered SES and age as control variables; there was no significant relationship between verbal creativity and control variables (R^2=-.017, F(2, 52)= .52, p= .6). In the second step, we added TİFALDİ-R as a predictor variable to see an association of L1 proficiency. The model was still not significant when we added the second step (R^2=.063, F(3, 51)= 2.22, p= .09); however, a positive relationship has been found between TİFALDİ-R and verbal creativity (β= .311, p= .029). We entered three executive function measures (Bear Dragon, Digit Span, DCCS) in the third step, and the model remained nonsignificant (R^2 =.119 F(6, 48)= 2.22, p=.06). There was a negative association between Digit Span Task score and verbal creativity (β= -.411, p= .006). The results indicate lower working memory capacity was associated with a better verbal creativity score. There was no significant association between other executive function measures (Bear Dragon and DCCS) and verbal creativity. In the fourth step, we included PPVT-IV as the last predictor variable. In this step, the Model revealed a significant association with verbal creativity (R^2=.168, F(7, 48) = 2.56, p=.025). Our results confirmed Hypothesis 1.

Table 4.3 Predictors of Verbal Creativity in Children

Predictors		*B*	SE(B)	*p*	R_2
Step1					-.017
	Age	.020	.020	.895	
	SES	.050	.211	.743	
Step2					.063
	TİFALDİ-R	.311	.014	.029	
Step3					.119
	Bear Dragon	-.030	.169	.825	
	Digit Span	-.411	.084	.006	
	DCCS	.159	.116	.280	
Step4					.168
	PPVT-IV	.302	.014	.047	

4.7. Predicting Figural Creativity from L2 Proficiency and Executive Function Measures

In Hypothesis 1, we expected to find a significant relationship between L2 proficiency and figural creativity. In Hypothesis 5, we expected that there would be an association between figural creativity and working memory. We tested the regression model to investigate the association between figural creativity and bilingualism considering executive functions, L1 proficiency, SES, and age. We ran a four-step regression model. We added SES and age in the first step, which did not show a significant association R^2=.069, F(2, 52)= 3.00, p=.06. In the second step, TİFALDİ-R was added to measure L1 proficiency; the second step model is still not significant R^2 = .051, F(3, 51)= 2, p=.12. In the third step, we entered executive function measures (Bear Dragon, Digit Span, and DCCS). Model turned significant after adding executive measures in the third step F(6, 48) = 3.06, p=.013, R^2 = .186. There is a significant relationship between Digit Span Task and figural creativity (β= .341, p= .009). We found an association between figural creativity and executive functions but only with a working memory capacity. Higher working memory capacity related to better figural creativity performance. Nonetheless,

no significant association has been found between Bear Dragon and DCCS tasks. The regression model reveals a significant relationship in the fourth step including the PPVT-IV $F(7, 47) = 5.46$, $p < .001$, $R^2 = .366$. A significant association has been found between the PPVT-IV score and figural creativity ($\beta = .503$, $p < .001$). The model results indicated that higher L2 proficiency was related to higher figural creativity performance; however, L1 proficiency was not related to figural creativity. (The detailed findings can be seen in Table 4.4). Results showed that Hypothesis 1 and Hypothesis 5 had been confirmed.

Table 4.4. Predictors of Figural Creativity in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					.069
	Age	.059	.056	.620	
	SES	.114	.560	.352	
Step2					.051
	TİFALDİ-R	-.116	.039	.334	
Step3					.186
	Bear Dragon	-.011	.450	.924	
	Digit Span	.341	.223	.009	
	DCCS	.230	.321	.078	
Step4					.366
	PPVT-IV	.503	.038	<.001	

4.8. Predicting Verbal Fluency from L2 Proficiency and Executive Function Measures

In the present study, we used verbal fluency sub-scores as dependent variables. Dependent variables of the verbal fluency task were (1) Animal Category, (2) Food Category, (3) Picnic Category, (4) Fluency Score, (5) Flexibility Score, (6) Originality Score, and (7) Total Verbal Fluency Score. We used the original scoring schema and had seven outcome variables to test all.

We tested Hypothesis 1, whether there was a relation between L2 proficiency and creativity, and Hypothesis 3 and Hypothesis 4, whether inhibitory control and cognitive flexibility had related to verbal creativity (*Verbal Fluency Task*). To investigate the concurrent link from L2 proficiency to total verbal fluency score of verbal fluency task, age and SES were included as control variables in the first step. The model was not significant for control variables R^2= -0.146, $F(2, 52) = .94$, p= .39. TİFALDİ-R was entered in the second step, the model was significant for TİFALDİ-R score $F(3, 52) = 2.97$, p= .048, R^2= 0.097. The model showed that higher L1 proficiency was associated with a high score in the verbal fluency task (β= .334, p= .040). Executive function measures (Bear Dragon, Digit Span, and DCCS tasks) were included in the third step. The model was not significant for executive function measures R^2= 0.09, $F(4, 48) = .09$, p= .105. In the fourth step we entered the PPVT-IV score, the model was not significant R^2= 0.08, $F(7, 47) = 1.81$, p= .105. Hypothesis 1, Hypothesis 3, and Hypothesis 4 had not been confirmed. (For details, see Table 4.5).

