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DIPLOMARBEIT

Titel der Diplomarbeit

The use of zero forms, bare nouns, articles + nouns, and pronouns for reference and co-reference in a picture story by individuals with Down syndrome. Correlations with age, IQ, grammar and vocabulary.

Verfasserin

Mag. phil. Monika Susanne Boniecki

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The present thesis is part of an ongoing, larger project, titled "*An explorative study on clinical, neurophysiological and linguistic markers and cognitive abilities in Down Syndrome*" [original German title: "Explorative Studie über klinische, neurophysiologische und linguistische Marker und kognitive Fähigkeiten bei Down Syndrom"]. This project was developed by Dr. Anastasia Dressler and is partly carried out in an interdisciplinary co-operation with Prof. Wolfgang U. Dressler.

For the present thesis, Prof. Wolfgang U. Dressler provided the project with some of the tests developed in his work group. Dr. Anastasia Dressler supervised the selection of participants, and the psychological test that was administered at the Vienna General Hospital, Department of Pediatrics. She also oversaw the linguistic tests that were carried out by me in the hospital. Moreover, she reported back to participants' families. The linguistic parameters needed for analysis and the results were discussed in collaboration. All in all, this was an interesting work experience for me, where I could not only enhance my practical knowledge of academic research, but also gain many valuable insights from our interdisciplinary work. For this I am very grateful.

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Declaration of Authenticity

I confirm to have conceived and written this paper in English all by myself. Quotations from other authors and any ideas borrowed and/or passages paraphrased from the works of other authors are all clearly marked within the text and acknowledged in the bibliographical references.

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Introduction

Narrative research in Down Syndrome (=DS) has mainly been concerned with the macro-level (Boudreau & Chapman, 2000; Finestack, Palmer, & Abbeduto, 2012; Kay-Raining Bird & Chapman, 1994; Miles & Chapman, 2002). There is little research on the micro-level, and only two studies (Lorusso, et al., 2007; Moore, Clibbens, & Dennis, 1998) investigated the referential devices used for introducing, maintaining and switching animate story characters. It was found that individuals with DS show specific difficulties in the use of reduced reference (i.e. pronoun, nominal substitute, zero anaphora), and in particular in the use of personal pronouns. This entails that individuals with DS have difficulties in marking the status of main characters as opposed to peripheral characters. However, the question remains, why.

The main purpose of the present thesis was to answer the question, why the use of personal pronouns is atypical in individuals with DS. In order to answer this question, Austrian German-speaking individuals with DS aged between 7.8 years chronological age (=CA) and 30.2 years were tested. The spectrum of referential devices used to introduce, maintain and switch animate story characters was investigated, and correlated with participants‘ CA, IQ (working memory, processing speed, logical thinking, language comprehension), morphosyntactic skills (nominal plural and past participle test), and lexical skills (types, token, lemmata). This allowed an understanding of the interrelationship between textual skills, CA, IQ, grammatical skills, and lexical skills.

In order to provide a comprehensive discussion of the research question, the present thesis comprises a theoretical background and a description, analysis and discussion of the experimental research. The theoretical background first consists of a summary of findings on DS individuals‘ clinical and cognitive phenotype. In particular, the summary focuses on DS individuals‘ working memory, processing speed, fluid reasoning, language production and language comprehension. Second, the use of referential devices for introducing, maintaining and switching in German are shown and illustrated with examples relevant for the present experiment. Third, development research of referential devices in TD is summarised, and findings on the use of referential devices in DS are sketched. In a second part, the empirical study is presented. It is concluded with a discussion of the relevant findings and suggestions for future research. Finally, in the Appendix, the instructions and the results are provided.

Theoretical background

1 Down syndrome phenotype

Down syndrome (DS) is a genetic disorder, that was extensively described in 1866 by the English physician John Langdon Down and subsequently named after him. It is the most common genetic disorder, as it affects 1 in 600 individuals (Harris, 1998 cited after O'Brien 2002). Down syndrome shows a specific clinical and cognitive phenotype, but there are individual differences as to the severity of the syndrome. In what follows the clinical and cognitive phenotype will be described in more detail (for reviews see Fidler & Daunhauer, 2011; Lott & Dierssen, 2010; G. O'Brien, 2002; Roizen & Patterson, 2003). With regard to the research questions, an emphasis will be put on the linguistic phenotype in DS and observed interrelationships between verbal and non-verbal cognition.

1.1 Clinical and developmental phenotype

The genetic disorder in DS is caused by a full or partial triplication of chromosome 21. Therefore, the disorder is also known as trisomy 21. Depending on how the triplication of chromosome 21 manifests, three different subcategories of DS can be distinguished (Rondal, 2010): A so-called *standard trisomy 21* develops in the majority of cases (97%). Here, “the genetic error takes place in the ovula or in the spermatozoid before syngamy or during the first cell division. All the living cells of the embryo receive three chromosome 21s” (p. 122). Another subcategory is called *mosaicism*. It has a much lower incidence rate (1-2%). In this form, “the genetic error takes place during the second or third cell division. In those cases, the embryo develops with a mosaic of normal cells containing the regular number of 46 chromosomes and cells with three chromosome 21s” (p. 122). Finally, a so-called *translocation* can occur, but it too is rare (1-2%). In the case of translocation, “the additional chromosomic material is not a triplicate of chromosome 21 but a part or the totality of another chromosome (often chromosome 14 or 22)” (p. 122). Frequently, the error occurs in the development of the ovula or spermatozoid, or during the first cell division. Sometimes, however, the biological mother or father, who is phenotypically normal, has a translocation in her/his genetic makeup and passes it on.

As described in O'Brien (2002), the outward appearance of individuals with DS shows characteristic facial features, such as “upward- and outward-slanting eyes” (p. 182), a characteristic epicanthic fold and a flattened nasal bridge. Individuals have a short stature and tend to be overweight.

The clinical phenotype in DS shows many symptoms, including neurological, behavioural, gastroenterological, cardiac, orthopedic, hematological, and endocrinological. Symptoms may be

more or less pronounced in each individual. The following summary highlights the most important ones.

With regard to neurological symptoms, individuals with DS show muscular hypotonia, seizures, co-morbid autism and Alzheimer (see Leshin, 2002). Muscular hypotonia “is defined as low tone of the muscle in its resting state“ (p. 188), which means that all muscles in the body have a lowered tension. As a result individuals with DS are delayed in motor development, and have constipation and gastroesophageal reflux.

Another neurological symptom in some individuals with DS are seizures. The prevalence of this syndrome in DS varies between studies, but may be estimated to lie between 5-10% (Leshin, 2002). They occur frequently before the second year of life and later in the third decade of life. If present, seizures have an important impact on cognitive development, as they are related to developmental age (Eisermann, et al., 2003), mental impairment (Kumada, et al., 2005) and autism (Eisermann, et al., 2003). Therefore, it is important to consider occurrence of seizures in linguistic studies.

Also without the main effect of seizures, autism is comorbid with DS (Dressler, Perelli, Bozza, & Bargagna, 2011; Dykens, 2007; Hepburn, Philofsky, Fidler, & Rogers, 2008; Kent, Evans, Paul, & Sharp, 1999). Autism describes a group of neurodevelopmental disorders, that “are characterized by deficits in communication and socialization, along with repetitive and stereotyped behaviour“ (Troy, Knoch, & Barton, 2011, p. 9). In DS 1-11% of individuals develop autism (Dressler, et al., 2011). The onset of autism is later in children with DS than in children with autism alone, and occurs around the age of 14 (Rasmussen, Borjesson, Wentz, & Gillberg, 2001). Children with a dual diagnosis of DS and autism show poorer language skills (pragmatic and semantic) along with poorer social skills compared to children with DS alone (Kent, et al., 1999). Therefore, it is necessary to take account of the effect of autism in language studies and intervention.

A final neurological symptom in individuals with DS is Alzheimer‘s disease. Individuals with DS are more likely to develop Alzheimer's disease than individuals in the general population (for reviews see Fidler & Daunhauer, 2011; Lott & Dierssen, 2010). Over 75% of individuals with DS aged 65 years and above develop clinical signs of dementia (Coppus, et al., 2006; Tyrrell, et al., 2001), and it is not clear what causes the development of dementia in some individuals with DS as opposed to others (Lott & Dierssen, 2010, p. 627), however, genetic inheritance and family involvement may be of importance (Fidler & Daunhauer, 2011, p. 19). Symptoms “include forgetfulness, impaired short-term memory, confusion, problems with learning, and deficits in visuospatial organisation. Gait disturbances, sphincteric incontinence, and seizures complete the clinical presentation of Alzheimer's disease in people with Down's syndrome.” (Lott & Dierssen, 2010, p. 627). Also with regard to language, changes occur; “a decline in social conversation, regression in conversational style, and problems with verbal expression in social contexts” (Lott & Dierssen, 2010, p. 627) has been noted. Therefore, linguistic studies in adults with DS should take into consideration the presence of Alzheimer‘s disease (e.g. Iacono, Torr, & Wong, 2010).

Along with neurological symptoms, individuals with DS show behavioural disorders (see Fidler & Daunhauer, 2011 for a summary). Behavioural disorders may be less severe in DS than individuals with other intellectual disabilities, because of strengths in social relatedness (Dykens, 2007). Problematic behaviours include hyperactivity (Pueschel, Bernier, & Pezzullo, 1991), inattention (Coe, et al., 1999), and low-level aggression, like disobedience (Coe, et al., 1999; Dykens, Shah, Sagun, Beck, & King, 2002). With increasing age, these behaviours become less prevalent, but mood and anxiety disorders become more common (Patti & Tsiouris, 2006).

In addition, individuals with DS also show gastroenterological problems. For example, these include intestinal obstruction (G. O'Brien, 2002). This is a “blockage of the intestines” (Martin & McFerran, 2008), which may lead to vomiting and an experience of abdominal pain. Moreover, individuals with DS are prone to develop coeliac disease (also spelled 'celiac disease' in American English) (Cohen, 2006; Leshin, 2002). It “is a disease of the small intestine in which the lining has been injured by long-term exposure to gluten, a protein found in oats, barley, rye, and wheat. The injury is caused by an inappropriate immunologic reaction in the lining of the intestine. The injured lining can no longer absorb certain nutrients“ (Leshin, 2002, p. 190). Consequently, individuals no longer gain weight or grow in height, and show a “bloated stomach, chronic diarrhoea, vomiting, decreased appetite, and irritability“ (p. 190).

Moreover, cardiac symptoms are present in individuals with DS. Many individuals with DS have a heart disease present from birth (G. O'Brien, 2002). Typically, it is caused by an “abnormal development of the endocardial cushions” (Barlow, et al., 2001, p. 91), which are important in the formation of the fetal heart. Therefore, regular medical examinations are necessary.

Orthopedic symptoms also occur in individuals with DS (Leshin, 2002, pp. 191-192). They are usually brought about by laxity of ligaments, which leads to movements of bones. A common problem is atlantoaxial instability. It “is caused by excess movement between the first and second vertebrae in the neck“ (Leshin, 2002, p. 191). Less common is atlantooccipital instability. This disorder “involves the first vertebra and the skull“ (p. 192). Both disorders may lead to “easy fatigability, difficulties in walking, abnormal gait, neck pain, limited neck mobility, head tilt, incoordination and clumsiness, sensory deficits, spasticity and/or hyperreflexia“ (p. 191).

Other symptoms in DS are otolaryngological by their nature (Leshin, 2002, p. 192). For example, individuals with DS have an atypical anatomy of the upper airways. To be more precise, they “have smaller midfacial areas, including nasal and sinus passages“ (Leshin, 2002, p. 192). This leads to recurring upper respiratory infections. Furthermore, hearing impairment or even loss occurs in individuals with DS. This may be brought about by otitis media with effusion, “a common condition in which viscous fluid accumulates in the middle ear, causing deafness” (Martin & McFerran, 2008). It may also be caused by a “dysfunction of the transfer of sound from the inner ear to the brain“ (Leshin, 2002, p. 193). For language development a hearing impairment has disadvantageous effects. As summarised in Roberts, Price and Malkin (2007), DS individuals with hearing impairment have difficulties with receptive grammar (morphological morphemes), productive vocabulary, MLU and speech intelligibility.

Further symptoms include hematological diseases (Leshin, 2002, pp. 193-194). For instance, individuals with DS are more likely to develop leukaemia. Leukaemia denotes “any of a group of malignant diseases in which increased numbers of certain immature or abnormal leucocytes are produced“ (Martin & McFerran, 2008). This increases the possibility of infections, anaemia and bleeding. Other hematological diseases include thrombocytopenia or thrombocytosis. Thrombocytes are blood platelets. In thromobcytopenia they are reduced, while in thrombocytosis they are increased. Thrombocytopenia leads to a clotting problem and may result in bleeding. Thus, some individuals require transfusions. Thrombocytosis is not known to cause any problems (Leshin, 2002, p. 194).

Endocrinological symptoms have also been found to occur in individuals with DS (Leshin, 2002, pp. 194-196). Frequent are thyroid disorders, especially hypothyroidism, which describes “subnormal activity of the thyroid gland“ ("Concise medical dictionary," 2010). Hypothyroidism leads to many symptoms. In adults it “causes mental and physical slowing“ ("Concise medical dictionary," 2010). The latter seems especially important for language performance. Moreover, diabetis mellitus is a frequent disease in individuals with DS. It “caus[es] the body to stop making insulin“ (Leshin, 2002, p. 196). Without enough insulin blood sugar rises.

Finally, individuals with DS show ophthalmological symptoms (Leshin, 2002, pp. 196-197). One of the first abnormalities to develop is a cataract, which is “any opacity in the lens of the eye, resulting in blurred vision” (Martin & McFerran, 2008). Moreover, already children with DS are frequently nearsighted, or farsighted, and show a propensity for developing an astigmatism (Leshin, 2002, p. 196). As visual acuity is important in literacy skills (Nandakumar, Evans, Briand, & Leat, 2011; Nandakumar & Leat, 2010), it is important to provide individuals with appropriate intervention.

1.2 Cognitive phenotype

As mentioned above, DS is a genetic disorder with an associated cognitive impairment (for reviews see Couzens, Haynes, & Cuskelly, 2012; Fidler & Daunhauer, 2011; Lott & Dierssen, 2010; Silverman, 2007). IQ in DS ranges between 40 and 70 and the intellectual impairment can be described as mild to moderate (Hodapp, Evans, & Gray, 1999). Several factors influence cognitive development, not only including genetics, but also intra-individual characteristics and environmental variables. As such, high persistence may contribute to an increase in cognitive development, while high negative mood may hinder growth (Couzens, et al., 2012). Another individual characteristic is health. Clinical disorders like epilepsy (Kumada, et al., 2005; Lott, et al., 2012), depression (Stein, Munir, Karweck, Davidson, & Stein, 2013) and hypothyroidism (see Coleman, 1994 for a review) negatively affect cognitive development. Environmental factors include maternal education, and school experience (Couzens, et al., 2012), showing that a supportive learning environment can improve cognitive development in DS.

Environmental factors include medication and other intervention, maternal support, stress, or infections. Finally, gene-environment interactions cannot be ruled out (Lott & Dierssen, 2010). In

what follows, the cognitive phenotype in DS will be described with an emphasis on working memory, processing speed and language, as these were the areas tested in the present thesis.

1.2.1 Working memory

Working memory is a concept that refers to “a limited capacity system for maintaining and manipulating information that underpins the capacity for complex thought and learning” (Baddeley & Jarrold, 2007, p. 925). There are various models describing working memory, but the most influential one was proposed by Baddeley and colleagues (Baddeley, 2001; Baddeley & Hitch, 1974). It has also been applied in the context of DS research and will therefore be used here.

According to Baddeley, working memory consists of four parts: a system which controls attention; the *central executive*, a short-term storage of phonological information; the *phonological loop*, a short-term storage of visuo-spatial information; the *visuo-spatial sketchpad*, and a system which integrates the incoming information with long-term memory; the *episodic buffer*. These subsystems will be described in more detail and discussed in the context of DS research.

