The Relationship between Cognitive Flexibility in Drawing and Inflectional Morphology in Children Aged 5-7.

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Abstract

This study was conducted to study the long-disputed relationship between cognition and language from a new angle: Cognitive flexibility measured as creativity in drawing in relation to inflectional morphology in typically developing children aged 5-7. Research has found that cognitive flexibility and/or shifting are related to certain aspect of language development, particularly in groups of children with atypical language development such as specific language impairment, bilingualism and reading problems. The present study can contribute to a better understanding of the relationship between cognition and language problems, as well as provide a new angle to study the theoretical concept of cognitive flexibility from. Inflectional morphology was tested with two similar tasks, one that used existing Dutch words and another that tested children's ability to generalize morphological rules to non-existing words. Contrary to the hypothesis there was no significant relationship between cognitive flexibility in drawing and inflectional morphology. Both intelligence and age explained more variance in inflectional morphology. Inspection of the data showed distinctive age patterns for inflectional morphology: The 7-year-olds scored higher than the 5- and 6-year-olds and there was especially less variation in the older groups compared with the younger groups. This is in accordance with the theory of development of morphological awareness by Berko (1953). The results suggest that cognitive flexibility as measured with a creative drawing task is not related to inflectional morphology in typically developing children.

Keywords: morphological awareness, inflectional morphology, language development, language acquisition, verbal language ability, cognitive flexibility, executive functions, WUG

The Relationship between Cognitive Flexibility in Drawing and Inflectional Morphology in Children Aged 5-7

Although the relationship between language and cognitive functioning has long been disputed, today it is generally assumed that there is interaction between cognition and language (Karmiloff-Smith, 2009; Newcombe, 2013). Historically, nativists argue that there is ‘universal grammar’ and that all babies are born with an innate or ‘hard-wired’ structure of language abilities (Ambridge, 2016). This view is closely related to modularity, the idea that the human brain consists of a system of modules that each have a specific function, for example language (Barrett & Kurzban, 2006). In contrast to nativism, constructivists reject the idea of innate human knowledge and pledge that children learn language by differentially processing linguistic input (Ambridge, 2016). Nowadays there is a general acceptance of the constructivist idea that language is part of all human cognition, although on the other hand, the idea of modularity has not been fully disregarded (Barrett & Kurzban, 2006). It seems that there now is consensus among both nativists and constructivists that both parties were a bit right (Newcombe, 2013). Only recently several new perspectives have emerged within different scientific fields that combine both nativist and constructivist ideas about language and cognition. One of these is the idea of *neuroconstructivism*, that takes a developmental stance (Karmiloff-Smith, 2009). Within this perspective it is assumed that neurological differences between certain networks within the brain make some networks more adapt or relevant for processing certain types of input than others. Therefore, over time and with repeated processing of input, networks will specialize in processing certain kinds of input. Neuroconstructivism incorporates aspects of both nativism and constructivism and brings them together.

The research that provided evidence that there is indeed a link between language development and cognition, focused on ‘executive functions’ (EF) in order to study the link between cognitive functioning and language development (e.g. Henry, Messer, & Nash, 2012; Kaushanskaya, Park, Gangopadhyay, Davidson, & Weismer, 2017; Van Der Sluis, De Jong, & Van Der Leij, 2007). The most generally accepted EF framework distinguishes three separate executive functions: shifting (shifting/switching between mental sets or tasks), updating (updating the working memory), and inhibition (inhibiting impulsive responses) (Miyake et al., 2000). The EF framework, however, is a general understanding of cognition and it turns out that not every executive function is relevant for language development. There is sufficient evidence that inhibition and shifting are related to language, but updating does not seem to be related at all (Kaushanskaya et al., 2017; Van Der Sluis et al., 2007). What is more, inhibition and shifting seem only to be related to certain aspects of language development. Lexical-semantic knowledge for example, was found to be related to inhibition, while reading skills were not related to inhibition at all (Kaushanskaya et al., 2017; Van Der Sluis et al., 2007). Notably, although there is evidence that both inhibition and shifting are related to language development, the evidence for inhibition is stronger than for shifting (Henry et al., 2012; Ibbotson & Kearvell-White, 2015; Kaushanskaya et al., 2017).