We tested the association between L2 proficiency and all categories of the verbal fluency task. In Model 3, we tested the association between animal category and bilingualism, L1 proficiency, and executive functions. In Model 4, we tested the relationship between food category and bilingualism; in Model 5, we examined the relationship between picnic category and bilingualism. For all three models (Model 3, Model 4, and Model 5), we entered age and SES in the first step, and the models were not significant in the first step. TİFALDİ-R was entered in the second step, and the models were not significant again. We inserted executive function measures in the third step, but the models were not significant after adding the third step. In the last step, we entered PPVT-IV to investigate the association of bilingualism/L2 proficiency; however, the models remained not statically significant. Model 3, Model 4, and Model 5 showed no significant relationship between verbal fluency scores in the animal category, food category, and picnic category and L1 proficiency, executive functions, and L2 proficiency. (See Appendix D)

We investigated the relationship between the fluency score (Model 6), flexibility score (Model 7), and originality score (Model 8) of Verbal Fluency Task and L2 proficiency,

L1 proficiency, and executive functions with the four-step regression model. SES and age were added as control variables in the first step. All three models (Models 6, 7, 8) showed no significant association in Step 1. We entered the TİFALDİ-R score representing L1 proficiency in Step 2. The Model 6 ($F(3, 52) = 3.70$, $\beta = .338$ $p = 0.017$, $R^2 = 0.147$), Model 7 ($F(3, 52) = 2.93$, $\beta = .300$ $p = .042$, $R^2 = 0.095$), and Model 8 ($F(3, 52) = 3.32$, $\beta = .944$ $p = .026$, $R^2 = 0.112$) turned significant after adding step 2. Model 7 also was significant for L1 proficiency. The results showed a significant relationship between high TİFALDİ-R score/L1 proficiency and fluency, flexibility, and originality scores of the Verbal Fluency Task. Bear Dragon, Digit Span, and DCCS Task were included in the third step. The models were not significant after adding step 3. In step 4, we included the PPVT-IV score that made the models not significant. (See model estimates in Appendix D)

Table 4.5 Predictors of Total Verbal Fluency Score in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					-.014
	Age	-.012	1.365	.927	
	SES	-.065	13.658	.651	
Step2					.112
	TİFALDİ-R	.334	.950	.040	
Step3					.106
	Bear Dragon	.177	10.946	.216	
	Digit Span	.077	5.542	.604	
	DCCS	-.060	7.546	.696	
Step4					.105
	PPVT-IV	.148	.939	.340	

5. DISCUSSION

The study aimed to investigate the relationship between different types of creativity: verbal and figural creativity, and L2 proficiency with taking into account the association of executive functions. For this purpose, we tested 56 preschool children aged between 4 to 6. We asked two research questions on the relationship between bilingualism, creativity, and executive function: (1) How does L2 proficiency relate to preschool children's creativity? (2) What is the relationship between inhibitory control, working memory, cognitive flexibility, and verbal and figural creativity?

Regarding our first research question, results indicated that bilingualism, measured by L2 proficiency, was positively associated with figural creativity and verbal creativity. Results showed no significant association between verbal fluency and L2 proficiency.

Regarding our second research question, our results showed that cognitive flexibility and inhibitory control were not significantly related to verbal or figural creativity tasks. Unexpectedly, working memory capacity and verbal creativity (from *Story Completion Task*) were negatively related, while there was no significant positive relationship between working memory and *Verbal Fluency Task*. On the other hand, figural creativity score and working memory capacity were associated.

5.1 Verbal Creativity

Two sets of verbal creativity measures were used to determine the performance of verbal creativity. The first one was *Story Completion Task* (Mottweiler & Taylor, 2014). We asked our participants to finish an unfinished story. The results showed that L1 and L2 proficiency positively related to verbal creativity on this task. Previous studies showed disagreements on the relationship between bilingualism and verbal creativity. Kharkhurin (2010b) claimed that bilingual individuals have worse performance on verbal creativity tasks due to poorer verbal skills than monolinguals.

On the other hand, recent research has shown that L2 proficiency was positively associated with verbal creativity (Sampedro & Pena, 2019b). In the present study, our findings from the *Story Completion Task* support a positive relationship between bilingualism and verbal creativity; bilingual individuals had better scores on Story Completion Task due to their L2 proficiency. Children who were more proficient at L2 had better scores on verbal creativity and narrated more creative and original stories in *Story Completion Task*. The increased score on the verbal creativity task was also related to better L1 proficiency.

The second verbal creativity task was the *Semantic Verbal Fluency Task*; originally, this task was used to measure verbal fluency. Leikin and Tovli (2014) used *Semantic Verbal Fluency Task* as a creativity task, coding responses according to fluency, flexibility, and originality sub scores of divergent thinking. The present research used the same procedure. Leikin and Tovli (2014) found that participants' performance depends on the subcategories of the task (animal, food, and picnic). In the study of Leikin and Tovli (2014), there was no difference between bilingual and monolingual children on animal tasks, but bilingual children performed better in food and picnic categories than monolingual children. Specifically, bilingual children had higher scores in fluency and flexibility on food verbal fluency and flexibility and originality on picnic verbal fluency (Leikin & Tovli, 2014).