Working memory is impaired in DS, with a specific profile of strengths and weaknesses. For example, the viso-spatial sketchpad and the phonological loop are two slave systems, which are affected differentially. The visuo-spatial sketchpad is “capable of holding and manipulating visual and spatial information” (Baddeley & Jarrold, 2007, p. 926). It is needed for visuo-spatial short-term memory, for example, to temporarily remember a path. The phonological loop “involves the temporary storage of phonological information in a form that decays over a matter of seconds unless refreshed by rehearsal” (p. 925). It is needed for verbal short-term memory, for example, to temporarily memorise a string of auditorily presented numbers, and it helps to “convert a visual stimulus, such as a printed word, into a phonological representation by subvocal naming” (p. 925). In the context of DS research, it has repeatedly been pointed out that individuals with DS have a relative strength in visuo-spatial memory and a deficit in verbal short-term memory (see Jarrold, Baddeley, & Phillips, 1999 for a review).

The most cited study to support this view was carried out by (Jarrold & Baddeley, 1997) (but see Vicari, Carlesimo, & Caltagirone, 1995). Participants included 15 children with DS, 15 children with moderate learning difficulties (MLD) and 15 TD children, all matched on vocabulary age. The tests included a digit span measure and a Corsi span measure. In the digit span measure, children heard one to nine digits and had to repeat them in the correct order. In the Corsi test, children saw a mouse on a computer screen, which looked out one to nine cheese holes. The children had to remember the order of the cheese holes, where the mouse had looked out.

Results showed that compared to MLD and TD control groups, DS children showed a strength in the Corsi task (visuo-spatial task), but a deficit in the digit span task (phonological loop task). The reverse was noted for the two control groups. This finding suggests that “Down's syndrome is associated with a selective impairment of the phonological loop” (p. 101).

As has been pointed out by (Gathercole & Alloway, 2006), it is not clear what causes this deficit in the phonological loop. It might be due to an impairment in subvocal rehearsal, fast decay, or a limited phonological storage. Baddeley and Jarrold (2007) argue for the latter.

Regardless of the reason for an impaired phonological loop in DS, the deficit in verbal short-term memory may have serious consequences on language acquisition, comprehension and production. Authors have suggested that DS individuals with reduced verbal short-term memory may have difficulties acquiring new words (Baddeley & Jarrold, 2007; Chapman, 2003; Gathercole & Alloway, 2006; Jarrold, et al., 1999; Vallar & Papagno, 1993). The importance of (verbal) working memory for vocabulary performance has also been demonstrated in the present study (see Chapter 6.4.1.6). Moreover, it has been shown elsewhere that a reduced verbal short-term memory (STM) in DS negatively affects receptive grammar (Laws, 1998) and expressive language as measured by mean length of utterance (MLU) (Laws & Gunn, 2004). Finally, it seems plausible that a reduced verbal short-term memory will influence DS individuals ability to keep longer stretches of speech in mind. As such, some grammatical tests requiring participants to repeat parts or a full sentence should be interpreted with care.

Another component of working memory is the central executive. It is “the most important” (Baddeley & Jarrold, 2007, p. 926) part of working memory. It is a system that controls attention, to be more specific, it enables the “focusing and dividing [of] attention and possibly ... attentional switching” (p. 926). In this it is limited, because its capacity is limited. The central executive is needed when two tasks are carried out simultaneously.

Regarding DS, little research has been carried out to investigate the central executive, but results indicate that the central executive is impaired (Lanfranchi, Baddeley, Gathercole, & Vianello, 2012; Lanfranchi, Cornoldi, & Vianello, 2004; Lanfranchi, Jerman, & Vianello, 2009; Vicari, et al., 1995) (but see Pennington, Moon, Edgin, Stedron, & Nadel, 2003). Remember that the central executive controls how attention is selected and shared among two tasks. As such, dual task studies within a modality (e.g. verbal or visual) and across two modalities (e.g. verbal and visual) are possible means by which the central executive can be investigated. Lanfranchi, Baddeley, Gathercole and Vianello (2012) carried out a single task and cross-modal dual task study. The authors built on earlier work by Lanfranchi, Cornoldi and Vianello (2004) and wanted to investigate “whether the DS deficit in dual task performance reflected an overloading of the peripheral storage subsystems [i.e. the phonological loop and the visuo-spatial sketchpad], or, ... a deficit in the capacity to divide attention between two tasks [i.e. the central executive]” (p. 159). A dual task experiment testing within modality and across modality performance is conducive to investigate this question.

To carry out the experiment, 45 children with DS and 45 TD children matched on verbal abilities were tested. A total of six tasks were administered, including dual tasks alongside single tasks. The verbal single task, was a selective word recall task, where the participant heard one or two lists of words (2-3 words per list) and had to remember the first word of each list. Similarly, in the cross-modal dual task, the participant was presented a list of words (2-5 words) and had to remember the first word, as well as tap when shown a red card. In the verbal dual task, the child was again

presented a list of words (2-5 words) and had to remember the first word, but he/she also had to tap when hearing the word *ball*. In the visuo-spatial single task, the participant was shown a path taken by a frog on a chessboard and had to remember where the frog had started. In the cross-modal dual task, the participant also had to remember where the frog had started moving along a path, but additionally had to tap when hearing the word *ball*. In the visuo-spatial dual task, the participant again had to keep in mind where the frog had set off, but also had to tap when the frog passed a red square.

Results showed that DS participants showed a strength in the visuo-spatial single task as their performance did not differ significantly from TD participants. DS performance in visuo-spatial dual tasks, however, was significantly lower. Concerning the verbal domain, DS participants showed a deficit as they achieved lower scores than TD participants on all verbal short-term memory tasks, especially the verbal dual task.

In sum, Lanfranchi, Baddeley, Gathercole and Vianello (2012) could replicate earlier findings that DS individuals show strengths in visuo-spatial short-term memory when performing single tasks, and a comparable weakness in verbal short-term memory. This indicates that there is a "phonological loop limitation, possibly due to more rapid decay" (p. 163), which "is quite specific to DS, as it is not present in other genetic syndromes" (p. 163). Moreover, the study supports previous findings that DS individuals show a weakness in dual tasks for both modalities. However, it elaborates on these findings and demonstrates that the impairment in dual tasks is also present in cross-modal (visuo-spatial and verbal) dual tasks. This deficit indicates a "central executive impairment which could be specific to dual task performance" (p. 163) within and across domains. The authors point out that the deficit may, however, not be syndrome specific, as it has also been observed in individuals with intellectual impairment with other aetiologies, and as such might be correlated with intelligence.

This is important to remember in DS narrative research, as any textual task requiring two processing components – verbal or non-verbal – will influence linguistic performance. As such, studies in which DS participants are asked to watch a (silent) film and simultaneously tell the ongoing story (e.g. Moore, et al., 1998), should be interpreted with care. In this task, the load on the central executive is high and likely leads to disproportionally poorer narrative performance of DS than TD participants. Similarly, studies using a picture story should ensure that DS participants know the pictures before telling the story. In this way, the load on the central executive can be reduced and narrative performance brought to light (see also Chapman, 2006). This was accounted for in the present study (see Chapter 5.3.6).

The final component of working memory to be described is the episodic buffer. It is "a limited-capacity storage system based on a multidimensional code. It is a buffer in the sense that its capacity is limited and in that it forms a means whereby different codes can be combined or bound into objects or episodes" (Baddeley & Jarrold, 2007, p. 927). The episodic buffer is, for example, needed if a string of Arabic numerals and digit words need to be remembered temporarily, as here visual short term memory from the visuo-spatial sketchpad is combined with verbal short term

memory from the phonological loop (Eysenck & Keane, 2005, p. 204). With regard to DS, no studies on the episodic buffer have been carried out up to date.

1.2.2 Processing speed

Processing speed can be defined as “[t]he rate at which a person performs simple perceptual or cognitive tasks such as apprehension, scanning, retrieval, and response to stimuli” (Colman, 2009). There are few studies specifically addressing processing speed in DS. This is not surprising, as research on processing speed in clinical populations has only been “'re-discovered' more recently” (A. R. O'Brien & Tulsky, 2008, p. 1). As a result little is known about processing speed in DS and conflicting findings exist (see Silverman, 2007 for a review).

The majority of research indicates that individuals with DS have reduced processing speed (but see Silverman & Kim, 1997). This is already apparent in infants with DS (Karrer, Karrer, Bloom, Chaney, & Davis, 1998; Zelazo & Stack, 1997). It has also been demonstrated in children with DS (Lincoln, Courchesne, Kilman, & Galambos, 1985) and young adults with DS (Berkson, 1960; Lalo, Vercueil, Bougerol, Jouk, & Debu, 2005).

But the question remains whether reduced processing speed in DS was detected because of slower mental processing (Zelazo & Stack, 1997), or if there are other reasons, such as slow motor response (Silverman, 2007) or misunderstanding of the task requirements (Lalo, et al., 2005). Moreover, it is an unresolved issue whether reduced processing speed in DS is syndrome specific, or a general characteristic of intellectual disability.

Regarding language acquisition and production in DS, it would be fruitful to further investigate processing speed. In TD, research has pointed to the importance of processing speed. For example, it has been shown that global processing speed influences reading ability in children (Peter, Matsushita, & Raskind, 2011). Such research is still missing in DS.

1.2.3 Fluid intelligence

Fluid intelligence is “[a] fundamental factor of human intelligence ..., corresponding roughly to non-verbal reasoning, requiring rapid understanding of novel relationships“ (Colman, 2009). It is thus not based on declarative knowledge (Snow, Kyllonen, & Marshalek, 1984). Most commonly, fluid intelligence is measured by Raven‘s Progressive Matrices (RPM) (Colman, 2009). This is a psychological test that exists in different versions. For individuals with intellectual disability (ID) the Raven‘s Colored Progressive Matrices (RCPM) (Raven, Court, & Raven, 1998) are of importance. The task in this test is to look at a coloured matrix and select a similar matrix from a set of given options.

Although fluid intelligence, as measured by the RCPM, is used for matching test and control participants on non-verbal intelligence in language studies on DS and SLI (e.g. Laws & Bishop, 2003), little research has been carried out to specifically investigate fluid intelligence in individuals

with DS. First results indicate that there are quantitative differences between DS individuals and TD adults in fluid intelligence. However, it is not as yet clear if there are also qualitative differences. For example, it has been shown that adolescents and adults with DS achieve a significantly lower number of correct responses on the fluid intelligence tasks in the RCPM than TD children matched on mental age (Meyers, Dingman, Attwell, & Orpet, 1961; Vakil & Lifshitz-Zehavi, 2012). But as in TD, fluid intelligence has been shown to increase in children, adolescents and adults with DS (CA 14-42 years) over a test period of 5 years (Berry, Groeneweg, Gibson, & Brown, 1984; see also Couzens, Cuskelly, & Haynes, 2011).

With regard to qualitative research into fluid intelligence in DS, some results indicate that there are no qualitative differences between DS individuals and TD children. For example, individuals with DS find the same items in the RCPM difficult vs. easy as children with TD as well as children and adolescent with intellectual disability (ID) of undifferentiated aetiology matched on RCPM (Facon & Nuchadee, 2010). Such a response profile may have been attained, because “the Raven contains relatively homogeneous sets of items“ (Facon & Nuchadee, 2010, p. 247). Therefore, “there is no reason, *after the matching of groups on the test‘s raw score*, for differential functioning to be seen in relation to individuals‘ intellectual efficiency or to their membership in specific etiological groups“ (p. 247). However, the authors stress, that different results might be obtained with individuals with Williams syndrome, who are known to have difficulties in visuo-spatial memory.

Other research indicates that there are qualitative difference in fluid intelligence in DS vs. TD individuals. For example, children and teenagers with DS show different proportions of errors on the RCPM compared to children with TD and children with moderate learning disability matched on RCPM (Gunn & Jarrold, 2004). That is individuals with DS make more errors where they “provide[ ] half the correct pattern, but [are] unable to combine all the features of the target pattern correctly“ (p. 452). Moreover, individuals with DS make more errors where they “merely chose an item that had no relation to the target figure they were attempting to complete“ (p. 452). They, however, make less errors where they “reproduce part of the pattern immediately above or beside the target gap“ (p. 452). These error types change in TD children with age, but not in DS individuals. Because of a dearth of research, the authors cannot provide a final explanation of these findings, but suggest that individuals with DS may have problems in putting together all elements of the target pattern, problems in visual perception and accomodation, or they may give up more readily on such difficult tasks as the RCPM than TD individuals.

In a similar vein, performance differences in eye-movements on the RCPM task have been observed in adults with DS and adults with ID of undifferentiated aetiology compared to TD children matched on mental age (Vakil & Lifshitz-Zehavi, 2012). ID groups looked at the matrices for a shorter time before they looked at the options. They also switched more frequently from one region to another. Thus, adults with DS and adults with ID of undifferentiated aetiology employ different scanning strategies from TD children. This result supports Gunn and Jarrold‘s (2004) proposal, that differences in visual perception may give rise to differences in performance between DS and TD individuals.

1.2.4 Language

Language is an area of difficulty for individuals with DS. One of the main questions within research on DS (and other clinical groups) is whether language is delayed or deviant with regard to typical development (Rice, Warren, & Betz, 2005, p. 10; Schaner-Wolles, 1992, pp. 13-14).

> "In the delayed scenario, the language impairments can seem to share many points of similarity with younger, typically developing children, as if the language system is chronologically guided such that by a certain age level typically developing children have acquired a set of particular language skills, whereas the language of children with language impairments reflects a less mature pattern very similar to younger children. In contrast, in the deviant scenario the language system of children with language impairments might not parallel that of younger children. Instead the kinds of errors and limitations in language use and competency are inconsistent with what is known about any given level of typical language acquisition." (Rice, et al., 2005, p. 10)

In order to answer this question for language in DS, researchers have argued that it is important to look at productive vs. receptive language development in different language domains (i.e. lexicon/ pragmatics vs. syntax/morphosyntax) and to compare development across these. The following overview provides a discussion of the findings. It is based on reviews by (Abbeduto & Chapman, 2005; Chapman, 1995; Chapman & Kay-Raining Bird, 2011; Lynch & Eilers, 1991; Roberts, Price, & Malkin, 2007) and complemented by the present author.

1.2.4.1 Language production

Phonetics and phonology

Phonological development in DS is influenced by a number of factors (see Stoel-Gammon, 2001 for a review). First, children with DS often experience hearing problems (78%). This can impede phonological and later language development. Second, children and adults with DS show differences in anatomy and physiology. Anatomical differences include the skeletal and muscular system affecting articulation and phonation. Physiological differences include the central and peripheral nervous system, resulting in difficulties with accurate and fast speech production. A final factor influencing phonological and later language development is the language learning environment of the child with DS. Some research shows that the input received by DS children is "less well suited to the vocal and verbal abilities of children with Down syndrome" (Stoel-Gammon, 2001, p. 94), because it is not rich enough. For example, the input shows little syntactic and morphosyntactic variation and a low MLU. This may influence children's vocalizations and later expressive language.

In pre-linguistic vocal development, canonical babbling is an important landmark. Canonical babbling, also known as reduplicated babbling, refers to vocalizations containing consonant-vowel

syllables that are repeated. Importantly, these are syllables that exist in the adult language surrounding the child. Frequent examples include 'baba' or 'dada'. The onset of babbling in TD is set around 6-9 months (Harley, 2001).