The relationship between cognition and language has also been studied from another cognitive perspective, namely that of *cognitive flexibility*. There has, however, been some confusion and debate among neuroscientist about what cognitive flexibility actually is (Ionescu, 2012). Consequently, the term cognitive flexibility has been used to refer to several different constructs. The main question regarding cognitive flexibility was whether cognitive flexibility is the same as shifting, and therefore a separate executive function, like updating and inhibition. Ionescu settles the debate by arguing that shifting and cognitive flexibility are different from each other, since shifting has originally been referred to as an executive function. Instead, Ionescu argues that cognitive flexibility is a property within the whole cognitive system, that emerges from the interaction between cognitive mechanisms (i.a. executive functions, attention mechanisms), and from interactions of cognition with sensorimotor mechanisms and context over time. In other words, cognitive flexibility is the term used to refer to whatever interactions between cognitive mechanism that underlies all flexible behaviour. The difficulty with this definition however is that there is not yet a clear picture of what cognitive flexibility actually is. And since there are many different cognitive mechanisms that all interact in different ways depending on the situation, it is important to study the concept of cognitive flexibility from many different angles (Ionescu, 2012). Otherwise our understanding of what cognitive flexibility entails is going to be biased.

There have been various indications that cognitive flexibility is related to language development (Colé, Duncan, & Blaye, 2014; Farrant, Maybery, & Fletcher, 2012; Okanda, Moriguchi, & Itakura, 2010). Cognitive flexibility has for instance been related to early reading skills, bilingualism and specific language impairment. As has been discussed above, the literature on the relationship between executive functioning is ambiguous on whether or not shifting is related to language development. Most of the studies on cognitive flexibility however, generally defined cognitive flexibility as a concept that in hindsight is very similar to shifting. Because the terms shifting and cognitive flexibility have been mixed up, there are also studies that suggest that cognitive flexibility is not related to language development (i.a. Henry et al., 2012; Reichenbach, Bastian, Rohrbach, Gross, & Sarrar, 2016). All in all, the literature is not at all conclusive on the relationship between cognitive flexibility and language development.

The current study will be following the Ionescu's (2012) conceptualization of cognitive flexibility to study the relationship with language development. Therefore, this study aims to contribute to the emerging picture of cognitive flexibility by focusing on children's drawings as the angle to study language development from. In a procedure designed by Karmiloff-Smith (1989), children are asked to draw a non-existing flower. The idea was that it takes some kind of cognitive flexibility for children to be able to change their internal representation of a flower into something that does not exist. This cognitive process has in earlier years been referred to as 'representational flexibility'. Following Ionescu's definition of cognitive flexibility as interactions between contextual cues and cognitive mechanisms, the kind of flexibility that is necessary for thinking up ways to make a flower non-existing could be indicative of cognitive flexibility. Karmiloff-Smith (1989) showed that throughout development, children learn more and different ways to make their flower non-existing. In other words, their representation of a non-existing flower changes over time, indicating that cognitive flexibility is developing over time. Which underlying cognitive mechanisms constitute this kind of flexibility remains to be studied, but it seems likely that when children's cognitive abilities develop, cognitive flexibility also increases as there are more interactions between cognitive mechanisms possible.

In order to study how cognitive flexibility is related to language development, the current study will focus on one aspect of language development that has not been previously examined: Morphological awareness, and specifically, inflectional morphology. As a language ability, morphological awareness is relevant for various other language skills, such as word recognition, spelling, verbal ability and reading (Carlisle, 2003; Kirby et al., 2012; Okanda et al., 2010; Rispens, McBride-Chang, & Reitsma, 2008). Therefore, a better understanding of how morphological awareness and cognitive flexibility interact in typically developing children, could also be beneficial for our understanding of specific language impairment, bilingualism, reading disabilities etc. Inflectional morphology will be measured with two similar tasks, with one using existing words and the other non-existing words. The latter task is used because the ability to apply a certain morphology rule in non-existing words indicates that children have fully internalised that specific rule (Berko, 1958). This is therefore a good indicator of children's morphological awareness.