Contrary to the previous findings, we did not find any significant differences depending on the categories of the verbal fluency task. We found that L1 proficiency is positively associated with sub-scores of the verbal fluency task (fluency, flexibility, and originality); nevertheless, L2 proficiency was not related to verbal fluency task performance. First, we calculated a verbal creativity score for each verbal fluency category (animal, food, and picnic); we did not find any significant association between any subcategories of verbal fluency task and L1-Turkish, L2-English proficiency, and executive functions. Then, we calculated fluency, flexibility, and originality scores for the verbal fluency task considering animal, food, and picnic subcategories. There was only a positive association between L1 proficiency for fluency, flexibility, and originality scores. In Gallon et al. (2002) study, bilingual adults had lower scores on the semantic fluency task than

monolingual participants; they suggest that the language competence of bilingual individuals was worse than monolinguals. In our sample, participants who had better L2 proficiency produced a fewer number of answers (fluency), fewer categories of responses (flexibility), and fewer divergent answers (originality). More L2 proficient individuals may know more semantic words than low bilingual individuals. Still, when the time came to list words on asked categories, individuals with better L1 proficiency performed better, leading to better verbal creativity scores on semantic verbal fluency tasks.

There is a discrepancy in creativity literature on whether verbal creativity and bilingualism are positively related. Our study showed that bilingual participants have better performance in narration. They used more original supplements to make a creative story, and, in this task, grammatical and vocabulary knowledge (e.g., number of words, syntactic complexity) were not taken into consideration. On the other hand, in the Verbal Fluency Task, participants who produced more words and divergent words in given categories were rated higher scores. Our results showed no significant association between bilingualism and *Verbal Fluency tasks*. The differences between two different verbal creativity tasks could be came from there. In the verbal fluency task, L1 proficiency plays a key role. The relationship between verbal creativity and bilingualism could change through the type of verbal creativity task; if the task needed better verbal abilities to succeed in it, bilingual participants would be less successful at that task.

Some studies show a positive relationship between working memory and verbal creativity (e.g., De Drue et al., 2012; Benedek et al., 2014). In the De Drue et al. (2012) study, they found a significant relationship between verbal creativity tasks that asked brainstorming about environmental protection and verbal working memory capacity.

We hypothesized that verbal creativity scores would be positively associated with executive functions. However, we could not support that hypothesis. We found no significant association between three core executive function scores and *the Verbal Fluency Task*. Moreover, verbal creativity scores from Story Completion Task and two executive function measures: inhibitory control and cognitive flexibility, had no significant relationship. Unexpectedly, there was a negative relationship between Story

Completion Task scores and working memory capacity. Those who were better in the Story Completion task had lower scores on working memory. The unexpected finding might be task-related; we used Backward Digit Span Task to measure working memory capacity; this task was negatively related to verbal creativity performance and might be too boring for those children with higher creativity. Haager et al. (2016) show a positive relationship between boredom and creativity due to increased fluency performance. However, boredom also impairs cognitive functioning; individuals who get bored with a task stop paying attention to it, and boredom reduces the chance of achievement (Pekrun et al., 2010). This could explain the unexpected result of the relationship between verbal creativity and working memory task; children who get bored from the *Backward Digit Span Task* had poorer performance on it. Lu et al. (2021) claim that visuospatial working memory is related to creativity performance and visuospatial working memory tasks predict verbal creativity performance better. When participants were asked to generate a verbal creativity output, visuospatial representation plays a crucial role in direct mental representations. Because of that, visuospatial representation is crucial for verbal creativity tasks instead of semantic or numeric representations (Lu et al., 2021). We used Digit Span Task to measure working memory, if we used visuospatial working memory tasks, we might find a positive relationship between visuospatial working memory and verbal creativity.

5.2 Figural Creativity

Figural creativity performance was measured by using the *Test of Creative Imaginary Abilities.* Participants completed seven unfinished drawings as they wished, and figural outputs were evaluated by three independent experimenters (coders). As hypothesized, figural creativity was associated with bilingualism/L2 proficiency. We found that higher L2 proficiency was positively related to figural creativity performance. Our findings are in line with previous research that demonstrated an association between figural creativity and bilingualism (Kharkhurin 2010a, Kharkhurin 2010b; Sampedro & Pena, 2019b). Although there are some findings on bilingual disadvantages in verbal tasks, bilingual individuals have better performance on figural tasks (Bialystok & Shapero, 2005). Because performance on figural tasks like *Test of Creative Imaginary Abilities* is not

directly related to language processing but performance on figural tasks related to controlling, shifting, and updating attention.

Bialystok and Shapero (2005) state that bilingual individuals can control their attention for better performance on figural tasks like identifying an alternative image in a figure that explains the association between cognitive advantages of bilingualism and figural creativity. Moreover, we found that figural creativity was related to working memory capacity, as hypothesized. Children with higher L2 proficiency were expected to have better cognitive abilities; in this study, we found that L2 proficient participants have better working memory capacity and better figural creativity performance. While the results showed that bilingualism and figural creativity is associated and children high in L2 proficiency have better scores on figural creativity, we found no relationship between age, SES, L1 proficiency, and figural creativity. L1 proficiency and figural creativity were significantly associated. A recent study has investigated the relationship between verbal and figural creativity between bilingualism/multilingualism among young adult participants in a workplace environment. They found that bilingual participants have better performance on creativity tasks, and their performance is superior, especially in figural creativity tasks; researchers suggested being in multilingual workplaces is beneficial for creativity performance (Geenen et al., 2022). The present thesis also found that higher L2 proficiency was related to better figural creativity performance. In our study, children who had better L2 proficiency mostly attended bilingual preschools and being in a bilingual school environment could be related to better performance on creativity. Because those children attending L2-educated preschools need to operate two languages, they switch between languages daily. Studies found that these two processes (operating and switching languages) related to creativity performance (Leiken & Tovli, 2014; Sampedro & Pena, 2019a).