Regarding the development of babbling in DS, it can be concluded that pre-linguistic vocal development in DS infants is “nearly typical” (Stoel-Gammon, 2001, p. 95) till the age of 15 months. It has been shown that babbling in DS infants emerges around the same time as babbling in TD, namely around eight and eight and a half months (B. L. Smith & Oller, 1981) (but see Lynch & Eilers, 1991 who found a two month delay in onset of canonical babbling in DS). Moreover, DS infants show a similar increase in canonical babbling over time, comparable to TD infants (Steffens, Oller, Lynch, & Urbano, 1992). Because of the quasi typical development of canonical babbling in DS, it could be assumed that later phonological development of words is unimpaired. However, this is not entirely true (Stoel-Gammon, 2001). It is the case, that DS children show “the same phonological characteristics” (p. 96) of word productions as TD children. In general stops, consonants and glides are rather produced correctly, whereas fricatives, affricates and liquids are pronounced erroneously. But the phonological development in DS proceeds slower, is prone for more phonological errors, and shows more variance in errors. This is possibly due to problems in motor speech control (Dodd, 1975, 1976).

A final important factor in phonological development is intelligibility. In TD intelligible speech to strangers is developed by about 50% in 2 year-olds (Coplan & Gleason, 1988; Vihman, 1988), about 75% in 3 year-olds (Coplan & Gleason, 1988; Vihman, 1988) and fully developed in 4 year-olds (Coplan & Gleason, 1988; note that this is earlier than suggested by Flipsen, 2006). In DS, however, some individuals produce unintelligible speech throughout their lives. This is independent of mental age, and due to problems in motor speech programming (Dodd, 1975, 1976) and atypical prosody (Shriberg & Widder, 1990).

Lexicon

As summarised in Roberts et al. (2007), the onset of first words in TD is around the end of the first birthday, between 10-15 months (Hoff, 2001). In DS, however, the onset of first words is late with respect to chronological age and great individual variability exists to the actual emergence of first words. For example, in a wide-scale study, Berglund et al. (2001) showed that in DS children aged between 12-23 months 12% produced one word, in 24-35 months 80% uttered one word, and in 36-47 months 90% spoke one word. This shows a lag of about 32 months.

However, Chapman (1995) has pointed out, that this delay is relativised, when non-verbal mental age is considered. A study by Cardoso-Martins et al. (1985) showed that six DS children aged between 17-19 months, matched with six TD children on cognitive development, had the same onset of production and comprehension of object names. This indicates that children with DS start producing first words around the same mental age as TD children, at least concerning lexical reference to objects.

As lexical development progresses, children's vocabulary grows. In children with DS the growth of cumulative vocabulary is slow relative to their chronological age, and it is still a matter of debate whether expressive vocabulary size is a strength or a weakness with regard to mental age (Roberts, Price, & Malkin, 2007). Studies have inconclusively shown that in children with DS, expressive vocabulary is on a par with non-verbal cognition (Laws & Bishop, 2003), or that it is lower (Hick, Botting, & Conti-Ramsden, 2005; Roberts, Price, Barnes, et al., 2007). Similarly, in adolescents with DS it has been reported that vocabulary size is higher than non-verbal cognition (Glenn & Cunningham, 2005), or that it is lower (Chapman, Schwartz, & Kay-Raining Bird, 1991, 1998; Miller, 1988). Roberts et al. (2007) draw the conclusion that the question of expressive vocabulary size is a matter of testing. When standardised tests are used (e.g. British Picture Vocabulary Scales), then individuals with DS show strengths in cumulative vocabulary, but when spontaneous speech is used (e.g. narrative samples), then individuals with DS show a weakness.

A similar debate surrounds vocabulary diversity in DS. Presently, differing findings suggest that either lexical variety in DS is comparable to TD peers, or qualitatively different. An illustrative example comes from research on mental and internal state verbs. For instance, Grela (2002b) studied mental state verbs (e.g. think, know, wish, believe, forget) in DS and TD children matched on MLU during mother-child play. He concluded that both groups produced an equal proportion of mental verbs. This, however, stands in contrast to Beeghly and Cicchetti (1997) and Hesketh and Chapman (1998). Beeghly and Cicchetti studied internal state verbs, which include mental state verbs, in DS and TD children matched on mental age. Their use of internal state verbs was assessed analysing a picture book task, in which mothers and children talked about pictures, and verbal interaction during mother-child play. The analysis covered a wide variety of different internal state word categories: sensory perception (e.g. feeling, seeing), physiological states (e.g. being hungry, waking up), affect (e.g. loving, hating, kissing), moral judgement (e.g. being nice), obligation (e.g. being supposed to), volition (e.g. wanting), ability (e.g. can), and cognition (e.g. knowing). The analysis showed that TD children produced a higher proportion of internal state verbs and a higher number of different internal state verbs. Similarly, Hesketh and Chapman studied (among other measures) metacognitive verbs (e.g. know, think, remember) and metalinguistic verbs (e.g. promise, mean) in DS and TD children matched on MLU. Productions were obtained from a narrative sample. Results showed that individuals with DS used a smaller proportion of metacognitive and metalinguistic verbs than TD children.

The different findings may be accounted for by two factors: First, the number of participants varied between studies. While Grela (2002b) included 7 children with DS, Beeghly and Cicchetti (1997) tested 39 and Hesketh and Chapman (1998) 29 children with DS. Second, the amount of different verb categories investigated differed between the studies, with Beeghly and Cicchetti investigating most categories, and thus providing an encompassing insight. Therefore, it can be concluded that individuals with DS show a strong likelihood for a weakness in internal state verbs.

This conclusion is on a par with findings that show a weakness of DS individuals with theory of mind, which is at the heart of the ability to understand another person‘s mental states (Abbeduto,

Pavetto, et al., 2001). Moreover, it can be explained by the fact that mothers of children with DS use internal state words less frequently when conversing with their children at mealtime, than mothers of TD children (Tingley, Gleason, & Hooshyar, 1994).

Syntax

In comparison with lexical development, syntactic development has repeatedly been identified as a specific weakness in DS (for reviews see Chapman, 1995; Roberts, Price, & Malkin, 2007; Rondal & Comblain, 1996; Rondal & Guazzo, 2012). Already the transition from one to two-word utterances lags behind TD peers. For example, Iverson, Longobardi and Caselli (2003) studied five children with DS with a mean chronological age of 47.6 months, a mean mental age of 22.4 months and a mean language age of 18 months. They were compared to TD children matched on language age and expressive vocabulary size. Results showed that at this level of development, TD children produced two word utterances, but DS children never did.

Later in development, when multi-word utterances are produced in DS, the average mean length of utterance (MLU) grows with chronological age (Chapman, 1995; Rondal, Ghiotto, Bredart, & Bachelet, 1988). However, the rate of growth is slow so that MLU remains lower in DS children and adolescents compared with TD children matched on chronological age. For example, it has been demonstrated that at 4 years of age children with DS reach an MLU of 1.25, at 6 years an MLU of 2, at 9 years an MLU of 3, and at 11 years an MLU of 3.50 (Rondal, et al., 1988; Rondal, Lambert, & Sohier, 1980). Late adolescents with DS with English as their first language showed an MLU between 3-3.5 (Fowler, Gelman, & Gleitman, 1994). This is lower than the MLU found in French-speaking adolescents with DS, who had an MLU of 5.98 with a SD of 2.62 (Rondal & Lambert, 1983).

With regard to non-verbal mental age, it has been demonstrated that in children as well as adolescents with DS (5.6-20.6 CA), MLU was significantly lower than in mental age matched TD children (2.2-6.1 CA) in conversation, where DS participants showed a mean MLU of 2.45 with a SD of 1.14, in contrast to TD participants, who reached a mean MLU of 4.02 with a SD of 1.42. The same trend was observed in narrative productions, where DS participants produced a mean MLU of 3.00 with a SD of 1.45 and TD participants showed a mean MLU of 4.69 with a SD of 1.74.

Such reduced MLU is observed, because individuals with DS show difficulties in the use of morphosyntax and syntax. Concerning morphosyntactic relations, individuals with DS show a lower use of unbound and bound, tensed and non-tensed morphemes (see the section below for more details). As regards syntactic relations (see Rondal & Guazzo, 2012 for a review), conjunctions are less frequently used in DS resulting in fewer sentence co-ordinations and subordinations.

There is a debate underway on whether individuals with DS reach a ceiling in syntax above which their MLU does not develop any further. This idea was first presented by Fowler (1990). She proposes that syntactic development in DS is delayed, but develops along the same stages as in TD. However, ultimate attainment in syntax and morphosyntax is low, which cannot be directly

attributed to intellectual impairment or verbal abilities. For this phenomenon Fowler coined the term “delay-deficit“. She concludes, that these limits may be explained by the critical period hypothesis (Lenneberg, 1967), which states that after puberty language acquisition is no longer efficient or possible. When individuals with DS are delayed in their language development as they reach the end of the critical period, their language can never fully develop. A second alternative explanation provided by Fowler is that individuals with DS are limited in what they can acquire to simple syntax (see Chapman, 1995). Fowler's proposal has been criticised by Chapman et al. (1998) and Chapman et al. (2002), who found an increase of MLU in children and young adolescents. The authors suggest that apparently different findings in MLU arise because of different sampling methods. When MLU is measured in conversation, a ceiling can be observed, but not when it is measured in narratives.

Morphology and Morphosyntax

Morphosyntax has also been identified as a specific weakness in DS. It is lower with regard to both, chronological age and mental age. Individuals with DS show a lower use of the copula *be*, auxiliaries (*do, be, have*), secondary verbs (e.g. *I wanna se*e, or *I see a boy running*), noun and verb inflections (e.g. 3rd person singular -*s*, regular past tense -*ed*, present progressive -*ing*, regular noun plural -*s*, or noun possessive *'s*), articles, prepositions, personal and indefinite pronouns (Rondal & Guazzo, 2012).

Order of acquisition seems to be similar to TD peers (Bol & Kuiken, 1990; Rutter & Buckley, 1994). For example, Rutter and Buckley (1994) carried out a longitudinal study with twelve English-speaking DS children, who were aged between 12-38 months at the beginning of the study and 43-67 months at the end. Data was gathered using parental reports and compared with Brown‘s (1973) developmental sequence for English-speaking TD children. Results showed that soon after children with DS produced their first words, they started acquiring morphological rules. Especially, the first six morphemes were acquired by DS children in the same order as in TD children: (1) present progressive -*ing*, (2) preposition *on*, (3) preposition *in*, (4) plural -*s*, (5) irregular past tense, and (6) possessive -*s*. Moreover, most of the morphosyntactic rules were acquired by DS children. Exceptions included copula *be*, 3rd person singular -*s*, and auxiliary *be,* which had not yet been acquired by DS test participants. In sum, Rutter and Buckley take their results to suggest that “once the children with Down's syndrome “get going” with the production of language, they in fact show a similar pattern as typically developing children in the early acquisition of grammar” (Rutter & Buckley, 1994, p. 76). Comparable results were obtained in Dutch children and teenagers with DS (Bol & Kuiken, 1990).

Nevertheless, the question remains, if later in development there are some morphological structures that are particularly difficult to acquire for individuals with DS compared to TD peers. In the literature, finiteness has been discussed as a possible area of weakness. In English, finite morphemes comprise copula *be*, the auxiliaries *be* and *do*, 3rd person singular -*s*, regular past

tense *-ed*, and irregular past tense. Non-finite morphemes, on the other hand, include nominal and adjectival inflectional morphemes, for example, regular plural *-s* and comparative *-er*.

Some studies suggest that finiteness is an area of weakness in DS (M. Brown, 2004; Laws & Bishop, 2003; O'Neill & Henry, 2002; Schaner-Wolles, 2004). For English, Brown (2004) found that in an elicitation task, DS children omitted tensed morphemes (3rd person singular *-s*, past tense *-ed*, *be*, *do*) significantly more than TD children matched on MLU, while omissions of non-tensed morphemes (plural *-s*, progressive *-ing*, prepositions *in/on*) were comparable across groups. Although not suggested by Brown, this points to a specific impairment of finiteness marking in DS.

For German, Schaner-Wolles (1992, 2004) reports findings showing that children and adults with DS used the verb second rule, but marked less finite forms than TD children matched on mental age (e.g. **Papa fahren weg*. *''Father drive INF away.'). Therefore, she suggests that morphosyntax as opposed to syntax is a specific weakness in DS.

Other researchers found no evidence for impaired finiteness marking (Eadie, Fey, Douglas, & Parsons, 2002; Ring & Clahsen, 2005b). Eadie et al. (2002), for example, found that in interaction with an adult, children with DS used fewer tensed bound morphemes (regular past tense *-ed*, 3rd person singular *-s*) as well as non-tensed morphemes (plural *-s*, possessive *-s*, progressive *-ing*, *articles*) than TD children matched on MLU. Similarly, Ring and Clahsen (2005b) demonstrated that adolescents with DS performed comparably to TD children matched on MA on non-tense morphemes (noun plurals, comparative adjectives) similar to tense morphemes (past tense) in an elicitation task.

These diverging results might be due to differences in participant selection. Studies have used MLU or MA to match test and control groups. MLU is a variable that affects performance on past tense morphology in DS (Laws & Bishop, 2003). Once DS individuals reach an MLU of 4.5, their performance on past tense morphology does not differ from TD controls. Future studies should, therefore, not only control for MA, but also MLU. Moreover, more needs to be found out about the impact of MA on the development of inflectional morphology.

Another factor might have influenced results is the test material used. Brown (2004), for example, did not include irregular morphemes in her analysis. However, DS individuals may perform better on irregular than regular inflection, as will be explained below. Thus, Brown's analysis might have biased the results. Future studies should thus consider ir/regularity in order to arrive at a firm conclusion.

As just mentioned, ir/regularity is a morphosyntactic phenomenon that has been discussed with regard to specific strengths and weaknesses in DS. Some studies suggest that individuals with DS perform comparably to TD and SLI peers on the irregular past tense, while they show particular difficulties on the regular past tense relative to TD and SLI controls (Eadie, et al., 2002; Laws & Bishop, 2003). One explanation that could account for the relative strength of DS individuals in irregular morphology has been offered by Laws and Bishop (2003). The authors noted that higher results on expressive vocabulary correlated with better performance on the irregular past tense.

This result can be interpreted with a dual route model (Pinker, 1991), where lexical items, including irregular past tense forms, are stored as unanalysed chunks in associative memory, whereas regular past tense forms are . As such, the strength in irregular morphology could be explained by strengths in associative memory.

However, a specific strength in irregular past tense morphology in DS has not been demonstrated in all studies. Ring and Clahsen (2005b), as has been mentioned above, carried out an elicitation experiment with DS adolescents in which they tested (among other structures) the use of existing and non-existing past tense forms in English (e.g. *swim – swam* and *crive – crove*). As there were no differences in performance on existing and non-existing verbs, they were collapsed in the analysis. Results showed that adolescents with DS omitted regular and irregular past tense marking significantly more than TD children matched on mental age. However, when only looking at correct forms, no significant difference could be observed between DS individuals and TD controls. Unfortunately, the authors do not provide an error analysis.

Moreover, Stathopoulou and Clahsen (2010) did not replicate a strength of the irregular past tense in DS. The authors carried out a perfective past tense grammaticality judgement experiment with Greek speaking adolescents with DS. They were matched with TD children on mental age. The experiment contained existing verbs, with sigmatic and non-sigmatic verbs. Sigmatic verbs are "morphologically transparent with phonologically predictable stem alternations" (p. 872), e.g. *hala-s-a*, meaning 'I spoiled', and make up the majority of perfective past tense verbs. Non-sigmatic verbs "are morphologically less transparent. They contain idiosyncratic stem changes, no segmentable perfective past tense affix and are thought to be lexically stored as exceptions" (p. 872). Non-existing verbs were also tested. They included forms which rhymed with existing verbs, and forms which did not. Results showed that for existing verbs both, DS and TD, individuals performed better on sigmatic than non-sigmatic forms. Differences could be observed in non-existing verbs, where TD controls showed pronounced preferences for sigmatic forms in non-existing verbs rhyming with sigmatic verbs, but not in non-existing non-rhyming verbs. DS participants, on the other hand, preferred sigmatic choices to a lesser degree and, importantly, were not influenced by rhyme. The authors could not provide a final explanation for the preference of sigmatic verbs, as sigmatic verbs are rule-generated and at the same time used very frequently. Therefore, the storing and processing of verb forms cannot be interpreted unequivocally.