The current study is executed in the Netherlands and accordingly, first a brief explanation of inflectional morphology in the Dutch language is provided. There will be three types of inflections tested in this study: Plural formation of both existing and non-existing nouns, past participle formation of existing words and past tense formation of non-existing words. The tasks will test two regular rules to form plurals in both existing and non-existing words and irregular plurals will be testing only for existing words. Regular plurals can be formed by adding either the suffix *-en* (e.g. bril → brillen) or *-s* (e.g. vlinder → vlinders). The irregular plurals are formed by adding the suffix *-en* to nouns that also require an additional change in pronunciation (e.g. weg → wegen). The Dutch verbs that are tested in this study can be either weak (regular), strong (semi-regular) or irregular. The past participle of weak verbs is formed by adding the suffix *ge*- in front of the stem and then adding either *-d* or *-t* after the stem (koken → gekookt). For strong verbs, the suffix *ge*- and *-en* are added and the stem is made 'longer', requiring a change in pronunciation (zitten → gezeten). In irregular verbs, either the suffix *ge*- or *ver*- is added before the stem and either the suffix *-en*, *-t*, or *-d* is added after the stem, but the stem itself also changes completely. Note that the irregular verbs in this task have a similar morphological structure as weak and strong past participle. Finally, past tense in non-existing weak words is tested, which is formed by adding either *-te* or *-de* to the stem (gopen → goopte). In weak verbs the pronunciation of the stem stays the same, even though the written stem does change.

With the current study we aim to conduct an explorative examination of a possible relationship between children's morphological awareness and cognitive flexibility in typically developing children. Therefore, the research question is: What is the relationship between cognitive flexibility in drawing and inflectional morphology in children aged 5-7? Because it is likely that intelligence is also related to children's morphological awareness, we measured non-verbal intelligence to statistically control for any variance explained by intelligence. By measuring intelligence with a non-verbal intelligence test, we made sure that the effect of intelligence was not polluted by problems with verbal language or communication (Reichenbach et al., 2016). Based on the literature we hypothesize that there is a positive relationship between cognitive flexibility in drawing and inflectional morphology in children aged 5-7, when controlling for the effect of intelligence. Besides the main analysis, this study is suitable to examine the relationship between children's age and inflectional morphology in the Dutch language. Based on Berko's (1958) work on the development of English morphology in children, we expect to find patterns that show that 5-year-old children have less morphological abilities than 6- and 7-year-old children.

Method

This study was part of a larger project within the thesis program of the bachelor Child, Family and Educational Sciences at Utrecht University. The ten participating students all collected data from around 10 participants separately, which was later merged into an overall dataset. No interrater-reliability checks were performed, though each student scored the raw data collected by another student separately. Differences in scoring of the drawing task were discussed between the students until consensus was reached.

Participants

A total of 113 Dutch children (52 girls, 61 boys, M_{age}= 76.2 months) were recruited through primary school teachers. In total 41 5-year olds, 44 6-year olds and 28 7-year olds took part in our study. Three participants were excluded because they were older than 7 years. Most schools were located in the region of Utrecht, the Netherlands, although some were located in other parts of the country, in an attempt to recruit a demographically diverse sample. Teachers provided information on children that were suitable for this study after which the parents were contacted directly via email to obtain informed consent. Children with known developmental problems and/or psychopathological disorders were excluded from participation, as were multilingual children.

Measurements

Inflectional morphology in existing words. Inflectional morphology in existing words was tested using the ‘word formation’ subtest of the ‘Taaltoets Alle Kinderen’ (TAK) [Language Test All Children] (Verhoeven & Vermeer, 2006). The TAK is a Dutch language test that covers a comprehensive list of verbal language abilities to be tested in children aged 4-9. The word formation subtest covers plural formation and past participle formation in 24 items, each accompanied with an illustration. The plural task comprises 12 items that test three ways in which plurals are formed in Dutch. The plural task is accompanied with 2 pictures for each item, first a single illustration of the target word, then a picture showing two or multiple of the target object. The past participle task tests the formation of the past participle of weak-, strong-, and irregular verbs. The pictures alongside the past participle items show an illustration of the activity that the verb represents. The TAK is judged to be a reliable and valid measure of children’s verbal language abilities (Egberink, Leng, & Vermeulen, 2007). Cronbach’s alpha of the word formation task has been shown to be .89 or .91 depending on the moment of testing (Verhoeven & Vermeer, 2006).

Inflectional morphology in non-existing words. Inflectional morphology in non-existing words was tested using the same task that Berko (1958) designed to study children’s development of morphological awareness. The items regarding inflectional morphology were adapted from the Dutch version of the WUG (Berko, 1958; Rispens et al., 2008).The adapted WUG consists of 10 items that measure 2 types of inflections, plural and past tense. The 6 plural items measure children's ability to generalize the two regular plural rules that the TAK also measures: Adding *-en* or *-s* to a non-existing word (e.g. vigger → viggers or kuim → kuimen). The last 4 items measure children's ability to form weak forms of the past participle (e.g. gopen → goopte). The test is similar to the TAK, in that children are shown a picture illustrating the non-existing words and are then asked to finish a sentence. The pictures regarding the last 4 items are showing a man with a non-existing object. Children are then told that 'this man is [aan het gopen]. Yesterday he was also [aan het gopen]. What did he do yesterday? Yesterday [goopte hij]…' and are then asked to finish the sentence.