5.3 Creativity and Executive Functions

We hypothesized that different executive functions (inhibitory control, working memory, and cognitive flexibility) would differently relate to different creativity types (verbal and figural creativity). We partially confirmed our hypotheses on the contribution of executive functions to the relationship between bilingualism and creativity. The first

hypothesis was that inhibitory control and cognitive flexibility would be associated with verbal creativity performance. However, the results showed no significant relationship between verbal creativity and inhibitory control, and cognitive flexibility. Benedek et al. (2014), who found that verbal creativity was related to inhibitory control, participants who had better performance on inhibitory control tasks (color Stroop Task) showed high scores on verbal creativity tasks (AUT and instance task). The study suggests that more creative idea generation is related to inhibiting prepotent responses, which causes remarkable and common but less creative responses. However, we found no significant relationship between inhibitory control and creativity measures (*Story Completion Task*, *Verbal Fluency Task*, and *TCIA*).

Palmiero et al., (2022) reviews studies to examine the relationship between divergent thinking and three core executive functions, and they state that discrepancies in findings of an association between creativity and inhibitory control result from a lack of theoretical background to define this relationship. Therefore, Zabelina et al. (2016) suggest that inhibitory control involves distant and irrelevant input; inhibitory control might be related to later systematic thinking. A study shows that inhibitory control is associated with insight problem-solving tasks instead of divergent thinking tasks (Tidikis & Ash, 2018). Inhibitory control might be related to tasks requiring more systematic thinking and taking time, like insight problem-solving tasks but not divergent thinking tasks that require immediate responses. Thus, our results showed no significant association between inhibitory control and verbal creativity tasks. Participants had no extra time to think and respond to Story Completion and Verbal Fluency Task deeply. In these cases, inhibitory control could not involve the creativity process. Future research should consider using creativity tasks suitable to think before producing a solution like problem-solving tasks. The present study showed no significant association between cognitive flexibility and neither of the creativity tasks. We hypothesized that cognitive flexibility and verbal creativity would be significantly related; however, the results did not support the hypothesis. In the literature, cognitive flexibility seems to be a key component of creativity (Baghetto & Kaufman, 2007), generating more creative and original ideas and producing novel outputs need the flexibility of thought (Palmierro et al., 2022). At the same time, it should be noted that there are few studies investigating the relationship

between cognitive flexibility and divergent thinking/creativity (Palmiero et al., 2022). Krumm et al. (2018) examine the relationship between verbal and figural creativity and cognitive flexibility tasks (Wisconsin Card Sorting Task). That study shows that cognitive flexibility and verbal and figural creativity are related; participants with higher scores on cognitive flexibility tasks performed better at creativity tasks. On the other hand, some studies show that there is no significant association between creativity (verbal and figural) and cognitive flexibility (Benedek et al., 2014; Zabelina et al., 2019). Even though some studies found a positive relationship between creativity and cognitive flexibility (e.g., Krumm et al., 2018), some studies still did not find any relationship between cognitive flexibility and creativity (Benedek et al., 2014; Zabeline at al., 2019). Future research should investigate cognitive flexibility and different creativity tasks.

The relationship between working memory and creativity was an understudied phenomenon in creativity and divergent thinking literature (Dijk et al., 2019). Most studies in this research field focused on the relationship between inhibitory control or cognitive flexibility and creativity (e.g., Edl et al., 2014; Zhang et al., 2016). Only a few research have investigated the relationship between working memory and creativity (e.g., De Dreu et al., 2012; Zabelina et al., 2019). Previous studies investigating the relationship between creativity and working memory do not specifically examine solely figural creativity performance (e.g., Benedek et al., 2014; Zabelina et al., 2019). However, Benedek et al. (2014) and Zabelina et al. (2019) studies have a total creativity score from verbal and figural creativity tasks and found a positive relationship between working memory and creativity. Benedek et al. (2014) found that working memory capacity is positively related to creativity, but they only administered verbal creativity/divergent thinking tasks. Zabeline et al. (2019) also showed that working memory and creativity are associated; in this study, they use ATTA as a creativity measure, and ATTA includes both verbal and figural creativity tasks; however, as in previous studies, they did not analyze the effects of working memory on verbal and figural creativity separately. They had an overall ATTA score and found that working memory related to the fluency of divergent thinking. We examined the relationship between figural creativity and working memory. As hypothesized, figural creativity and working memory were associated in the

present study. Results showed that participants with higher working memory capacity perform better at *the Test of Creative Imaginary Abilities*.