Another insight into the acquisition of ir/regularity in DS comes from Schaner-Wolles (1992). In an elicitation test, she investigated the production of German noun plurals and regular comparative marking of adjectives in children and adults with DS. She pointed out that, in contrast to English, German noun plurals make up an idiosyncratic class and there is no default plural morpheme (*-e*, *-er*, *-(e)n*, *-s* and *zero*) (but see Clahsen, Rothweiler, Woest, & Marcus, 1992 for a different view). Comparative marking of adjectives, on the other hand, mostly follows a regular paradigm (*klein, klein-er*, meaning 'small, small-er' or *groß, größ-er* meaning 'big, bigg-er'). Results showed that individuals with DS performed better on regular morphemes (i.e. comparison of adjectives) than irregular morphemes (i.e. noun plurals). In this, they did not differ from TD children. As stressed by

Schaner-Wolles, this is striking, as comparison is a cognitively more demanding concept than plurality.

Taken together, the research on the use of regular and irregular morphology is inconclusive. This is not surprising given the differences in methodology and chronological age. Future studies should investigate this topic further, as it is important to establish if individuals with DS show strengths or rather weaknesses in morphology.

Regarding ultimate attainment of morphosyntax in DS adults, little research has been carried out. In a review Rondal and Comblain (1996) suggest that (as with syntax) ultimate attainment in morphosyntax cannot be reached by most individuals with DS due to the critical period hypothesis at around 12-14 years (Lenneberg, 1967). The existence of exceptional individuals with DS who do master morphosyntax (Rondal, 1994, 1995; Seagoe, 1965) does not dismiss this claim. As argued by Rondal and Comblain (1996), their full development of morphosyntax was completed in childhood before the end of the critical period. An opposing view was suggested by Schaner-Wolles (1992). She found no evidence for a stagnation or regression of syntactic or morphosyntactic abilities after puberty. What is more, she reports that with intervention, individuals‘ language abilities could be improved. Therefore, the question, to what extend children and adults with DS can develop their morphosyntactic abilities, remains open.

Pragmatics and discourse

Before summarising pragmatic and discourse development in DS, it is perhaps appropriate to define the terms *pragmatics* and *discourse*. As pointed out by Perkins (2007) the terms have been used somewhat inconsistently in clinical linguistics, but a trend can be found:

> “If the focus of one's research is phenomena such as coherence, cohesion, discourse markers, information structure, narrative or topic, it is more likely to be referred to as discourse. If it focuses on issues such as implicature, inference, reference, politeness or speech acts, it will usually be considered to come under the heading of pragmatics. Conversation is equally comfortable in both camps.” (pp. 21-22)

Pragmatics and discourse are usually seen as a strength in DS (Abbeduto, Warren, & Conners, 2007; Chapman, 1995; Roberts, Price, & Malkin, 2007). Strictly speaking, pragmatics and discourse are concerned with the use of language. However, research in DS has also included studies on non-linguistic aspects of communication using norms of discourse and of pragmatics. Studies look at eye-gaze, hand gestures, smiling or laughing. This is typical in clinical linguistics, as participants frequently have a severe language impairment (Perkins, 2007, p. 9). Moreover, it has been suggested that gestures enhance language acquisition (Capone & McGregor, 2004). Infants with DS use these social-communicative signals later as CA matched infants (Abbeduto, et al., 2007), but as often as, or even more frequently than MA matched TD infants (Fischer, 1987; Franco & Wishart, 1995). Moreover, they have a wider repertoire of signs (Franco & Wishart, 1995). Therefore, the ability to use social-communicative signals is seen as a strength in DS.

However, the signals are used less spontaneously and are more frequently a response to mother initiated speech (Fischer, 1987).

Whereas non-linguistic social interaction is a strong point in DS, non-linguistic object requesting and comments are areas of difficulty. Infants with DS show a later onset and less frequent use of object requesting, even relative to MA matched TD infants (Abbeduto, et al., 2007). Moreover, infants with DS are delayed in directing another person's attention to an object of interest (=comment), compared to MA peers (Adamson & Chance, 1998; Berger, 1990). When requesting or commenting, gestures remain important for children with DS. They use more non-linguistic signs than TD children at the same sensorimotor stage (Greenwald & Leonard, 1979) or mental age (L. Smith & Tetzchner, 1986), and less signs plus vocal behaviour (Greenwald & Leonard, 1979). This may be due to deficits in expressive language (Mundy, Sigman, Kasari, & Yirmiya, 1988).

As language in DS children grows, they engage in conversational exchanges. Studies have looked into exchanges between DS children and their mothers, and investigated DS children‘s pragmatic skills (Beeghly, Weiss-Perry, & Cicchetti, 1990; Coggins, Carpenter, & Owings, 1983; Owens & MacDonald, 1982; Roberts, Martin, et al., 2007; Tannock, 1988), as well as pragmatic characteristics of maternal input (Cardoso-Martins & Mervis, 1985; Iverson, et al., 2003; Rondal, 1978). Regarding DS individuals‘ pragmatic abilities, it is as yet not clear in how far they behave similarly or differently from TD peers. It seems that children with DS utter the same communicative intentions in the same developmental rate as TD children matched on mental age (Coggins, et al., 1983; Owens & MacDonald, 1982). The most frequent intention uttered is 'answering', for example to a yes/no-question. This “reflects their passivity in conversation with adults” (Abbeduto, et al., 2007, p. 57). Similarly, children with DS less frequently introduce a new topic (Tannock, 1988). However, when in exchange about a topic, children with DS show the same number of turns as mental age matched TD children (Roberts, Martin, et al., 2007; Tannock, 1988), or an even higher number of turns (Beeghly, et al., 1990). Although the length of exchange on a topic is comparable, if not greater than in developmentally matched TD peers, the amount of elaborative information is lower (Roberts, Martin, et al., 2007).

In conversation, it is sometimes necessary to clarify the spoken content for the listener. Children with DS have been shown to revise their utterances more than half the time, when an adult expressed a clarification request (Coggins & Stoel-Gammon, 1982) However, on their own, children, adolescents and young adults are less prone to assist the listener in understanding their utterance compared to MA matched TD children (Abbeduto & Murphy, 2004; Abbeduto, et al., 2006). This may reflect DS individuals “limited understanding of basic principles of informational adequacy in linguistic interaction” (Abbeduto, et al., 2007, p. 58).

In narrative discourse, individuals with DS have been found to show a particular strength at the macrolevel (Finestack, et al., 2012; Miles & Chapman, 2002). In a picture story telling task, individuals with DS made more reference to the theme of the story and told more of the important plot line events than MLU matched TD children, and were comparable to a syntax comprehension control group. However, individuals with DS used more utterances to tell the story. This may have

been a way of compensating for the expressive language deficit. In sum, the DS test group “had a conceptual understanding of the picture story similar to that of the TACL-R [Test of Auditory Comprehension-Revised] group [i.e. the syntax comprehension group] and a strategy for expressing that understanding despite expressive lexical and syntactic limitations” (Miles & Chapman, 2002, p. 175). However, it needs to be pointed out that the TACL-R group had a higher chronological age and mental age than the MLU group. Their longer life experience might have given them an advantage over the MLU group, and as such might have made them more comparable to the DS group, who had the highest chronological and mental age.

This strength in narrating story content is enhanced, if individuals with DS are supported by visual stimuli (e.g. a wordless film), but weakened, if only auditory content is provided. For example, Boudreau and Chapman (2000) showed that children and adolescents with DS re-tell more story content of a wordless film than expressive language matched TD children, and perform relative to MA matched TD children. Whereas, Kay-Raining Bird and Chapman (1994) provided evidence that children and adolescents with DS re-tell less content of auditorily presented narratives than MA matched TD children. This reflects DS individuals' strength in visual short term memory and deficit in auditory short term memory, also for narrative content (see Chapter 1.2).

On the microlevel of narrative discourse, interesting results on the semantic and syntactic complexity of stories have been obtained in DS individuals. Kay-Raining Bird et al. (2008) demonstrated that children and young adolescents with DS differed from TD children matched on reading comprehension only in the length of their stories. Interestingly, they produced more words, but showed the same lexical and syntactic complexity. Also, in their use of internal state verbs they were comparable to the control group. Internal state verbs are “reflecting feelings (e.g., sad), volition or cognitive states (e.g., want, think), perceptions (e.g., saw), or communicative actions (e.g., said)” (p. 441-442). The finding that individuals with DS use internal state verbs similarly to TD controls replicates the same finding by (Grela, 2002a), but differs with Hesketh and Chapman (1998), who found that individuals with DS use fewer metacognitive and metalinguistic verbs when telling stories. Future studies should further investigate the use and comprehension of internal state verbs in DS.

1.2.4.2 Language comprehension

The studies discussed so far have investigated the productive aspects of language acquisition in children, adolescents and young adults with DS. It has been argued that individuals with DS show relative strengths in vocabulary use, pragmatics and discourse rather than syntax and grammatical morphology. In what follows, the development of these language skills will be described from a different perspective, namely language perception and comprehension (for reviews see Chapman, 1995; Roberts, Price, & Malkin, 2007; Silverman, 2007).

Speech perception

There has been little work on speech perception in DS, but preliminary results suggest that toddlers and children with DS perceive speech differently from TD peers. For example, Eilers and Oller (1980) studied three year old mentally impaired children (two of them had been diagnosed with Down syndrome) and seven month old TD infants in their ability to discriminate differences between vowels and differences between consonants. Participants were exposed to pairs of vowels with constant speech formants (e.g. *beet* [bit] vs. *bit* [bɪt]) and pairs of vowels with rapidly changing speech formants (e.g. awa [awa] vs. ara [ara]). Results indicate that mentally retarded children find it more difficult to process rapid formant changes, which are used in consonant discrimination, than steady-state characteristics of speech, which are used in slowly spoken vowels. As pointed out by Lynch and Eilers (1991) these results were confirmed in other studies (Eilers, Bull, Oller, & Lewis, 1984; Eilers, Moroff, & Turner, 1985) and suggest that a “deficit in rapid processing might result in severe language problems” (Eilers, et al., 1985, p. 99).

Vocabulary

Vocabulary comprehension has been identified as a particular strength in DS individuals. It may be that this strong point can be attributed to a fairly good comprehension of novel words, also known as 'fast mapping'. In studies investigating fast mapping, children and adolescents were exposed to non-existing words for objects or non-existing words embedded in a spoken story (Chapman, Kay-Raining Bird, & Schwartz, 1990; Kay-Raining Bird, Chapman, & Schwartz, 2004). Results showed that individuals with DS perform comparable to TD peers matched on MA and syntax comprehension. The relatively good ability to comprehend and memorise new vocabulary in DS is predictive of the relatively large vocabulary size found in DS.

It has been shown that receptive vocabulary in children and adolescents is on a par with MA matched peers (Cardoso-Martins, et al., 1985; Chapman, et al., 1991; Laws & Bishop, 2003; Miller, 1999) (but see Roberts, Price, Barnes, et al., 2007), or even higher (Chapman, et al., 1991; Rosin, Swift, Bless, & Kluppel Vetter, 1988). Good or superior vocabulary comprehension skills, especially in adolescents and adults, are usually explained by the higher CA of DS participants when compared to MA matched TD participants. As a result of higher CA, DS participants have a wider life experience, in which they may have encountered more varied opportunities for vocabulary learning (Chapman, 1995; Roberts, Price, & Malkin, 2007).

However, not all semantic areas are equally well grasped by individuals with DS. It has repeatedly been shown that individuals with DS perform better on vocabulary comprehension tests that are frequency based (e.g. the Peabody Picture Vocabulary Test by Dunn et al. (1997)) than on tests that require conceptually more difficult words, such as relational word (e.g. *between*) (e.g. Test of Auditory Comprehension by Carrow-Woolflok (1999)) (Chapman, 2006; Miolo, Chapman, & Sindberg, 2005; Price, Roberts, Vandergrift, & Martin, 2007). It can therefore be concluded that

vocabulary size, which is correlated with life experience, but not lexical knowledge of more challenging concepts is a strong point in DS (but see Facon, Magis, & Courbois, 2012).

Syntax

Syntax comprehension involves the understanding of meaning as expressed by the structure of a sentence. Results on syntax comprehension are inconclusive. Some findings suggest that in children with DS syntax comprehension develops in parallel with MA peers (Miller, 1999), whereas other studies indicate that children, adolescents and young adults with DS have lower syntax comprehension abilities than MA matched peers (Abbeduto, et al., 2003; Chapman, et al., 1991; Rondal & Edwards, 1997; Rosin, et al., 1988). An interpretation of such findings is provided by Chapman (1995), who points out that syntax comprehension changes in the lifespan of individuals with DS. In childhood it is comparable to MA matched peers, but in adolescence and young adulthood it falls behind MA matched controls.

A particular area of difficulty for individuals with DS is the comprehension of reversible passive sentences (e.g. *The man is eaten by the fish*). Here it seems that adolescents with DS find it more difficult to interpret them than MA matched TD children, as they interpreted them like active sentences. As such, word order seems to guide understanding more strongly than voice (Ring & Clahsen, 2005a). However, exceptional understanding of reversible passives has been documented in one adolescent with DS (Rubin, 2006).

Another area of difficulty in DS is the comprehension of reflexives (Perovic, 2006). Reflexive pronouns (e.g. *herself, himself*) need to be interpreted by establishing a syntactic relation between the reflexive and its antecedent. TD children are able to comprehend this relation from the age of four, however adolescents with DS show “extreme difficulty” (Perovic, 2006, p. 1624) compared to TD children matched on verbal MA.

It is interesting to note, that syntax comprehension declines in adolescents with DS, while MLU (as described above), grows with chronological age. The reason for this is as yet unknown. However, (Chapman & Kay-Raining Bird, 2011) speculate that it is associated with the measures used to assess syntax comprehension: “The measures of the syntax comprehension depend crucially on auditory STM for the sentence, and visual STM for the picture alternatives inspected, and both STM systems are compromised in adolescence (visual STM is MA-equivalent in younger children).” (p. 174). So, it is possible that these tests of syntax comprehension are biased.

Morphosyntax

As has been described above, the use of morphosyntax is impaired in DS individuals. At the same time, the comprehension of morphosyntax is difficult (for reviews see Roberts, Price, & Malkin, 2007; Rondal & Guazzo, 2012). In sum, definite and indefinite articles, prepositions, auxiliaries *be* and *have*, copula *be*, pronouns, gender and number agreement are particularly difficult to interpret

for individuals with DS when matched with peers on CA and MA (Bartel, Bryen, & Keehn, 1973; Semmel & Dolley, 1971).

Similar to the comprehension of syntax, the comprehension of morphosyntax slows and in some individuals even declines with age (Chapman, et al., 2002; Laws & Gunn, 2004). According to Laws and Gunn (2004), this may be because of deficits in phonological memory, especially the phonological store, and is independent of hearing problems.

Reading

Reading comprehension in DS has received some interest recently. It can be estimated that most children with DS acquire reading comprehension up to the sentence level (Laws & Gunn, 2002), but discourse comprehension is a specific deficit in DS (Nash & Heath, 2011). It has been long assumed that reading comprehension is dependent on general cognition, productive and receptive language skills, phonological awareness and hearing (see Hulme, et al., 2012). Recently, studies on reading in DS children and young adults (Hulme, et al., 2012; Nash & Heath, 2011; Steele, Scerif, Cornish, & Karmiloff-Smith, 2013) show that in contrast to TD children, phonological awareness only influences the beginning stages of reading in DS, and as such is not a predictor of reading skill longitudinally. Also in contrast to TD, letter knowledge does not have an impact on reading skill in DS prospectively (Hulme, et al., 2012; Steele, et al., 2013). On the other hand, vocabulary knowledge seems to be important for reading comprehension in both TD and DS (Nash & Heath, 2011; Steele, et al., 2013), as well as verbal working memory (Nash & Heath, 2011). In general, progress in reading in DS is slow, but can be improved with practice (Seagoe, 1965).