Creativity in drawing. To measure children's cognitive flexibility in drawing, we used the procedure of drawing a non-existing flower designed by Karmiloff-Smith (1989). Children were first asked to draw 'summer', to activate the cognitive mechanisms related to drawing a representation of something from memory. After that, children were asked to draw a flower, and then asked to draw a flower that 'does not exist, that you invented yourself, that you've never seen before, a weird flower, a flower that you made up'. Finally, they were asked to explain why the flower does not exist. The drawing of the non-existing flower was scored using the 7-point scale designed by Karmiloff-Smith. This scale comprises 6 categories in which the drawing of the non-existing flower could have been changed in comparison to the existing flower. The categories were (a) no change at all (b) shape of elements changed, (c) shape of whole changed, (d) deletion of elements, (e) insertion of new elements, (f) position or orientation changed and (g) cross-category insertions. Categories b, c, and d are considered to be simple changes and the categories e, f, and g are considered to the complex changes (Karmiloff-Smith, 1989). The total simple and complex changes were counted and based on these scores the children were added to one of four creativity groups. The first group, showing the least creativity, were children that made one simple change. The slightly creative group were children that made either 2 or 3 simple changes, or a single complex change. The moderately creative group were children that made one complex along with one or two simple changes. Finally, the last group comprised children that either made one complex change alongside three simple changes *or* two or more complex changes.

Intelligence. A short version of the Dutch version of the Wechsler Non-Verbal scale of Cognitive Ability was administered to get a general idea of the participant's intelligence, comprising the subtests 'Matrices' and 'Recognition' (Wechsler & Naglieri, 2008). The raw data was converted into IQ scores based on the Dutch WNV norms. Overall, the WNV scale of Cognitive Ability has excellent COTAN rating, meaning that the test has been judged to be sufficiently reliable and a valid measure of children's intelligence (Egberink, Leng, & Vermeulen, 2009).

Procedure

Testing took place during normal school hours; children were taken out of their usual lessons to a separate room provided by the school. The four tasks were administered to the children in fixed order and for the verbal tasks an audio fragment was recorded. The first task was the word formation task of existing words. Children were shown the pictures that depicted a word and were then asked to finish a sentence to inflect the target word. The drawing task was next, children were first asked to draw 'summer' and then asked to draw a flower. After this they were asked to draw a non-existing flower and to explain why that flower does not exist. The third part consisted of the administration of the two WNV subtests and the WUG-test was the last part of test. For the inflectional morphology tasks and the drawing task, the children's precise answers were written down and checked with the audio recording. After testing, the children's answers were scored by the student and recorded in a detailed dataset.

Analysis

First the data will be explored to check for any outliers. After this, the data will be examined in order to detect any developmental patterns of inflectional morphological abilities. For this, a series of one-way ANOVA's were performed to compare the creativity groups means and the age group means on differences in inflectional morphology. These were also compared with the data reported in earlier research. After checking whether the assumptions were met, the main analysis was performed. The hypothesis is that there is a positive relationship between cognitive flexibility in drawing and inflectional morphology. The hypothesis will be tested with two univariate analysis of variance (ANCOVA), one for inflectional morphology in existing words and another for non-existing words, with intelligence as the covariate.

Results

Exploring the data to check for outliers yielded one significant result. One subject had an extremely low score on the existing word measure (< 3 SD from the mean). A score this far from the mean indicates problematic language development and was therefore excluded from further analysis.

First, I compared the group means and standard deviation of the inflectional morphology of existing words with those reported in earlier studies, see Table 1. The group means in our sample are slightly higher than those found in samples with typically developing children without language problems (Van Daal, Verhoeven, & Van Balkom, 2004; Van Weerdenburg, Verhoeven, & Van Balkom, 2006). Based on these earlier reports, we would expect the group means in this study for children who are a year older. Nevertheless, it does indicate that our sample does indeed represent children in the typically developing population, especially since the scores of children with severe language problems are profoundly lower than those found in our sample.

Table 1.