We hypothesized that figural creativity would be associated with working memory capacity considering previous literature. The results supported our hypothesis. Our participants attending L2 preschools have better performance on figural tasks or figural creativity tasks (e.g., Test of Creative Imaginary Abilities) in relation to working memory capacity. We found that working memory capacity contributes to the relationship between bilingualism and figural creativity because bilinguals have a cognitive advantage in working memory capacity (Bialystok, 2005). On the contrary, the relationship between verbal creativity from Story Completion Task and working memory was unexpected. The results demonstrate a negative relationship between verbal creativity and working memory capacity. Zabelina et al. (2019) found that higher scores in creativity tasks (used ATTA) and verbal working memory capacity are associated. When they used visual working memory tasks, Benedek et al. (2014) showed a similar relationship between creativity and working memory. Our unexpected findings might be related to the given task; we administered the Backward Digit Span task to participants that included a series of numbers to remember and repeat numbers in a backward manner. Verbal creativity performance might not be related to numeric working memory but to other working memory types such as verbal working memory or visuospatial working memory. Another explanation for surprising results would suggest individual differences among participants. Children who perform better at Story Completion Task might not enjoy Backward Digit Span Task. Preschoolers who are more interested in art and narrating a story might not be interested in math/number-related tasks. More creative children would get bored with Backward Digit Span Task due to the fully structured direction of the task.

5.4 Limitations and Future Directions

First of all, in this study, we used three different executive function tasks to measure inhibitory control, cognitive flexibility, and working memory. Most of the children participating in the study efficiently completed Bear Dragon Task that measured inhibitory control. Thus, the variance of the inhibitory control score was not high as expected.

Due to the pandemic lockdown, this study was held online via the Zoom application. Parents assisted the children while in data collection sessions with the experimenter. Some parental behavior might be affected the child's performance on the tasks. Most parents say some words to encourage the child to perform better. Being in different environments with children is also a limitation. Experimenters cannot intervene when a problem comes up. Even though we carried out the same procedure for all participants, they might face some distractions in their home environment.

The results showed that working memory and different types of creativity had been associated differently. Future studies should investigate the relationship between different types of working memory (e.g., verbal working memory and visuospatial working memory) and creativity. Also, we found no significant association between SES and creativity performance in our sample, which ranged from middle to high SES. Future research should examine this association with different SES groups incorporating low SES children.

6. CONCLUSION

This thesis investigates the relationship between bilingualism, creativity (verbal and figural), and executive functions. As previous studies indicated, we found an association between verbal and figural creativity and bilingualism. We investigated the relationship between inhibitory control, cognitive flexibility, working memory, and verbal and figural creativity in the present study. Only working memory and figural creativity was significantly related.

We suggest that when examining the relationship between bilingualism and creativity, considering the degree of bilingualism is crucial. Some studies showed a medium level of bilingualism restrains better performance on creativity tasks (Leikin & Tovli, 2014). Therefore, L2 proficiency is a more accurate predictor of creativity than self-reported bilingualism. In this study, we investigated the relationship between L2 proficiency and different types of creativity. L2 proficiency was significantly related to both verbal and figural creativity. The present study demonstrated that L2 proficiency and figural and verbal creativity were significantly associated, and L2 proficiency should be considered when examining the relationship between bilingualism and creativity. This thesis contributed to the literature by investigating the relationship between L2 proficiency and verbal and figural creativity by independently considering the association of inhibitory control, cognitive flexibility, and working memory.

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APPENDIX A: DEMOGRAPHICS FORM

Merhaba!

Bu araştırma Kadir Has Üniversitesi Psikoloji Anabilim Dalı Yüksek Lisans Öğrencisi Pınar Karataş tarafından Dr. Aslı Aktan-Erciyes danışmanlığında yürütülmektedir. 4-6 yaşındaki çocukların yaratıcılık süreçlerini incelediğimiz çalışmaya çocuğunuz ile sizi davet ediyoruz. Katılmak için lütfen aşağıdaki formu doldurunuz. Çalışmamız iki oturum halinde Zoom uygulaması üzerinden gerçekleşecek olup, katılan çocukların dil gelişimleri standart testler ile ölçülüp aileleri ile sonuçları paylaşılacaktır.

Teşekkürler

Pınar Karataş

Çocuğunuzun araştırmaya katılmasını kabul ediyor musunuz?

1> Evet 2>Hayır

1		Çocuğunuzun doğum tarihi	Gün/ay/yıl
2		Yaşadığınız şehir	
3		Kaç çocuğunuz var	Sayı ile belirtiniz
4		Çalışmaya kaçıncı çocuğunuz ile katılıyorsunuz	1>Birinci 2>İkinci 3>üçüncü 4>dördüncü 5>beşinci 6>diğer/belirtiniz
5		Annenin mesleği	belirtiniz