1.3 Modular vs. connectionist cognition in DS

Some researchers have debated on the cognitive organisation in individuals with DS (Abbeduto & Chapman, 2005; Abbeduto, Evans, & Dolan, 2001; Chapman, et al., 1998; Rondal, 1995). It is important to understand cognitive structure in this clinical population and other individuals with intellectual disability (ID) in order to be able to devise and implement successful intervention programmes (Rondal, 1995), and to shed a light on typical development. In short, two different views on cognitive organisation in DS can be distinguished: modular vs. connectionist theories. In what follows these theories will be explained in more detail and evidence will be provided that supports these theories.

It is nowadays commonly agreed that the mind consists of functional subsystems, called modules. These modules in turn are believed to contain elementary symbolic representations and processes operating on them. Concerning language, these symbolic representations may be propositions, schemata or semantic nets, and the processes operating on them are grammatical operations (Györi, 2006, pp. 16-52).

The question is whether initially modules are domain specific, that is, whether they work independently, or whether they are domain general, that is, whether they interact with each other. In the early days of modern cognitive science the first view was put forward by Noam Chomsky (Chomsky, 1959, 1988, 1990) and Jerry Fodor (e.g. Fodor, 1983). Chomsky is primarily concerned with language/grammar. He proposes that the child comes to life with an inborn capacity for language acquisition, the so-called *language faculty*. It consists of abstract grammatical knowledge about the constraints of human languages, so-called *universal grammar*. The language faculty is autonomous, as it only processes linguistic information and in doing so works rather independently of other cognitive systems. The processes operating on linguistic input and output are specific to language as opposed to other cognitive domains (see Györi, 2006 for a summary). Expanding on Chomsky's work, Fodor put forward a similar account of the cognitive architecture, its representations and the processes operating on them, but his interest lay with the mind more generally. Fodor proposes that cognition is at least partly modular, in particular language processing and perception. The modules are “domain specific, innately specified, hardwired, autonomous, and not assembled” (Fodor, 1983, p. 37). In addition, Fodor postulates some higher-level non-modular processes, like reasoning and thinking.

More recently, however, a strong view of domain specificity has come under sharp criticism. There are various theories and research programmes that break with Fodor's initial proposal (for an overview see Györi, 2006). Most prominently, connectionism stands in opposition to Fodor's view of the mind. In connectionism the brain is compared to a computer network and complex behaviour is explained in terms of elementary computing units. When input is fed into the network, an activation level is computed. When this activation exceeds a certain threshold level, an output can be calculated. Frequently, a learning algorithm adjusts correct input-output mappings. This algorithm can affect thresholds, or the strengths between units, or both. Frequently, connectionism is associated with: “(1) strong emphasis on the role of learning in cognitive development, as opposed to richness of genetic endowment, and (2) more interactionist views about both development and on-line processing.” (Györi, 2006, p. 28f.).

In DS research evidence has been gathered to support both accounts of cognition. For example, there is a reported case of dissociation between non-verbal cognition, and language. Rondal (e.g. (Rondal, 1991, 1995) investigated an adult woman with DS, Françoise, who spoke French. She had a moderate mental retardation, but showed an exceptional language performance and comprehension for individuals with mental retardation. Her articulation and receptive lexicon were very advanced, as was her receptive and productive syntax (including passives). The example of Françoise would support a modular account of cognitive organisation in DS (Rondal, 1991, 1995, 1998). However, this interpretation has received some criticism. Abbeduto (1996) pointed out that her mental age (approximately six years) and relatively preserved short term memory, may have contributed to her exceptional language performance.

Another set of evidence comes from the finding that individuals with DS show a dissociation between comprehension vs. production (for a review see Abbeduto & Chapman, 2005). As

described above in Chapter 1.2.4.2, most authors argue that comprehension is a strong point in DS, especially with regard to receptive vocabulary, which is often shown to be at or above non-verbal cognition. Similarly, receptive syntax is frequently seen as an area of strength in DS until it shows a point of weakness in adolescence and adulthood compared to MA matched peers. Language production, on the other hand, is regarded as an area of weakness in DS. Expressive vocabulary is poorer than that of MA matched peers in spontaneous language, likewise expressive syntax (measured in MLU) lags behind CA and MA matched peers. As explained by Chapman, Schwartz and Kay-Raining Bird (1998):

> "[t]he finding ... of an expressive language delay across syntactic and lexical domains is consistent with the view that comprehension and production processes are "modular" in the sense of being dissociable from one another in a language disorder. Indeed, viewed developmentally, the expressive language delays of the child with Down syndrome begin in expressive phonology and nonverbal requests, are reflected next in slower expressive vocabulary accumulation, and then show the lexical and syntactic deficits demonstrated in this study (Chapman, 1995). The developmentally shifting locus of deficit argues against a modularity based on linguistic domain (Fodor, 1983) and for the effects of more general cognitive processes, such as auditory working memory and social cognition, that would affect the acquisition of new forms and content in context."

Finally, it has repeatedly been noted, that there is a dissociation between the lexicon and syntax in DS (Chapman, 1995; Rice, et al., 2005). As has been described earlier in Chapter 1.2.4.1, most researchers agree that individuals with DS show a strength in vocabulary size. However, syntax has been identified as a special area of weakness (Perovic, 2006; Ring & Clahsen, 2005b). As pointed out by (Richardson & Thomas, 2009) such divergent abilities have been noted in various disorders, and results "suggest that pragmatics and semantics are more closely linked to overall mental age … , while phonology and syntax can dissociate" (p. 467). The dissociation noted in DS can be explained by both theoretical frameworks, modular and non-modular. As pointed out by (Chapman, et al., 1998):

> "The divergence between syntactic and lexical comprehension skill ... could arise from increased access to vocabulary learning opportunities (Chapman et al.'s 1991 interpretation), processing limitations (either the auditory short-term memory deficit or the hearing problem that characterize children with Down syndrome, Chapman, 1995), or the modularity of linguistic domains within comprehension (Fodor, 1983)."

Taken together, the evidence presented so far remains rather inconclusive. While Rondal argues for a modular organisation of cognition in DS, Abbeduto, Chapman and colleagues maintain a non-modular account, in which non-verbal cognition as well as practice are stressed as important variables in linguistic performance. The present thesis hopes to contribute to this discussion.

2 Nominal and pronominal reference and co-reference

Reference, or objective reference, is “the activity or condition through which one term or concept is related to another or to objects in the world“ (McArthur, 1998). In longer stretches of language, such as narratives, repeated reference is made to the same concept or object. In such cases, co-reference is given. To be more precise, co-reference, is a “relationship between two linguistic units such that they denote the same referent in extralinguistic context“ (Chalker & Weiner, 1998). Co-reference can be achieved by various means (Linke & Nussbaumer, 2000). For the present study, co-reference as established through nominal and pronominal anaphora is of interest. Anaphora “is commonly used to refer to a relation between two linguistic elements, wherein the interpretation of one (called an anaphor) is in some way determined by the interpretation of the other (called antecedent)“ (Huang, 2000, p. 1). This entails that an anaphora itself has no or nearly no inherent meaning, and only becomes interpretable by the process of linking it to its antecedent. Its function is to add to text coherence.

The question, which antecedents are identified as possible referents, has been investigated extensively, particularly by syntactic approaches. Moreover, research has aimed to identify the function that anaphora has in discourse organisation. This was pursued by textual/pragmatic approaches. Finally, studies examined the function of anaphora as processing signals. This was followed by cognitive approaches.

In what follows, I will first describe the use of reference and anaphora in the target system, German. Next I will outline the TD acquisition of reference and anaphora from a syntactic, functional pragmatic and cognitive perspective. Then, I will summarise the one available study on reference and anaphora use in DS individuals.

2.1 Nominal and pronominal reference and co-reference in German

German is special with regard to the referential devices availble in the language. The following overview of referential devices in German will be tailored to the present research question. Thus, I will concentrate on referential devices as used in oral narratives to introduce, maintain and switch characters in subject position. Herefore, I draw on Bamberg (1987), but extend his description with original examples.

2.1.1 Introducing a character

When describing character introductions, one must keep in mind the communicative setting. Where there is no pictorial support, there are two possible forms that can be chosen to introduce

an unmarked character: (1) a proper name, and (2) an indefinite article + noun.[1] The following example illustrates the two alternatives. The referential forms are highlighted in bold.

(1) Eines abends sitzt **Tim** in seinem Zimmer.

*One evening **Tim** is sitting in his room.*

(2) Eines abends sitzt **ein Bub** in seinem Zimmer.

*One evening **a boy** is sitting in his room.*

As German has gender agreement, the indefinite article varies morphosyntactically. This is shown in the table below:

Gender	Nominative Singular	Gloss
feminine	eine Frau	*a woman*
masculine	ein Mann	*a man*
neuter	ein Kind	*a child*

Table 1: Declension of the German indefinite article in the nominative singular.

When pictorial support is available, a speaker can also choose (3) a definite article + noun, (4) a personal pronoun, or (5) a demonstrative pronoun. These forms can be chosen, because the character is in the speaker‘s and listener‘s joint attention, and may be pointed to. Although grammatically correct, these forms indicate an early level of textual development, which will be discussed in more detail below. The morphosyntactic variations can be found in the tables beneath.

(3) Es ist Abend. **Der Bub** sitzt in seinem Zimmer.
*It‘s evening. **The boy** is sitting in his room.*

(4) **Er** sitzt in seinem Zimmer.
***He** is sitting in his room.*

(5) **Der** sitzt in seinem Zimmer.
***This one** here is sitting in his room.*
***That one** there is sitting in his room.*

[1] Note that writers may use a creative strategy called 'jumping in', where the character is introduced with a definite article + noun (e.g. 'der Bub') or a personal pronoun (e.g. 'er').

Gender	Nominative Singular	Gloss
feminine	die Frau	*the woman*
masculine	der Mann	*the man*
neuter	das Kind	*the child*
	Nominative Plural	**Gloss**
all genders	die Frauen/die Männer/die Kinder	*the women/the men/the children*

Table 2: Declension of the German definite article in the nominative singular and plural.

Gender	Nominative Singular			
	Personal Pronoun	**Gloss**	**Demonstrative Pronoun**	**Gloss**
feminine	sie	she	die	this
masculine	er	he	der	this
neuter	es	it	das	this
	Nominative Plural			
	Personal Pronoun	**Gloss**	**Demonstrative Pronoun**	**Gloss**
all genders	sie	they	die	they

Table 3: Declension of the German personal pronoun in the nominative singular and plural.

2.1.2 Maintaining a character

When a character remains the topic in the subsequent sentence, reference is said to be maintained. In German, a speaker can choose between three forms to signal maintaining: (1) definite article + noun, (2) pronoun, and (3) zero anaphora. These possibilities are demonstrated below:

(1) Abends sitzt Tim in seinem Zimmer. **Der Bub** beobachtet einen Frosch im Glas.
*In the evening Tim is sitting in his room. **The boy** is watching a frog in a jar.*

(2) Abends sitzt Tim in seinem Zimmer. **Er** beobachtet einen Frosch im Glas.
In the evening Tim is sitting in his room. He is watching a frog in a jar.

(3) Abends sitzt Tim in seinem Zimmer und **ø** beobachtet einen Frosch im Glas.
*In the evening Tim is sitting in his room and **ø** watching a frog in a jar.*

Note that zero anaphora is frequent in co-ordinated clauses, like (3). It cannot, however, be used in all co-ordinated clauses. For instance, zero anaphora is incorrect with conjunctions, such as 'und so' (*and so*), 'und dann' (*and then*), 'und jetzt' (*and now*).

As can be seen in the above examples, an indefinite article + noun (e.g. 'ein Bub') is not an appropriate choice. It would be grammatically correct, but infelicitous at the discourse level, as 'Tim' would not be interpreted as its antecedent. To the contrary, a listener would assume a different intended referent.

2.1.3 Switching a character

When an already mentioned character is re-introduced, there are two different forms that can be used: (1) a proper name, and (2) a definite article + noun.

(1) Abends sitzt Tim in seinem Zimmer. Er beobachtet einen Frosch im Glas. Der Frosch sitzt glücklich da. **Tim** freut sich darüber.
In the evening Tim is sitting in his room. He is watching a frog in a jar. The frog is sitting around happily. Tim is happy about this.

(2) Abends sitzt Tim in seinem Zimmer. Er beobachtet einen Frosch im Glas. Der Frosch sitzt glücklich da. **Der Junge** freut sich darüber.
In the evening Tim is sitting in his room. He is watching a frog in a jar. The frog is sitting around happily. The boy is happy about his.

Note that the use of an indefinite article + noun or pronoun would be grammatically correct, but infelicitous on the discourse level. An indefinite article + noun would be interpreted as referring to another boy.

2.2 Nominal and pronominal reference and co-reference in TD

Following Huang (2000) and Hickmann (2002) different approaches to the investigation of anaphora can be distinguished. They include: syntactic approaches, textual functional approaches, and cognitive approaches. In order to give an overview of the broad field of acquisitional research on children's referring expressions, I will discuss some selected studies with respect to these different approaches (for reviews see Hickmann, 2002; Hickmann & Hendriks, 1999). The main focus will be on textual functional and cognitive approaches, which are relevant for the present study.

2.2.1 Nativist syntactic approach

I will only shortly touch upon the nativist syntactic approach, because it is applied in analyses of children‘s sentence processing, but is not common in analyses of children's narrative discourse. Proponents of nativist approaches adopt Chomsky's (1965) theory of *universal grammar* (see

Chapter 1.3) and postulate that humans have an innate, unconscious knowledge of language, which enables them to acquire every natural language. With respect to anaphora, this universal grammar comprises knowledge about universal principles that guide the interpretation (and subsequently production) of anaphora, pronominals, referential expressions and their antecedents. It also comprises knowledge about parameters that explain cross-linguistic variation (e.g. null subjects). This knowledge of anaphora has been described in the theory of *government and binding* (Chomsky, 1981). In what follows I will illustrate developmental research within the framework of *government and binding*.

As just mentioned, Chomsky argues for the existence of three universal principles that guide the use of anaphors (reflexive pronouns), pronominals (nonreflexive pronouns), and referring expressions (lexical noun phrases (NPs)). These principles are termed Principles A, B, and C respectively, and defined below :

(A) An anaphor must be bound in its governing category.

(B) A pronominal must be free in its governing category.

(C) An R-expression must be free.

It is commonly agreed that children show mastery of reflexive pronouns and thus Principle A early on. At the same time children show knowledge of the binding principle for nonreflexive pronouns and hence Principle B. However, their performance on nonreflexive pronouns is less consistent (e.g. Chien & Wexler, 1987, 1990; Deutsch, Koster, & Koster, 1986). For example, Chien and Wexler (1987) asked children to act out sentences such as (1) to (4):

(1) Kitty1 says that Amy2 should point to herself2.	Principle A
(2) Kitty1 wants Amy2 to point to herself2.	Principle A
(3) Kitty1 says that Amy2 should point to her1.	Principle B
(4) Kitty1 wants Amy2 to point to her1.	Principle B

Results showed that at the age of 6;6 children interpreted sentences with reflexive pronouns obeying Principle A with an accuracy of 90%. Sentences with nonreflexive pronouns obeying Principle B were interpreted correctly 78% of the time. These results are interpreted in support of binding theory.

Moreover, children demonstrate knowledge of the binding of lexical NPs, that is Principle C (for a review see Lust, Eisele, & Mazuka, 1992). For example, Grimshaw and Rosen (1990) carried out a truth-value judgement task with four to five year olds. Although the authors had a broader research interest, only data relevant to Principle C will be presented here. In their experiment, Grimshaw

and Rosen read out grammatical and ungrammatical sentences and illustrated them by using puppets. Examples of these sentences are given below:

(5) I just saw Ernie do something with Big Bird. He1 patted Big Bird2. Principle C

(6) *Ernie was fighting with Big Bird. He1 hit Ernie1. Principle C

Results showed that children accepted correct binding of lexical NPs, and hence Principle C, to a high degree (83%). They rejected ungrammatical binding above chance level (62.5%). Therefore, the results are taken as evidence for binding theory.