Comparison of Group Means and Standard Deviation of Morphology of Existing Words

Age	Severe Language Problems	Typical Development	Present study
	Mean (SD)	Mean (SD)	Mean (SD)
4 y/o[a]	5.47 (4,00)	11.36 (4,23)	
5 y/o			14.98 (4,31)
6 y/o[b]	10.05 (4,61)	15.70 (4,40)	17.66 (3,74)
7 y/o			20.71 (3,30)
8 y/o[b]	15.69 (5,24)	21.34 (3,00)	

Note. [a]Van Weerdenburg, Verhoeven, & Van Balkom (2006); [b]Van Daal, Verhoeven, & Van Balkom (2004)

Next, I inspected the inflectional morphology scores in more detail to see whether we could detect patterns or trends related to creativity in drawing, which are reported in Figure 1 (see the appendix for a detailed table). Overall, there are almost no differences between the four drawing categories in terms of any of the tested morphological rules, either in existing words or non-existing words. The differences between groups that are present are small: Generally, no more than one point higher or lower than the other groups. It is therefore not possible to detect any trends that might suggest a relationship between cognitive flexibility in drawing and inflectional morphology, although this will be further tested in the main analysis.

Figure 1. Visual representation of group differences of the four creativity groups in inflectional morphology

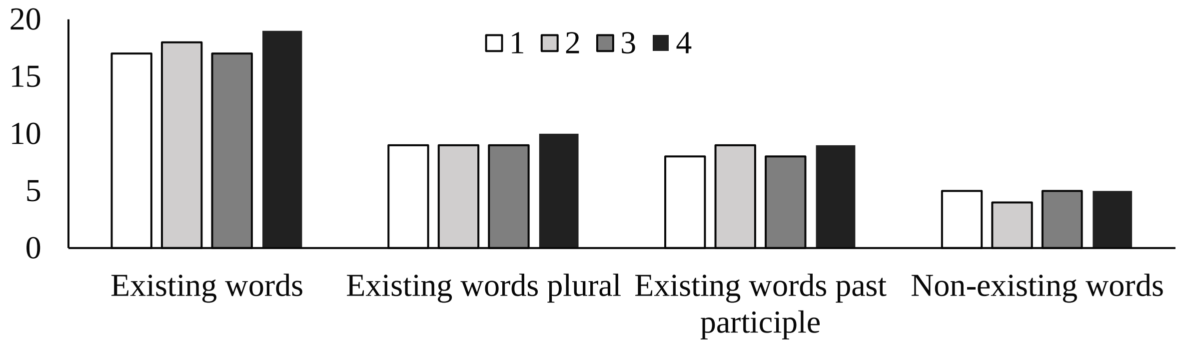
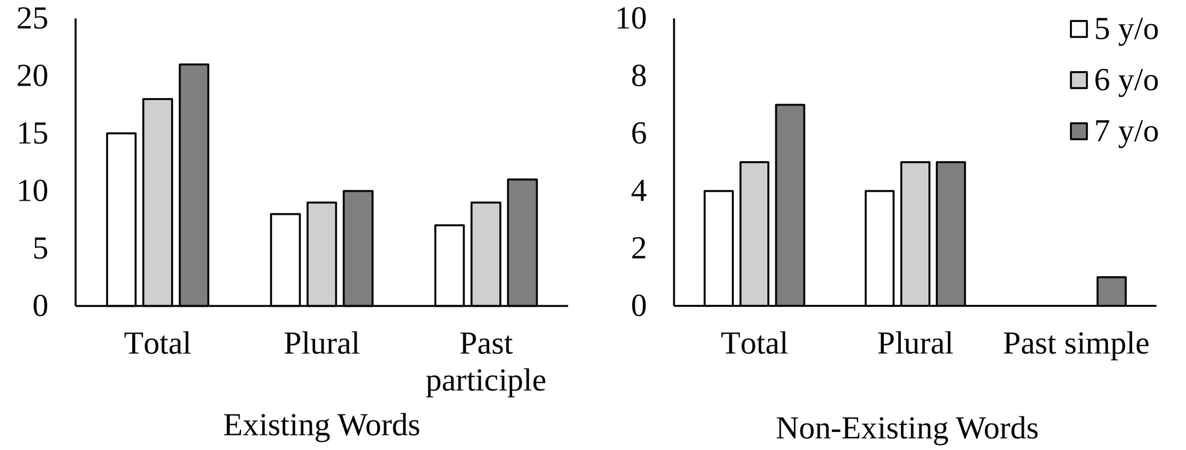


Figure 2. Visual presentation of differences between group means of total scores on inflectional morphology



When examining the group means of inflectional morphology for the different age groups, it is possible to detect more pronounced patterns (see the appendix for details). Figure 2 illustrates the total scores of existing and non-existing words per age group. As was expected, the older groups tend to score higher on all types of inflections. Figure 3 displays the group means and standard deviations for the different types of morphological rules tested in existing words. This figure shows that all the three groups have the highest possible mean score on both regular plural formations, but the standard deviation is higher within the younger groups. A similar pattern is visible for weak and strong past participle formations. All groups have lower group means on irregular word formations compared to regular words.