6		Annenin eğitim durumu	1>İlkokul 2>Ortaokul 3>Lise 4>Üniversite 5>Lisansüstü
7		Annenin bildiği diller	Dilleri öğrenme sırasına göre yazabilirsiniz. İkinci bir diliniz yok ise "yok" yazabilirsiniz.
8		Babanın mesleği	Belirtiniz
9		Babanın eğitim durumu	1>İlkokul 2>Ortaokul 3>Lise 4>Üniversite 5>Lisansüstü
10		Anne ve baba birlikte mi	1>evet 2> hayır
11		Ailenizin aylık toplam geliri ne kadar?	1>3.000 TL'den az 2>3.000- 5.000 TL 3>5.000- 7.000 TL 4>7.000- 10.000 TL 5>10.000 TL'den fazla
12		Toplumdaki insanların sosyal ve ekonomik durumlarını belirten bir merdiven olduğunu düşünün. Merdivenin en alt yani 1. basamağında en dezavantajlı işlere sahip olanlar veya işsiz olanlar ve en düşük eğitime sahip olanlar var. Merdivenin en üst yani 10. basamağında ise	

		toplumdaki en saygın işleri yapanlar en yüksek gelir sahibi olanlar ve yüksek eğitimli insanlar var. Siz de kendi ailenizin durumunu düşündüğünüzde sizin en uygun basamak 1 ile 10 arasında neresi olacaktır? Aşağıda işaretleyiniz.	
13		Çocuğunuzun bildiği yabancı diller (varsa)	
14		Çocuğunuz okul öncesi eğitime devam ediyorsa gittiği okulda ne kadar İngilizce görüyor?	1>Sadece Türkçe 2> Türkçe ağırlıklı ama İngilizce de görüyor 3>Türkçe ve İngilizce eşit 4> Sadece İngilizce 5>Gitmiyor
16		Evinizde konuşulan diller nelerdir?	
17		Çocuğunuz ile gün içinde evde ne kadar İngilizce konuşulur?	1>Hiç 2>Günde 30 dakikadan az 3>Günde yarım saat bir saat arasında 4>Günde iki-üç saat arasında 5>3 saatten çok

18		Çocuğunuz ekran karşında ne kadar İngilizceye maruz kalır? Bu soruyu yanıtlarken tablet bilgisayar veya telefondan izlediği videoları oynadığı oyunları veya televizyondan izlediği İngilizce çocuk programı veya çizgi filmleri de düşününüz.	1>Hiç 2>Günde yarım saatten az 3>Günde yarım saat bir saat arası 4>Günde iki-üç saat 5>Günde üç saatten fazla
19		Çocuğunuzun İngilizce öğrenmeye başladığı yaş kaçtır?	

APPENDIX B: STORY COMPLETION PICTURE TASK

B.1. Story Completion Task Pictures

B.2 STORY COMPLETION TASK SAMPLE NARRATION

A.Ö (5:10)

Anahtar uyuyor	Key fits
Kapı açılıyor	Door opens
Sonra bir tane eve giriyorlar	They enter a house
Evde bir sürü meyve sebze var	There are many foods and fruits at home
Ve güzel ce masanın üzerinde yemekler var	and there are nice foods on the table
Kendi evleri	Their own house
Sonra ailece yemekleri, meyveleri yiyorlar	Then, they eat foos and fruits
Sonra da dışarıya çıkıp oynuyorlar ve bitiyor	They go outside and play end.

F.A (6:2)

anahtarı kilide sokmuşlar	They put key on the lock
sonra aralarına çalılar ve kaktüsler çıkmış varmış	then there were bushes and cactuses among them
önlerinde ve çöl kaplarınları	desert tigers appear behind them
onlar da korkup hemen kapıyı kilitleyip	they scrared and locked the door
kaçmışlar	they run

APPENDIX C: SAMPLE VERBAL FLUENCY SCORE

A.G (5;4)

Animal Category	**fluency**	**flexibility**	**originality**	**creativity**
Zürafa (giraffe)	1	10,00	0.1	
Zebra (zebra)	1	0.1	0.1	
Kaplumbağa (turtle)	1	0.1	0.1	
Sırtlan (hyena)	1	1,00	10	
aslan (lion)	1	0.1	0.1	
penguen (penguin	1	0.1	0.1	
Balık (fish)	1	10,00	0.1	
Vatoz (whipray)	1	1,00	10	
	8	22,00	20.6	50.6

Z.B (5;8)

Food Category	fluency	flexibility	originality	creativity
Patlıcan (eggplant)	1	10	0.1	
Brokoli (broccoli)	1	0.1	0.1	
Karnabahar(cauliflower)	1	0.1	1	
Portakal(orange)	1	10	10	
Mandalina(mandarin)	1	0.1	0.1	
Muz(banana)	1	0.1	0.1	
	6	20.04	11.04	35.08

B.D. (4;7)

Picnic Category	fluency	Flexibility	originality	creativity
Köfte (meatballs)	1	10	1	
Pişmiş biber (cooked pepper)	1	0.1	0.1	
Mangal (barbecue)	1	10	0.1	
	3	20.01	1.02	24.03

APPENDIX D VERBAL FLUENCY REGRESSION ANALYSES TABLE

D.1 Predictors of Animal Category of Verbal Fluency in Children

Table 1. Predictors of Animal Category of Verbal Fluency in Children

Predictors		β	SE(B)	p	R^2
Step1					-0.033
	Age	-0.0502	0.773	0.735	
	SES	-0.1102	7.734	0.474	
Step2					0.006
	TİFALDİ-R	0.1583	0.535	0.303	
Step3					0.0008
	Bear Dragon	0.1457	6.119	0.337	
	Digit Span	0.0669	3.076	0.674	