However, there has been considerable critique as to the validity of the theory of *government and binding* as a universal principle. For example, Huang (2000) argues that the theory cannot be applied cross-linguistically. Moreover, Hickmann (2002, p. 115) points out that there may be other than syntactic factors, responsible for the acquisition of referring expressions, such as cognitive factors (e.g. memory), or semantic and discourse factors, which help anaphor resolution. The approaches discussed below try to address some of these shortcomings.

2.2.2 Textual functional approaches

In contrast to nativists, proponents of functional approaches do not posit an innate knowledge of language which triggers language acquisition. In contrast, functionalists propose that “language has evolved and is acquired in relation to the communicative functions it serves. Language thus is not an arbitrary and autonomous system but, rather, is organized in relation to the needs of those who use it“ (Budwig, 1995, p. 4). Moreover, language is seen as “a system of forms and meanings. Forms are a vehicle through which the meanings can be realized“ (Budwig, 1995, p. 4). The goal of language acquisition is thus to learn the form-meaning mappings.

With regard to what follows, developmental research on cohesion and anaphora will be presented from the functional perspective. There has been textually oriented research interested in examining the linguistic devices used by children to organise discourse. As pointed out by Budwig (1995) these include the early works of Bamberg (1987), Hickmann (1987), and Karmiloff-Smith (1985). It may be added that also more recent work of these authors, as presented below, is relevant.

In developmental research on the use of reference and co-reference in narratives “the issue of central importance is the extent to which particular linguistic devices are employed to help organize stretches of discourse both intrasententially and across broader stretches of text“ (Budwig, 1995, p. 11). As such, the use of indefinite articles, definite articles and pronouns has been studied to investigate how these linguistic devices are used to mark new vs. already mentioned characters and to distinguish between main and subsidiary characters. Importantly, the developmental process is stressed.

For example, Karmiloff-Smith (1985) studied which linguistic devices children use to introduce a main character and how they learn to organise their narrative around it. To do so, she tested 420 L1 English and L1 French speaking children, aged between 4 and 9 years. They narrated picture stories, which varied in many respects, for example, the number of competing referents (from 2-8). The analysis concentrated on pronouns and articles + nouns in subject position. The data of English-speaking and French-speaking children were collapsed.

Results showed that there were three developmental levels of children's use of referential devices. Level 1 is attained by 4 and 5-year-olds. The following excerpt illustrates the linguistic devices used by this age group (p. 70):

> The girl's got a green dress like mine. She's coming out of her house and there there's a lady selling icecream. She wants a vanilla icecream. So she gives her one and she walks off licking it. And there she's dropped it so she's crying her eyes out … I dropped my icecream in the cinema once but I didn't cry. She's silly.

Here it can be seen that the main protagonist (i.e. the girl) is talked about in subject position and introduced by a definite article + noun. In the two subsequent sentences the girl is maintained by the use of the pronoun 'she'. However, in sentence 4 the subsidiary character (the ice-cream vendor) is switched to by the same linguistic device, the pronoun 'she', which renders this phrase ambiguous. Therefore, Karmiloff-Smith proposes that at Level 1 children do not notice such ambiguities, and "concentrate on the extralinguistic stimulus and use referential terms deictically" (p. 70). Put differently, this means that children at Level 1 do not yet focus on a topic (i.e. a main character) and as such cannot mark it linguistically.

Level 2 is reached by some 5-year-olds, but mainly by 6 and 7-year olds, and some 8-year-olds. The next excerpt demonstrates the linguistic devices used at this point in development (p. 71):

> There's a little girl who's going out for a walk. She sees an icecream van … stall and buys one. She walks off in the sun. But then she drops her icecream by mistake and starts to cry.

This example illustrates an important development at Level 2. New referents are introduced by an indefinite article + noun. But children choose one of the referents as main protagonist (i.e. topic). The main protagonist is assigned subject position in each sentence and referred to anaphorically by use of pronouns. Secondary characters are rather referred to by articles + nouns, proper names or stressed pronouns. Karmiloff-Smith calls this strategy the 'thematic subject constraint'.[2]

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[2] Note that there are languages, like Saramaccan, where the main hero is always signalled by a pronoun (personal communication, W. U. Dressler, 20.8.2013).

Level 3 is attained by children between the ages of 7 and 9. A final example shall show the linguistic devices used at this stage of development (p. 72):

> This is the story about a little girl who's taking a walk in the sunshine. She notices a lady selling icecream and as it's hot she decides to buy one. The lady hands her a cornet and she walks off to enjoy it. But suddenly she trips on a stone and drops the icecream, so she starts to cry because it starts to melt in the sun.

The above story illustrates that children having reached Level 3, also introduce referents using an indefinite article + noun. The main protagonist (i.e. the topic) is in subject position and subsequently referred to by pronouns, such as 'she' or 'her'. These pronouns are used anaphorically. This shows that the 'thematic subject constraint' still holds for Level 3, however, the interesting development at this level is that the constraint is no longer used rigidly. That is, the subject position is usually occupied by the main protagonist, but it can also be used for secondary characters. Interestingly, the main protagonist as topic is marked linguistically, by the use of pronouns, while secondary characters are referred to by definite article + noun (e.g. *the lady*).

In sum, the study showed “how the control process changes with development from one that is predominantly stimulus-driven to a predominantly top-down controlled discourse structure“ (p. 78). At the beginning of the developmental sequence children concentrate on the events depicted by pictures and use deictic forms to refer to characters carrying them out. Later on in development, children concentrate on the main character (i.e. the topic) as opposed to peripheral characters and mark this status linguistically by use of pronouns. Finally, children learn to incorporate an event into the previous discourse and show more differential use of anaphoric devices.

Building on work by Karmiloff-Smith, Bamberg (1986, 1987, 1994) examined which linguistic devices children and adults use in L1 German to introduce, maintain and switch characters (main and subsidiary). For example, Bamberg (1994) studied L1 German speaking children grouped by age in 3, 5 and 9 year olds, and compared their productions to an adult control group between 20 and 32 years. The task was to narrate the picture story 'Frog, where are you?' by Mercer Mayer (1969). Participants first looked through the pictures and were then given the following instructions: “Here is a book. This book tells a story about a boy [*point to picture on cover*], a dog [*point*], and a frog [*point*]. First, I want you to look at all the pictures. Pay attention to each picture that you see and afterwards you will tell the story.“ (Berman & Slobin, 1994, p. 22). The same story and procedure were used in the present thesis, and thus allows a good comparison between studies.

Children‘s and adults‘ stories were divided into utterances and coded for introducing, maintaining and switching. Moreover, characters were grouped into three: (a) the boy, the dog and the frog, (b) the gopher, the owl, the deer, and bees, and (c) the frog family. Finally, the linguistic devices used for introducing, maintaining and switching were coded; (a) indefinite article + noun (e.g. *ein Bub*, 'a

boy'), (b) definite article + noun (e.g. *der Bub*, 'the boy'), (c) pronoun (e.g. *er*, 'he' or *der*, 'this, that'), (d) possessive pronoun + noun (e.g. *sein Frosch*, 'his frog'), and (e) zero form.

Results showed a developmental trend (except for the frog family). For introducing characters, especially 3 and 5-year-old children preferred using the definite article *der* + noun as opposed to the indefinite article *ein/e* + noun. 9-year olds already showed higher numbers of usage of the indefinite article + noun compared to the definite article + noun, but it is preferred only for side characters (e.g. gopher). Adults, prefered using the indefinite article + noun to introduce characters, especially for side characters compared to the main character (i.e. the boy). Moreover, Bamberg points out that only younger children used the third person masculine pronoun *der* or *er* frequently, while older children and adults also gave the boy, the dog and the frog proper names.

As regards the frog family, it has already been pointed out, that reference to the frog family does not follow a developmental trend. Children referred to the frog family by a definite article + noun in the majority of cases (76.5%), but adults do so too (62.5%). Bamberg speculates “that this may be because the group of frogs represents a mixed category, one of whose members is “old information” and so has already been introduced before, the others being a number of other characters who need to be introduced” (Bamberg, 1994, p. 223). This explains, why even adults used a definite article + noun to introduce the frog family, and thus no developmental trend could be noted.

As regards the maintaining and switching of characters, Bamberg only analysed referential devices in subject position (like Karmiloff-Smith, 1985). His analysis revealed interesting results concerning zero forms and the distribution of pronouns compared to articles + nouns. Zero forms were but rarely used by younger children. 9 year-olds used them 13% of the time and adults 22%. Unfortunately, it is not clear from the presentation of results, if these were correct uses of zero forms. However, Bamberg stresses that with age participants learn to use zero forms for a particular discourse function, namely to “ti[e] activities of the same character together and presen[t] them as 'topical packages'“ (Bamberg, 1994, p. 226). Frequently, these activity packages are then switched to the activity of another referent by using a definite article + noun. The following example (p. 226) shall give an illustration. Here it can be seen that the boy + dog are maintained by a zero form and later on the focus is switched to the frog by use of a definite article + noun:

> *Aber irgendwann werden die beiden dann doch müde* [new referent], *gehen schlafen* [Ø = boy + dog], *und die Gelegenheit benutzt der Frosch* [new referent] *und entschlüpf wieder aus dem Glas* [Ø = frog].
>
> 'But at some point the two get tired after all [new referent], go to sleep [Ø = boy + dog], and the frog uses the opportunity [new referent] and slips out of the jar again [Ø = frog].'

Concerning the distribution of pronouns compared to articles + nouns in maintaining and switching, Bamberg noticed that the 3 and 5-year-olds used markedly more pronouns than the 9-year-olds, or the adult narrators. Interestingly, pronouns were mostly used for maintaining the boy, which is correct on the discourse level, but also for switching the boy, which is ambiguous for the listener. Other characters were correctly maintained by a pronoun, and when switching other characters, an article + noun was used. As such, young children use pronouns to establish a thematic subject, even if this is difficult for a listener to interpret, whereas older children and adults do not. As has been described above, this strategy is known as the 'thematic subject strategy' (e.g. Karmiloff-Smith, 1981). Bamberg‘s data, however, shows an earlier application of the 'thematic subject strategy' by German speaking children (3;5-4 years), compared to the English and French speaking children by Karmiloff-Smith (mainly 6-7 years). If this is due to cross-linguistic variation or different methodologies is currently unclear.

Although Bamberg‘s (1994) study in many ways elaborates on his previous work, there is unfortunately no further analysis of the linguistic devices specifically used for maintaining vs. switching reference. However, such a fine grained analysis is important in the context of the present research. Therefore, I will shortly summarise results from Bamberg (1987) on this topic. In the latter study Bamberg demonstrated that L1 German speaking adults (as opposed to younger children) use pronouns to maintain reference in the majority of cases, while they use nominals (determiner + noun or proper name) to switch reference. This has been termed the 'anaphoric strategy'. Few deviations from this strategy were noted, but they nevertheless had a discourse organisational function. When characters (especially the boy) were switched using a pronoun, the narrator intention was “to signal the continuation of foregrounded information“ (p. 61). An example shall illustrate this phenomenon. Note that the English translation is slightly different from Bamberg (p. 61):

> aber Peter sucht mutig weiter
> *but Peter courageously keeps on looking*
> irgendwo muß der Frosch doch sein
> *the frog must be somewhere*
> er klettert auf einen großen Stein
> *he climbs on a big rock*
> und ruft nochmals
> *and calls again*

In this example the narrator foregrounds the boy 'Peter'. He is the one moving on the plot of the story. However, the foreground action is shortly interrupted by a thought ('the frog must be somehwere'), only to be re-established again in the next line ('he climbs on a big rock'). So, here switching to the boy by use of the pronoun 'er' re-establishes Peter as the topic.

Another instance of deviation from the 'anaphoric strategy' is given when narrators use a nominal form for maintaining reference. Bamberg noted that this was done when moving on from one picture to the next to “signal the beginnings of new narrative units“ (p. 63).

The main principle of the 'anaphoric strategy' must be acquired by children, and Bamberg found that this principle is acquired gradually. 3;5-4 year olds predominantly use pronominal forms (*er*/*der*/*zero*) to maintain and switch reference. 5-6 year olds already show a higher use of pronominals for maintaining reference, but use pronominals and nominals to an equal degree for switching reference. Only in 9-10 year olds was the percentage of nominals for switching higher than the percentage of pronominals.

In sum, Bamberg (1987, 1994) found a developmental progression in the marking of newly introduced vs. already mentioned characters from definite article + noun to indefinite article + noun. Moreover, he confirmed the 'thematic subject strategy' (Karmiloff-Smith, 1981), that is, the use of pronouns to establish the main character, but demonstrated an earlier use. Finally, he showed children‘s development of the 'anaphoric strategy'. He found a non-differential use of pronominals in the maintaining and switching of characters at the beginning stages, and differential use by the age of 9.

In the above studies carried out by Karmiloff-Smith and Bamberg, the research focus laid primarily on an analysis of successive clauses or sentences. However, Bamberg (1987) already noted the importance of narrative units in the distribution of nominals and pronominals. This finding had been elaborated by Fox (1987), who emphasised the importance of discourse units, such as paragraphs, episodes, events, themes or turns in the analysis of anaphora and formulated it in his *hierarchy model*. The hierarchical model makes a specific prediction about the use of anaphoric devices in such discourse units:

> “it is assumed that the most important factor that influences anaphoric selection is the hierarchical structure of discourse. From this assumption follows the central empirical prediction of the theory, namely, mentions (initial or non-initial) at the beginning or peak of a new discourse structural unit tend to be done by a full NP, whereas subsequent mentions within the same discourse structural unit tend to be achieved by a reduced anaphoric expression.” (Huang, 2000, p. 309)

A hierarchical model has been applied in developmental research on the use of referential devices. For example, it has been used by Maya Hickmann and colleagues (e.g. Hickmann et al. 1995). In their study, 60 L1 French children of three age groups (6, 9 and 11 years) told the picture story 'Frog, where are you?' by Mercer Mayer (1969). As already mentioned, the same story was used in the present study. There were two conditions in which the story was told; in condition (a) children and the experimenter had mutual knowledge of the picture story, as they both looked at the book,

in condition (b) children and the experimenter had no mutual knowledge of the story, as s/he was blindfolded.

Hickmann et al. analysed the referring devices used for maintaining characters. Not all results presented in the paper will be discussed here. Important for an understanding of the contribution of the hierarchy model in research on children's use of referring expressions, are Hickmann et al.'s results on the significance of so-called 'frame boundaries'. A frame is equal to a picture in the picture story, and when moving from one picture to another picture, a frame boundary is crossed. Hickmann et al. showed that “coreferential pronouns are more frequently used within frames than across them … In contrast, coreferential nominals are more frequently used across frames than within them” (p. 289). This holds true for all age groups in the mutual knowledge condition. However, in the non-mutual knowledge condition, there was a significant effect of age; while 6-year-olds and 9-year-olds used more pronouns when talking about a character within a picture frame, and more articles + nouns when talking about a character crossing a frame boundary, 11-year-olds showed no effect of frame boundary. This suggests that “at 11 years the effect of coreference overrides the effect of frame boundaries in the absence of mutual knowledge.” (p. 291).

Another interesting discourse unit in Hickmann et al.'s study are episodic boundaries. The theory of story episodes goes back to e.g. Labov and Waletsky (1967). In Hickmann et al. “the term 'episode' is used ... to refer to 'chunks' of the story, the boundaries of which were determined on the basis of changes in the personal, spatial, and/or temporal parameters of the plot (appearance and disappearance of characters, night vs. day, home vs. forest vs. pond). This structure therefore focuses on the linear unfolding of chunks, not on their hierachical relations” (p. 291). Results showed that pronouns used for maintaining are used more often within episodes than across episodic boundaries. This is especially true for the mutual knowledge condition. For the non-mutual knowledge condition, there is again a significant age difference: 6-year-olds used markedly more pronouns for maintaining within episodes than across episodes. 9-year-olds showed the same trend, but to a lesser degree. 11-year-olds, however, showed the same percentage of coreferential pronouns within episodes as across episodes. This indicates that “at 11 years coreference overrides the effect of episodic boundaries in the absence of mutual knowledge” (p. 293).