Figure 3. Visual presentation of the group means and standard deviations per type of morphological rule in existing words

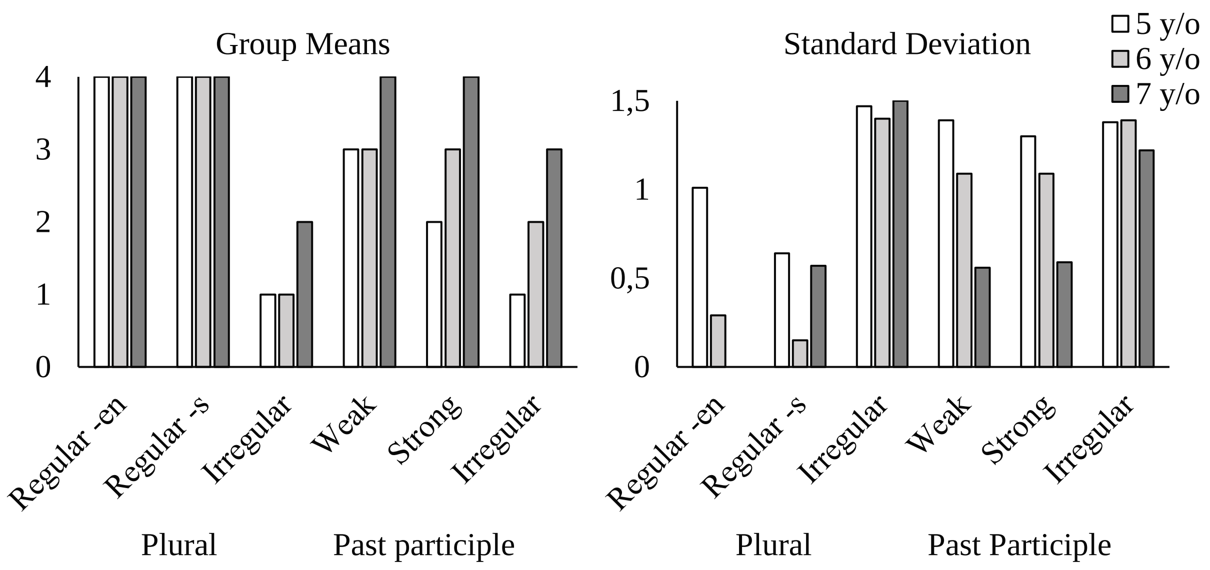


Figure 4. Visual presentation of the group means and standard deviations of inflectional morphology in non-existing words