	DCCS	0.0879	4.273	0.588	
Step4					0.010
	PPVT-IV	0.1093	0.532	0.507	

D.2 Predictors of Food Category of Verbal Fluency in Children

Table 2. Predictors of Food Category of Verbal Fluency in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					-0.0142
	Age	0.0193	0.598	0.766	
	SES	0.0357	5.985	0.894	
Step2					0.0184
	TİFALDİ-R	0.2281	0.481	0.137	
Step3					0.0347
	Bear Dragon	0.1665	4.797	0.269	
	Digit Span	0.1875	2.398	0.231	
	DCCS	-0.2035	3.441	0.226	
Step4					0.0282
	PPVT-IV	0.1332	0.412	0.414	

D.3. Predictors of Picnic Category of Verbal Fluency in Children

Table 3. Predictors of Picnic Category of Verbal Fluency in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					-0.033
	Age	-0.0659	0.510	0.870	
	SES	0.0380	4.988	0.663	

Step2					0.033
	TİFALDİ-R	0.2989	0.342	0.805	
Step3					-0.003
	Bear Dragon	0.1234	3.936	0.055	
	Digit Span	-0.0543	2.001	0.422	
	DCCS	-0.0996	2.770	0.743	
Step4					-0.014
	PPVT-IV	0.1111	0.336	0.506	

D.4. Predictors of Fluency Score of Verbal Fluency in Children

Table 4. Predictors of Fluency Score of Verbal Fluency in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					0.008
	Age	0.038	0.118	0.777	
	SES	-0.070	1.180	0.626	
Step2					0.147
	TİFALDİ-R	0.338	0.081	0.020	
Step3					0.133
	Bear Dragon	0.081	0.945	0.563	
	Digit Span	0.132	0.469	0.369	
	DCCS	-0.031	0.652	0.834	
Step4					0.135
	PPVT-IV	0.157	0.081	0.304	

D.5. Predictors of Flexibility Score of Verbal Fluency in Children

Table 5. Predictors of Flexibility Score of Verbal Fluency in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					0.004
	Age	0.040	0.337	0.779	
	SES	0.065	3.374	0.657	
Step2					0.095
	TİFALDİ-R	0.300	0.233	0.045	
Step3					0.080
	Bear Dragon	0.185	2.704	0.204	
	Digit Span	-0.036	1.342	0.813	
	DCCS	-0.013	1.846	0.932	
Step4					0.071
	PPVT-IV	0.114	0.232	0.469	

D.6. Predictors of Originality Score of Verbal Fluency in Children

Table 6. Predictors of Originality Score of Verbal Fluency in Children

Predictors		*B*	SE(B)	*p*	R^2
Step1					-0.016
	Age	-0.027	1.141	0.542	
	SES	-0.098	11.418	0.848	
Step2					0.097
	TİFALDİ-R	0.316	0.789	0.033	
Step3					0.090
	Bear Dragon	0.160	9.151	0.269	
	Digit Span	0.104	4.542	0.491	
	DCCS	-0.068	6.309	0.658	
Step4					0.087
	PPVT-IV	0.145	0.785	0.354	0.145

APPENDIX E: SAMPLE PICTURES OF TEST OF CREATIVE IMAGINARY ABILITIES

APPENDIX F: BEAR DRAGON TASK PROTOCOL

Hadi görelim bakalım benim dediğim şeyleri yapabiliyor musun?

Ellerini çırp/alkışla, dilini çıkar, gözüne dokun, kulaklarına dokun, karnına dokun, dişine dokun, ayaklarına dokun, kafana dokun, burnuna dokun, el salla.

Hadi kuklalarla bir oyun oynayalım. Bu iyi tatlı bir inek, o bizim arkadaşımız. İnek bizden ne isterse yapacağız ama bu kötü/kaba bir aslan. Aslanın söylediği şeyleri yapmayacağız. Tamam, şimdi bir kere deneyelim. Bu iyi bir inek "burnuna dokun" diyor, aferin. Aslan kötü olduğu için onun dediklerini yapmayacağız. Hadi aslan ile bir deneme yapalım. "Ellerini çırp"

İnek senden bir şey yapmanı istediğinde onu yap, aslan senden bir şey yapmanı istediğinde ise onu yapma, tamam mı? Hadi bakalım görelim biz oynarken kuralları hatırlayabilecek misin? Hazır mısın?

1	İnek	DİLİNİ ÇIKAR
2	Aslan	DİŞİNE DOKUN
3	İnek	KULAĞINA DOKUN
4	İnek	EL ÇIRP
5	Aslan	EL ÇIRP
6	Aslan	GÖZÜNE DOKUN
7	Aslan	AYAĞINA DOKUN
8	İnek	BURNUNA DOKUN
9	Aslan	BURNUNA DOKUN
10	İnek	KARNINA DOKUN
11	Aslan	EL SALLA
12	İnek	BAŞINA DOKUN
13	İnek	KARNINA DOKUN
14	Aslan	DİŞİNE DOKUN

APPENDIX G: FORWARD BACKWARD DIGIT SPAN TASK

F.1. DIRECTIONS

Directions/Yönergeler

Düz sayı dizisi için: Şimdi sana sırasıyla bazı sayılar söyleyeceğim bu sayıları aynı sırayla aklında tutup bana tekrar söylemeni istiyorum anlaştık mı?