In sum, Hickmann et al.'s (1995) result show that younger children (6-9 years) use pronouns to maintain reference to a main character. At picture boundaries or episodic boundaries, however, they use articles + nouns and as such mark the discourse structure. By the age of 11, children abandon this strategy when knowledge is not mutual.

Taken together, textual functional approaches aim to investigate how children use linguistic forms to organise their texts, especially narratives. Proponents investigate how anaphora relates to the given/new distinction, the establishing of a main character, or the signalling of discourse units by pictures or episodes. Importantly, it is stressed that “children‘s early use of specific devices does not necessarily match up with adult usage“ (Budwig, 1995, p. 11). Thus, children come to acquire the adult system by going through a “developmental sequence in which the children reinterpret

[linguistic] devices for various textual functions that, though consistently used, are sometimes at odds with the input they receive“ (Budwig, 1995, p. 11).

2.2.3 Cognitive approaches

Cognitive approaches in the study of referring expressions have stressed the importance of memory activation and attention in the comprehension and production of anaphora. The question is pursued in how far certain anaphoric referring expressions are used by a speaker/writer to cater to listeners‘/readers‘ cognitive statuses of antecedents (e.g. highly active and highly accessible vs. less active and less accessible) in order to foster effective comprehension. Many models have been proposed to account for the relation between anaphoric reference and memory activation. In what follows, I will shortly point out these models and discuss developmental studies concerned with children‘s use of anaphoric reference from a cognitive perspective.

Many cognitive models have aimed to account for anaphora use/comprehension by referring to the activation of the antecedent in memory. What distinguishes these theories are the different ways activation is understood (see Fretheim & Gundel, 1996; Huang, 2000). One of the most cited models is Ariel‘s (1988, 1990, 1991, 2004) *accessibility hierarchy*. It is based on Sperber and Wilson‘s (1986) *relevance theory*. Ariel claims that anaphoric forms function to mark degrees of antecedent accessibility in memory. They thus help addressees to interpret their meaning. For example, pronouns or zero forms are claimed to be markers for high accessibility. They will thus refer to an antecedent that is salient, i.e. accessible to the addressee, maybe because it is the only topic just being elaborated on. Full names or definite articles + nouns, on the other hand, are regarded as low accessibility markers. As such they will be used to refer to a non-salient antecedent, that is not (yet) a topic.

In a similar vein, Lambrecht (1996) was concerned with the cognitive status of referents and their antecedents. He added that it is not only important to speak of the activation of a referent, but also its so-called 'identifiability'. A referent is identifiable for a listener, if s/he is “able to pick it out from among all those which can be designated with a particular linguistic expression and identify it as the one which the speaker has in mind“ (p. 77). An NP, such as 'the sun' is a good example for an identifiable referent, as it has distinct referential characteristics and thus can be identified specifically. However, a referent that is identifiable (from long-term memory), is not automatically active (in short-term memory). This corresponds to the idea that “[k]nowing something and thinking of something are different mental states“ (p. 93). Active referents are usually referred to by pronouns, and can also be referred to by accented lexical phrases (e.g. proper names). Inactive referents, on the other hand, cannot be referred to by pronouns, and need to be referred to by accented lexical phrases. For a similar, but somewhat different view see Chafe (1994).

Yet another model that has to do with the cognitive status of referents and their antecedents is the *givenness hierarchy* (Gundel et al. 1993). Similar to the above mentioned models, it claims that anaphoric expressions function as a processing signal for the addressee. However, it is distinct

from Ariels‘s *accessibility hierarchy*. Ariel (and others) “view the statuses signalled by different forms as mutually exclusive, in the model [Gundel et al.] propose here the statuses are implicationally related (by definition), such that each status entails (and is therefore included by) all lower statuses, but not vice versa“ (Gundel et al. 1993, p. 276) (see the diagram below). So, for example, “an entity which is in focus is necessarily also activated, familiar, uniquely identifiable, referential, and type identifiable. However, not all uniquely identifiable entities are familiar and not all familiar entities are either activated or in focus.“ (p. 276).

most restrictive					*least restrictive*
in focus >	**activated** >	**familiar** >	**uniquely identifiable** >	**referential** >	**type identifiable**
it	*this/that N*	*that N*	*the N*	*indifinite this N*	*a N*

Figure 1.: The givenness hierarchy.

In the models described so far, accessibility (either in short- or long-term memory) is the central factor guiding anaphora use. The context under which an antecedent becomes salient and thus accessible, depends on “linguistic structural features, e.g., grammatical role, word order, definiteness, agreement etc., or by semantic features, i.e., properties of the antecedent, such as semantic inference relations, semantic role, topicality, animacy, etc. Very likely, salience is determined by interaction of a bunch of such criteria.“ (Bittner, 2007, p. 104). In addition, pragmatic inference plays a role in most models.

Coming to experimental data, cognitive research on anaphora has aimed to investigate the contexts under which an antecedent becomes salient and accessible. Studies have largely included adults. However, there are some studies investigating children. They include comprehension and production experiments, using conversational dialogues (Gundel, Ntelitheos, & Kowalsky, 2007), elicitation tasks (Bittner, 2007), or narratives (e.g. Gülzow & Gagarina, 2007), and have focused on the influence of topicality, animacy and grammatical role.

In acquisitional research, it has been shown that the developmental order of determiner and pronoun use parallels their cognitive accessibility. For example, Gundel et al. (2007) review L1 English conversational data by Brown (1973), and Bloom (1970), adding additional examples out of the CHILDES database (MacWhinney, 2000). The authors compare the use of anaphoric reference to Gundel et al.‘s (1993) *givenness hierarchy*. They demonstrate that in early development (from 1;6) children use the pronoun 'it', which is the most accessible form in the hierarchy, but do not use articles or demonstratives, which are less accessible. Importantly, 'it' is used (in accordance with predictions of the *givenness hierarchy*) when the referent has already been talked about and is in focus. Soon afterwards (from 1;11), children use the pronoun 'it' along the demonstrative pronoun 'that' + noun, which is next in the hierarchy. These forms are used appropriately with regard to a referent‘s cognitive status. 'It' is only used after a referent has been established and put in focus. 'That' + noun is used for both, reference introduction and frequently to

maintain reference. Note that the latter use does not yet approximate adult production, as demonstratives are rare in adult speech. The definite article starts being used around the age of three, but may appear earlier. It only slowly replaces the high use of demonstratives. The definite article is used for a range of cognitive statuses, but always for referents that are activated as opposed to ones that are introduced. The indefinite article is acquired later. Gundel et al. only found instances of correct use, that is "in contexts where a form that requires a stronger status would be inappropriate" (p. 16).

As such it can be concluded that "[t]he order of acquisition of forms that code cognitive statuses seems to parallel the order of forms on the Givenness Hierarchy, with pronouns, both demonstrative and personal, acquired first, and the indefinite article last." (Gundel, et al., 2007, p. 7). Also, "children use the full range of cognitive status encoding determiners and pronouns, and use them appropriately, by the time they are 3. Moreover, these children are capable of using referring forms in a way that suggests they are sensitive to the memory and attention state of their interlocutors" (p. 16). This can be taken as an indicator for children's theory of mind.

Bittner (2007) is also concerned with the role that accessibility and salience has on the use of anaphoric reference. She investigates this issue from a different angle, as she is interested in the influence of the antecedent's syntactic role (subject vs. object) and animacy on the comprehension and production of anaphora. With regard to the present research, only the production data will be reported here. In her study, L1 German-speaking children aged between 2 to 6 years completed an elicitation task. Results showed that in production animacy differentially influenced children's choice of anaphora. They preferred illegal zero pronouns with animate antecedents. This is illustrated in (7), which is an example provided by Bittner. Demonstrative pronouns, on the other hand, were preferentially used with inanimate antecedents. This is illustrated in (8). As the author does not provide a full dialogue for an example, I extend her example sentence.

(7)	Experimenter 1:	Der Elefant fährt den Traktor. Er ist blau.
		The elephant is driving the tractor. It is blue. (notice: both are blue)
	Experimenter 2:	Wie bitte? Was war los?
		Pardon? What happened?
	Child:	Ist blau.
		Is blue.
(8)	Experimenter 1:	Der Traktor schiebt den Bus. Er ist weiß.
	Experimenter 2:	Wie bitte?
	Child:	Der ist weiß.

On a more fine grained level, examining not only in/animacy, but its relation with syntactic role, a complex development was noted by Bittner. First (2;6-3 years), the use of zero pronouns was basically related to in/animacy, as explicated above. Later on in development (3;6-4;6), it interacted with syntactic role, in that zero pronouns were most frequently used with animate subjects and inanimate objects. Then (5;6), the clear preference receded, which parallels adult use.

Concerning personal pronouns, only weak preferences were noted. In the beginning, children tended to avoid personal pronouns. Then they showed a preference to use personal pronouns for animate subject and especially object antecedents. By the age of 5;6 no preference could be noted, so that older children had approximated adult use.

With regard to demonstrative pronouns, children started out using them when referring back to inanimate subjects and objects. Then they only showed a preference for inanimate subjects. From the age of 5;6 any preference disappeared, which mirrors adult use.

In sum, Bittner‘s results confirm an earlier finding for German, that initially (2;6-3;0) children use zero forms (subject drop). Also, overt subjects appear when children inflect verbs. Subsequently, zero forms are used alongside demonstrative pronouns for antecedent reference, and their choice interacts with in/animacy and syntactic role. At the same time personal pronouns are rarely used. Between 3;6 and 4;0 children more frequently use personal pronouns. Now their use is related to animacy and object role. Interestingly, “animacy appears as a slightly stronger cue“ (p. 120) for all anaphora productions in younger children. From 4;6 on children use pronouns and zero forms in an adult-like manner, i.e. they most frequently use personal pronouns, less demonstrative pronouns and rarely zero forms. The reason why demonstrative pronouns are used before personal pronouns, is that “the demonstrative pronoun is more general and thus more available to the child than the personal pronoun due to the syncretism of deictic and anaphoric features in this form and the importance of deictic reference in early child language“ (p. 119).

To conclude, Bittner‘s elicitation study showed that

> “the anaphoric preferences of the three pronoun types reveal the relation of antecedent features to antecedent salience. The formally least complex zero pronoun correlates with animate subjects, whereas the more complex personal pronoun correlates with object role and the even more complex demonstrative pronoun with inanimacy. The results provide evidence for positive answers to the questions on the salience hierarchy of these features ...: animacy > inanimacy and subject > object. Further, there is an interaction of both features with respect to salience hierarchy: animate subjects > animate objects > inanimate subjects > inanimate objects.“ (p. 121).

While Bittner‘s data revealed an especially interesting differential use of zero forms vs. demonstrative pronouns based on antecedent salience, Gülzow and Gagarina (2007) particularly concentrate on differential use of demonstrative vs. personal pronouns as related to antecedent salience. The authors take the *complementary hypothesis* (Bosch, Rozario, & Zhao, 2003) as their starting point. Similar to the *accessibility hierarchy* (e.g. Ariel, 2004), the *complementary hypothesis* postulates a “relation ... between a relatively high salience of the referent and a relatively low formal complexity of the anaphora“ (Gülzow & Gagarina, 2007, p. 204). With regard to German pronouns, it is hypothesised that personal pronouns, which have a low complexity, are

preferably used with subject antecedents, which are highly salient. Whereas, demonstrative pronouns, which are more complex, are used with non-subject antecedents, which are less salient. This has been confirmed in adult written data for the personal pronoun 'er' (*he*) and the demonstrative pronoun 'der' (*this, that*) (Bosch, Katz, & Umbach, 2007).

With regard to child language, Gülzow and Gagarina (2007) investigated the amount of use of pronouns during development and the interaction between demonstrative and personal pronouns and the grammatical role of the antecedent (subject vs. object). The authors collected narrative samples in German, Russian and Bulgarian from children aged between 2;6 and 6;0. They analysed co-reference of NPs, pronouns and zero forms with story characters. For a more concise discussion, only the German data on pronouns will be reported here. Gülzow and Gagarina found that the use of demonstrative and personal pronouns increases at the age of 3. By the age of 4 the use of demonstrative pronouns decreases, while the use of personal pronouns increases. With regard to pronoun use and the grammatical status of the antecedent, Gülzow and Gagarina did not replicate Bosch et al.‘s results in every respect. Thus, in the adult data antecedents in subject position were referred to with demonstrative and personal pronouns equally. Remember that the *complementary hypothesis* would have predicted a higher use of personal pronouns for antecedents in subject position. Antecedents in object position, however, were referred to by use of demonstrative pronouns by trend. This is in accordance with the *complementary hypothesis*. Children showed a development with age, which finally mirrored adult use. Two year-olds always referred to antecedents in subject position using personal pronouns. Three and four year-olds also showed a high number of subject references using demonstrative pronouns. Finally, five year-olds approximated adult use and solely referred back to subjects using personal pronouns. Coming to antecedents in object position, two year-olds used demonstrative pronouns, and no personal pronouns. This is predicted by the *complementary hypothesis*. The use of demonstratives to refer to antecedents in object position increases between two and three years. However, personal pronouns are also used. The authors propose that the difference in results between Bosch et al.‘s study and theirs might be due to different text types (written vs. spoken). They do not draw any firm conclusions about the validity of the *complementary hypothesis* for language acquisition.

In sum it can be said, that there exists little research from a cognitive perspective investigating the developmental use of anaphora. Thus far, studies have examined the activation or salience of antecedents. While some studies propose a relation between focus and anaphora (Gundel et al. 2007), others put forward an interaction between animacy and grammatical role (subject vs. object) with anaphora (Bittner, 2007). Future research is needed to replicate these findings.

2.3 Nominal and pronominal reference and co-reference in DS

The only study thus far to investigate referential expression in DS is Moore, Clibbens and Dennis (1998). The authors presented DS individuals (5-18 years CA, mean MA of 50 months) and TD children (grouped in 5, 7, and 10 year olds) with silent video clips showing various stories, and asked them to narrate a story while they were seeing it. A matching of DS and TD children was not made. Moore and colleagues were interested in the use of full references (which they defined as: indefinite article + noun, definite article + noun, or noun) and reduced references (which they defined as: pronouns, nominal substitute, zero form) in introducing, maintaining and switching story characters. Additionally, the authors included different conditions in their test design. In Condition 1 the listener (the experimenter or another child) could either see the video clip, or not. In Condition 2 participants either viewed a video where characters were moving, or still. Condition 3 the video showed one main character and either one or two peripheral characters.

Results showed that “the position of the listener when the child narrated the story had no effect on the referential forms used” (p. 66). From the presentation of results it is not clear, if this holds for TD as well as DS children. Moreover, the authors do not draw any conclusion from their finding.

For introducing the main and peripheral characters, TD and DS predominantly used full references in Condition 2 (moving vs. still video) as well as Condition 3 (1 vs. 2 peripheral characters). For maintaining reference to a character, TD and DS showed different results. TD mainly used reduced references for main and peripheral characters in both conditions. DS, however, showed no differential use of referring expressions. For switching reference, TD and DS again differed in performance. In Condition 2, TD used more reduced references for the characters. DS, however, equally used full and reduced references. In Condition 3, a main effect of number of peripheral characters was obtained. When only one peripheral character was presented, five year olds used significantly less full references to main characters than to peripheral ones. Seven and ten year olds showed no differential use. When two peripheral characters were presented, five year olds showed no differential use. Seven year olds used more full references for the peripheral character, whereas the ten year olds used more full references for the main character. In DS a higher number of full references for the main character than peripheral characters was observed, however, only when one peripheral character was present. When two peripheral characters were involved, no differential use of referring expressions was noted.