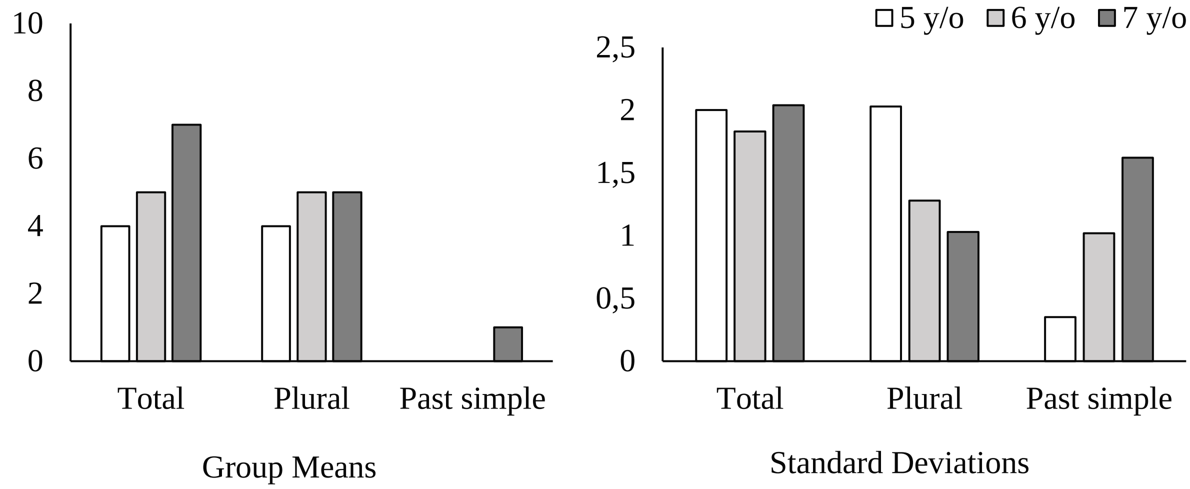


Figure 4 shows again the group means for the non-existing words, here accompanied with the corresponding standard deviations. Here again is an interesting pattern visible. In general, the standard deviations across all inflectional morphology items tend to show a pattern similar to that of the plural in figure 4, showing more variation within the younger groups than the older groups. For the past simple however, the pattern of the standard deviations is completely opposite. The pattern in the past simple shows a trend of higher variation within the older groups than in the younger groups

To test our main hypothesis, that creativity in drawing is predictive of children's inflectional morphology, two separate univariate analyses of variance (ANCOVA) were conducted. Intelligence was included as a covariate, since intelligence has a slight influence on both the TAK (r = 0.25) and the WUG (r = 0.18). Before doing the final analysis, we checked whether our data met the assumptions necessary for an ANCOVA. The assumption for normal distribution is met for the predictor variables age and intelligence. The assumption of homogeneity of variance is a bit more problematic, since it is theoretically not possible for our sample to have equal variance of our outcome variables at different values of the creativity categories. However, the standard deviations of the total existing words and non-existing words scores reported in the appendix vary between 4.3 and 3.3 and 1.83 and 2.04, which seem similar enough. In line with Field (2018), no statistical analysis was performed to test the assumption of homogeneity of variance. To test the assumption of independence of the covariate and the predictor variable, a one-way ANOVA was performed. The ANOVA revealed no significant group differences for the covariate on the creativity groups, $F(3, 100) = 0.56$, $p = 0.64$. The final assumption, homogeneity of regression slopes, was tested by fitting the correlation of intelligence and the creativity groups in the ANCOVA model. This yielded no significant effects within the TAK model, $F(3, 96) = 1.83$, $p = 0.15$, and the WUG model, $F(3, 96) = 0.51$, $p = .68$. Thus, homogeneity of regression slopes was assumed.

The first ANCOVA showed that intelligence was significantly related to inflectional morphology as measured with the TAK, $F(1, 99) = 11.2$, $p = 0.001$, $r = 0.98$. There was no significant effect of creativity in drawing on the TAK after controlling for the effect of intelligence, $F(3, 99) = 1.14$, $p = 0.34$. The second ANCOVA also showed that intelligence was significantly related to inflectional morphology when measured with the WUG task, $F(1, 99) = 4.28$, $p = 0.04$, $r = 0.23$. There was no significant effect of creativity in drawing on the WUG after controlling for the effect of intelligence, $F(3, 99) = 1.9$, $p = 0.14$. Thus, our results suggest that creativity in drawing/cognitive flexibility is not able to predict inflectional morphology in children between the ages 5 and 7.

Discussion

The main goal of this study was to find out whether cognitive flexibility in drawing was related to inflectional morphology in typically developing children aged 5-7. We examined inflectional morphology of both existing words and of non-existing words. The analysis showed that contrary to my hypothesis, cognitive flexibility in drawing is not related to inflectional morphology in children aged 5-7, both in existing words as in non-existing words. Non-verbal intelligence however was strongly related to either measure of inflectional morphology. This indicates that typically developing children with higher intelligence, learn inflectional morphological rules sooner than children with lower intelligence. Regarding the other goal of this study, it was possible to identify distinct patterns of inflectional morphology based on children’s age. In general, these patterns showed that younger children scored lower on the inflectional morphology items than the older age groups, indicating that inflectional morphology increasingly develops over time.

The age patterns that are reported in this study are similar to those reported by Berko (1958), although the past simple of non-existing words was lower in our sample. The past simple is not commonly used in verbal Dutch communication and consequently, Dutch children often only start learning these inflections only after they start to read (Rispens et al., 2008). This can explain why English and Dutch learners show different developmental patterns for past simple inflections. It seems that certain aspects of the language that children are learning also seem to be relevant for the development of morphological awareness. This is especially relevant in multilingual language development. Another distinctive pattern that was identified was that children generally had more difficulty with the formation of irregular words than regular words. Here again, the older groups did better than the younger groups. This is to be expected since children must learn the irregular forms through experience rather than learn a specific morphological rule that they can then learn to apply to similar words.