Ters sayı dizisi için: Şşimdi sana yine sırasıyla bazı sayılar söyleyeceğim ve senden benim söylediğim sayıları aklında tutup bana tam tersi olacak bir sırayla yeniden söylemeni istiyorum. Hadi bir deneme yapalım:

APPENDIX H: DISTRIBUTION OF CITIES THAT PARTICIPANTS CAME FROM

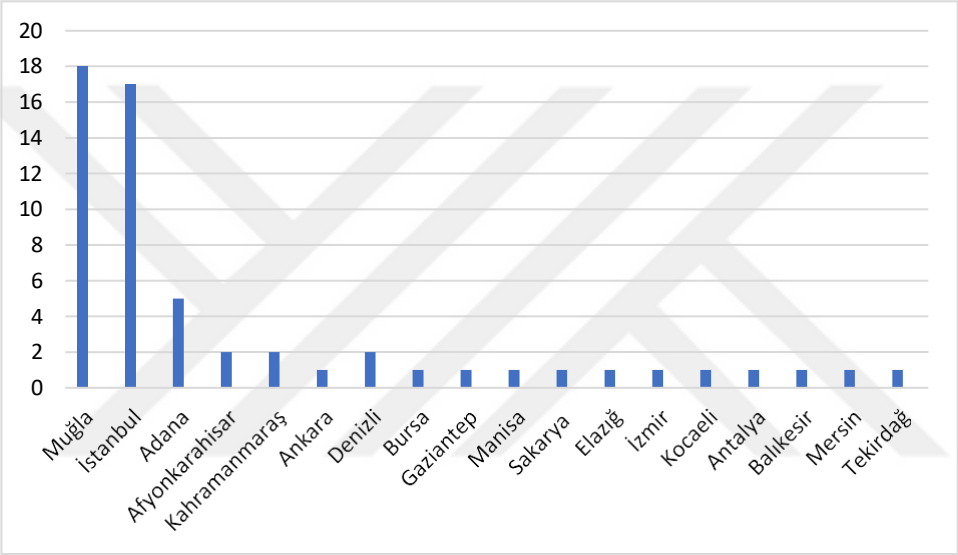

Figure H.1. Distribution of cities

CURRICULUM VITAE

Pınar Karataş

Graduate School of Social Sciences and Humanities, Psychology Department Kadir Has University, Istanbul, Turkey 34450

EDUCATION

2019- Present	**M.A. in Developmental Psychology** Kadir Has University, Istanbul, Turkey Advisor: Dr. Aslı Aktan-Erciyes
2014- 2019	**B.A. in Psychology** Istanbul Sehir University, Istanbul, Turkey

RESEARCH INTERESTS

Cross-cultural and developmental psychology, collaboration, social coordination, executive function, theory of mind, and bilingualism.

RESEARCH EXPERIENCE

09/2019 – Present	**Graduate Research Assistant** **Studies in Language and Bilingualism Lab**, Kadir Has University, Istanbul Supervisor: Dr. Aslı Aktan-Erciyes

Awarded with TÜBİTAK Graduate Student Scholarship

06/2018 – 09/2018 **Visiting Researcher**

Lund University, Sweden,

Supervisors: Tomas Jungert & Sean Perrin

Awarded Erasmus Grant

02/2021 – 09/2021 **Graduate Research Assistant**

Nazli Baydar's Lab, Koc University, Istanbul

Supervisor: Prof. Nazlı Baydar

Awarded TÜBİTAK Graduate Student Scholarship

06/2011 – 06/2012 **Undergraduate Research Assistant**

Developmental Psychology and Psychopalogy Lab, Koc University, Istanbul

Supervisor: Dr. Fatıma Tuba Yaylacı

PUBLICATIONS & PRESENTATIONS

PUBLICATIONS

Karataş, P. & Aktan-Erciyes, A. (2022). Relation between creativity, executive functions, and bilingualism. *Journal of Language and Linguistic Studies,* 18, 240-248.

Jungert, T., **Karataş, P.**, Iotti N.O. & Perrin, S. (2021). Direct Bullying and Cyberbullying: Experimental Study of Bystanders' Motivation to Defend Victims and the Role of Anxiety and Identification With the Bully. *Frontiers in Psychology, 11*, 616572.

POSTERS

Karataş, P., Jungert, T., Iotti, NO, Perrin, S Longobardi, C. (2019, June). Motivation to Defend Bullying: Experiment of Turkish and Swedish Schools. Poster presented at the 2nd Conference of the World Anti-Bullying Forum.

Aktan-Erciyes, A., Atalay, EN., Örengül, AŞ., **Karataş, P**., Göksun, T. (2020, October). Early Parental Causal Language Input Predicts Later Child Causal Verb Understanding. Poster presented at the 45th Boston University Linguistics Conference of Language Development.

Karataş, P., Sayın, B., Sarıçiçek, S., Tüzütürk, K., Aktan-Erciyes, A. (2022, January, Accepted). Effects of Bilingualism and Executive Functions on Verbal Creativity in Preschool Children. The poster was presented at the 12th Budapest CEU Conference on Cognitive Development.

TEACHING ASSISTANTSHIP EXPERIENCE

Fall 2021	Research Methods
Spring 2021	Developmental Psychology
Fall 2020	Research Methods
Spring 2019	Adolescence Psychology
Fall 2018	Lifespan Developmental Psychology

SKILLS

Language	Turkish (Native), English (Fluent)
Computer	SPSS, MPlus, Jamovi