Even though the scientific literature is uncertain of a relationship between cognitive flexibility and language development, the studies examining this relationship have one thing in common. Namely that most of the studies compared typically developing children with children with atypical (language) development. The current study was limited to typically developing children and it might just be that cognitive flexibility is not related to typical language development, or just not specifically to inflectional morphology. This does not rule out the possibility that cognitive flexibility it related to some other aspects of atypical language development. For example, as has been discussed in the introduction, there is evidence from several different studies that indicate that cognitive flexibility is related to certain aspects of language development (i.a. Colé et al., 2014; Farrant et al., 2012; Okanda et al., 2010). The results from this study however are in line with other research that could not find a relationship between cognitive flexibility and language development (i.a. Henry et al., 2012; Reichenbach et al., 2016).

In line with the definition of cognitive flexibility of Ionescu (2012) there are also some possible explanations for the current results. For example, it might be possible that the various interacting cognitive mechanisms that constitute the cognitive flexibility necessary to draw a non-existing flower, are not specifically relevant for inflectional morphology. Most studies that found a relationship between cognitive flexibility used a more shifting-related measure of cognitive flexibility, most often card-sorting tasks (Ionescu, 2012; Reichenbach et al., 2016). It might be a possibility that card-sorting tasks require the interaction between different cognitive mechanisms than the non-existing flower task, although the drawing task has been found to be related to bilingualism (Adi-Japha, Berberich-Artzi, & Libnawi, 2010). For this study we chose to focus on cognitive flexibility in a real-life domain, namely the drawing task instead of a laboratory test such as a card-sorting task of task-switching test. However, in line with Ionescu, it would be interesting for future research to compare cognitive flexibility in real-life domains with cognitive flexibility as measured with more conventional laboratory tasks.

The study had a number of limitations. First of all, as our results also indicate, it would have been useful to study children that were older than 7 too, since children are still learning the more complex inflectional rules until they are at least 10 years old (Berko, 1958). In our sample, only a few 7-year-olds were able to form the past simple, and not one child had the perfect score. This indicates that 7-year-olds are still learning the relevant morphological rules and in order to better detect developmental patterns of language acquisition, it would be useful to included older children in the research too. In this study however, we were determined to use a non-verbal intelligence test and were therefore forced to limit our sample to 5-7 years old, as there was no suitable non-verbal intelligence test available for a broader age range. Second, our sample size was relatively small and therefore the four creativity groups were small, especially considering the missing data on the drawing task. Therefore, we recommend researchers to recruit a large sample with participants who are of different ages, that will result in subgroups that are large enough to compare and analyse. In accordance with Ionescu (2012), we also recommend studying cognitive flexibility using a different or new instrument or to combine different several instruments to make comparisons. Even if creativity in drawing does turn out to be indicative of cognitive flexibility in the future, it is necessary to understand the concept of cognitive flexibility more completely.

All in all, from this study can be concluded that there is no relationship between cognitive flexibility and inflectional morphology in typical language development.

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Appendix A

Table 1.

Summary of Group Means for Creativity and Age on Inflectional Morphology

	Creativity in Drawing				Age		
	least	slight	mod.	most	5-y/o	6-y/o	7-y/o
	M	M	M	M	M (SD)	M (SD)	M (SD)
n	19	32	28	25	41	44	28
TAK 24 items	17	18	17	19	15 (4.31)	18 (3.74)	21 (3.30)
Plural 12 items	9	9	9	10	8 (2.29)	9 (1.52)	10 (1.97)
weak	4	4	4	4	4 (1.01)	4 (0.29)	4 (0.00)
strong	4	4	4	4	4 (0.64)	4 (0.15)	4 (0.57)
irregular	1	1	1	2	1 (1.47)	1 (1.40)	2 (1.52)
Past part. 12 items	8	9	8	9	7 (3.11)	9 (2.65)	11 (1.95)
weak	3	3	3	3	3 (1.39)	3 (1.16)	4 (0.56)
strong	3	3	3	3	2 (1.30)	3 (1.09)	4 (0.59)
irregular	2	2	2	2	1 (1.38)	2 (1.39)	3 (1.22)
WUG 10 items	5	4	5	5	4 (2.00)	5 (1.83)	7 (2.04)
plural[b]	4	4	5	5	4 (2.03)	5 (1.28)	5 (1.03)
past tense[a]	0	1	0	1	0 (0.35)	0 (1.02)	1 (1.62)

[a] 4 items; [b] 6 items