In sum, Moore, Clibbens and Dennis (1998) suggest that “when there is … limited information to be integrated – such as in stories which contain only one peripheral character where the distinction between the characters is maximally different – [DS] are able to distinguish linguistically between the characters” (p. 69). In this case, however, TD and DS performance seems to be qualitatively different: “[t]he referential strategy is the opposite of the one used by typically developing children” (p. 69). That is, full references are predominantly used for main characters in DS and not for peripheral characters.

Moore, Clibbens and Dennis' (1998) study provides an important first insight into the use of referring expressions in narratives produced by DS individuals. As it is the first study, it remains very general. For example, in the analysis no distinction was made between grammatically or textually correct vs. incorrect use of referential expressions. Moreover, no distinction was made between the use of indefinite article + noun, definite article + noun, and noun, as is common in analyses of referential expressions in narratives (see e.g. Bamberg 1994). Such an analysis, however, would be necessary to evaluate abilities of DS individuals to involve listeners in their narrative.

Empirical research

3 Research questions

The present study analyses DS individuals' textual skills (as measured by participants' use of nominal and pronominal devices to refer to animate characters in the picture story '*Frog, where are you?*' by Mercer Mayer (1969)) and compares them to participants' grammatical skills (as measured by a plural and past participle test), lexical skills (as measured by a type, token and lemmata analysis of participants' picture stories), and IQ (as measured by the HAWIK-IV). The main goal of this analysis was to investigate whether DS individuals' textual competence is realised as skills, derived from a unique model, or whether it is the result of the interaction between different models. In other words the present study aims to shed light on the question whether language in DS is organised modular or interactive (see Chapter 1.3). Another goal, was to investigate whether textual skills in DS are delayed or impaired when compared to TD.

In sum, the following research questions can be formulated:

1. Which referential devices do DS individuals with higher and lower grammatical skills use, when introducing, maintaining and switching animate characters?
2. Which referential devices do DS individuals with higher and lower lexical skills use, when introducing, maintaining and switching animate characters?
3. Which referential devices do DS individuals with higher and lower textual skills use, when introducing, maintaining and switching animate characters?
4. Which referential devices do DS individuals with a mild and moderate IQ impairment use, when introducing, maintaining and switching animate characters?
5. Is there a developmental progression in the use of referential devices for introducing, maintaining and switching characters? And does it follow typically developing children, or is it impaired?
6. Are there cut offs in the developmental progression which are marked by the use of special referential devices? Can these referential devices be used as clinical markers?

4 Hypotheses and predictions

Previous research in L1 English (Moore, et al., 1998) and L1 Italian (Lorusso, et al., 2007) showed that individuals with DS use various referential devices to introduce, maintain and switching characters. These include definite article + noun, indefinite article + noun, noun[3], pronoun, and zero anaphora. Based on these findings, it can be expected that DS participants with L1 German will use the same spectrum of referential devices. Moreover, it can be expected that individuals with DS will have particular difficulties with the use of pronouns, especially when they show poor lexical and morphosyntactic skills (Lorusso, et al., 2007) and when they are switching reference (Moore, et al., 1998). General IQ should not correlate with the use of personal pronouns, but sentence comprehension may (as has been shown for Cornelia de Lange Syndrome) (Lorusso, et al., 2007).

5 Method

5.1 Participants

All individuals with genetically verified Down Syndrome that have been treated at the Medical University of Vienna, Department of Paediatrics from January 2004 – June 2009 were invited to participate in the present study. Participants took part in three language tests: (a) a plural test, (b) a picture telling task, and (c) a past participle test. Additional tests included auditory evoked potentials, psychologic testing (HAWIK-IV), and a complete neurological and psychiatric assessment. Data were collected at the Department of Paediatrics. Informed consent to participate in the study was provided by relatives after written information was dispersed and discussed. Ethical approval was obtained from the national research ethics committees.

5.2 General procedure

During test session participants' relatives were either asked to stay or to wait outside the test room, depending on participants' wishes. The test sessions lasted between 13 and 50 minutes. Participants' oral productions were recorded using a DAT-recorder and a video camera. These data were later transcribed by the examiner. The procedure for each session was the same: participants first took part in a *Plural Test*, then they narrated the picture stories *Frog Where Are You?* and *The Fox and the Crow*. Finally, they participated in a *Present Perfect Test*. This verb test was administered last in order to avoid transfer of present perfect forms to the story telling tasks. Furthermore, Marschik, Einspieler, Vollmann and Einspieler's (2005) vocabulary size

[3] Note that it is not clear from previous studies, if grammatically correct plural nouns or grammatically incorrect bare nouns were analysed (see Chapter 2.3 for a discussion).

questionnaire; the *Austrian Communicative Development Inventory (ACDI) 1* and/or *2*, was filled out by relatives either before or after the test session.

5.3 Materials and procedure

5.3.1 HAWIK-IV

The *Hamburger Intelligenz Test für Kinder IV* (HAWIK-IV) (Petermann & Petermann, 2008) is a German language IQ test for children aged between 6;0-16;11 years. It is based on the English language *Wechsler Intelligence Scales IV* (WISC-IV) (Wechsler, 2004). The HAWIK-IV measures working memory, processing speed, fluid intelligence, and language comprehension (see Daseking, Petermann, & Petermann, 2009). The working memory sub-component includes, for example, the repetition of orally presented numbers, the repetition of numbers and letters in ascending or descending order, and calculation skills. The processing speed sub-component includes, for example, the mapping of abstract symbols with target symbols, or the mapping of pictures with target pictures within a given time frame. The fluid intelligence sub-component includes, for example, a mosaic test where participants have to re-build a red and white mosaic based on a pre-given stimulus picture. Another fluid intelligence test is matrix reasoning, where participants are presented with an incomplete pattern, and have to choose the correct completed pattern out of five possibilities. The language comprehension sub-component includes, for example, participants‘ ability to find similarities between words/concepts, their vocabulary size, and general comprehension of everyday problems and social conventions.

5.3.2 Plural test

5.3.2.1 Material

The linguistic test session started with a plural test. The plural test used was a shortened version of Laaha et al.'s (2006) *Plural Test for German*. Out of their 42 items, 21 were selected. They were balanced for the seven plural markers *-s*, *-en*, *-e*, *U+e*, *U*, *U+er, zero* and if possible also for gender (see Table 4).

plural marker	gender	test item	gloss	productivity
-s	masculine	Clown	*clown*	wp
	feminine	Pizza	*pizza*	p
	neuter	Klo	*toilet*	fp
-en	masculine	Bub	*boy*	np
	feminine	Uhr	*watch/clock*	p
	neuter	Bett	*bed*	np
-e	masculine	Bus	*bus*	p
	neuter	Flugzeug	*plane*	p
	neuter	Schaf	*sheep*	wp
U+e	masculine	Hut	*hat*	wp
	masculine	Ball	*ball*	wp
	feminine	Kuh	*cow*	np
zero	masculine	Pullover	*pullover*	p
	masculine	Tiger	*tiger*	p
	neuter	Messer	*knife*	p
U	masculine	Mantel	*coat*	np
	masculine	Hammer	*hammer*	np
	masculine	Nagel	*nail*	np
U+er	masculine	Schnee-mann	*snowman*	np
	masculine	Wurm	*worm*	np
	neuter	Haus	*house*	np

Table 4: Test items for the plural test. Productivity: fp = fully productive, p = productive, wp = weakly productive, np = non-productive.

The input frequency of the singular form ranged from low to middle (based on Vollmann, Sedlak, Muller, & Vassilakou, 1997) and the CELEX frequency of the singular form ranged from low to high (see Table 5).

plural marker	test item	gloss	input frequency	CELEX Laaha et al. 2006	CELEX singular Mannheim	CELEX plural Mannheim
-s	Clown	*clown*	l	l	65	0
	Pizza	*pizza*	m	l	1	0
	Klo	*toilet*	l	l	7	0
-en	Bub	*boy*	m	l	30	15
	Uhr	*watch/ clock*	h	h	4395	58
	Bett	*bed*	m	m	709	218
-e	Bus	*bus*	m	l	64	15
	Flugzeug	*plane*	m	m	446	114
	Schaf	*sheep*	m	l	83	54
U+e	Hut	*hat*	m	m	115	19
	Ball	*ball*	m	m	365	23
	Kuh	*cow*	l	m	240	89
U	Mantel	*coat*	m	m	157	22
	Hammer	*hammer*	l	l	74	5
	Nagel	*nail*	l	l	74	33
U+er	Schnee-mann	*snowman*	m	l	3	0
	Wurm	*worm*	l	l	26	10
	Haus	*house*	m	h	2000	213

Table 5: Test items for the plural test. Input Frequency: l = low (<5), m = middle (5-10), h = high (>10), Celex Frequency: l = low (1-100), m = middle (101-1000), h = high (>1000).

5.3.2.2 Procedure

Plural forms were elicited in the following manner: each participant was shown a colour picture depicting a singular noun (e.g. *Bub* 'boy'). The examiner said: *Das ist ein Bub* 'This is a boy'. A second picture followed, showing three examples of the same noun. The picture was accompanied by the question: *Und was sind das? Das sind drei/viele* ___ 'And what are these? These are three/ many ___'. Test items were presented in a fixed order to all participants. Three practice trials preceded the test (*Auto – Auto-s* 'car-s', *Banane – Banan-en* 'banana-s', *Baum – Bäum-e* 'tree-s'). If the examiner had the impression that during the course of the test the participant had forgotten test requirements, she repeated the three practice trials together with the participant.

5.3.2.3 Coding

Afterwards, participants' oral productions were transcribed by the examiner and coded for further analysis. Four categories were defined: (1) correct plurals, (2) erroneous plurals with incorrect plural marking (e.g. **Manteln* instead of *Mäntel*, 'coats'), (3) reiterated singular forms with omission of plural markers (e.g. **drei Bub*, 'three boy') and (4) other errors, such as no response or unintelligible response. Zero plurals were excluded from the statistical analysis, because they would have yielded correct responses even for participants who clearly did not understand plural meaning. However, zero plurals were included in the qualitative error analysis.

5.3.3 Past participle test

5.3.3.1 Material

W. U. Dressler's unpublished *Present Perfect Test for German* was used. The test consisted of 20 items, for which the pre-fix *ge-* is used to form the past participle. The only exception to this was the item *verkleiden - verkleidet* (‘dress up‘ - ‘dressed up‘). The items differ in their transparency. There are items with weak suppletion (e.g. *ziehen - gezogen*) and strong suppletion (e.g. *gehen - gegangen*). Strong forms are non-productive, while weak forms are productive. Table 6 below presents the test items with their vowel change pattern.

verb class	vowel change pattern in the infinitive, preterite and past participle			3rd person singular present tense
strong	lesen	las	gelesen	liest
	read	*read*	*read*	*reads*
strong	kommen	kam	gekommen	kommt
	come	*came*	*come*	*comes*
strong	rufen	rief	gerufen	ruft
	call	*called*	*called*	*calls*
strong	schieben	schob	geschoben	schiebt
	push	*pushed*	*pushed*	*pushes*
strong	heben	hob	gehoben	hebt
	lift	*lifted*	*lifted*	*lifts*
strong	stehen	stand	gestanden	steht
	stand	*stood*	*stood*	*stands*
strong	biegen	bog	gebogen	biegt
	turn	*turned*	*turned*	*turns*
strong	ziehen	zog	gezogen	zieht
	pull	*pulled*	*pulled*	*pulls*
strong	sitzen	saß	gesessen	sitzt
	sit	*sat*	*sat*	*sits*
strong	singen	sang	gesungen	singt
	sing	*sang*	*sung*	*sings*
strong	springen	sprang	gesprungen	springt
	jump	*jumped*	*jumped*	*jumps*
strong	finden	fand	gefunden	findet
	find	*found*	*found*	*finds*
strong	gehen	ging	gegangen	geht
	go	*went*	*gone*	*goes*
strong	trinken	trank	getrunken	trinkt
	drink	*drank*	*drunk*	*drinks*

verb class	vowel change pattern in the infinitive, preterite and past participle			3rd person singular present tense
weak	kleben	klebte	geklebt	klebt
	stick	*sticked*	*sticked*	*sticks*
weak	drehen	drehte	gedreht	dreht
	turn	*turned*	*turned*	*turns*
weak	verkleiden	verkleidete	verkleidet	verkleidet
	dress up	*dressed up*	*dressed up*	*dresses up*
weak	kriegen	kriegte	gekriegt	kriegt
	get	*got*	*gotten*	*gets*
weak	fragen	fragte	gefragt	fragt
	ask	*asked*	*asked*	*asks*
weak	niesen	nieste	geniest	niest
	sneez	*sneezed*	*sneezed*	*sneezes*

Table 6: Test items for the past participle test.

As can be seen in Table 7 the CELEX frequency for the verb stem ranged from low (*krieg-,* 12) to high (*steh-,* 11998) frequency stems. The CELEX frequency for the 3rd person singular present tense varied likewise from low (*niest*, 0) to high (*kommt*, 2418). Moreover, frequencies for the past participle were noted and used for the analysis. The general CELEX frequency for the past participles ranged from low (*geniest*, 0) to high (*gekommen*, 1079). The CELEX frequency for the past participles as occurring in written language ranged from low (*geniest*, 0) to high (*gekommen*, 161) and similarly in spoken language (*geniest*, 0) and (*gekommen*, 918).

stem	CELEX	3rd person present	CELEX	past participle	CELEX	CELEX spoken	CELEX written
les-	852	liest	127	gelesen	195	50	145
read		*reads*		*read*			
komm-	6315	kommt	2418	gekommen	1079	161	918
come		*comes*		*come*			
ruf-	3551	ruft	131	gerufen	94	7	87
call		*calls*		*called*			
schieb-	641	schiebt	58	geschoben	56	5	51
push		*pushes*		*pushed*			
heb-	-	hebt	167	gehoben	23	1	22
lift		*lifts*		*lifted*			
steh-	11998	steht	2329	gestanden	75	6	69
stand		*stands*		*stood*			
abbieg-	-	abbiegt	3	abgebogen	1	1	0
turn		*turns*		*turned*			
zieh-	8252	zieht	176	gezogen	301	23	278
pull		*pulls*		*pulled*			
sitz-	2904	sitzt	301	gesessen	55	9	46
sit		*sits*		*sat*			
sing-	257	singt	102	gesungen	46	14	32
sing		*sings*		*sung*			
spring-	1487	springt	94	gesprungen	17	0	17
jump		*jumps*		*jumped*			
find-	2624	findet	794	gefunden	833	78	755
find		*finds*		*found*			
weggeh-	-	weggeht	5	weggegang	20	6	14
go away		*goes away*		*gone away*			
trink-	248	trinkt	66	getrunken	82	13	69
drink		*drinks*		*drunk*			
kleb-	65	klebt	16	geklebt	6	0	6
stick		*sticks*		*sticked*			
dreh-	168	dreht	83	gedreht	57	3	54
turn		*turns*		*turned*			
verkleide-	-	verkleidet	20	verkleidet	20	2	18
dress up		*dresses up*		*dressed up*			
krieg-	12	kriegt	55	gekriegt	21	11	10
get		*gets*		*gotten*			
frag-	6708	fragt	280	gefragt	291	62	229
ask		*asks*		*asked*			
nies-	-	niest	0	geniest	0	0	0
sneez		*sneezes*		*sneezed*			

Table 7: Test items for the past participle test: frequency.

5.3.3.2 Procedure

All items were presented in a sentence context and the sentences were embedded in a description of a boy called 'Hans'. Past participles were elicited in the following manner: the examiner read *Hans singt gerne. Auch gestern hat er ge___?* 'Hans likes singing. Yesterday he has also ___?'. Sentences were presented in a fixed order for all participants. Two training items served as a means of familiarizing participants with the test format (*isst – gegessen* 'eats - eaten', *arbeitet – gearbeitet* 'works – worked').

5.3.3.3 Coding

Participants' pictures stories were coded for further analysis. Four categories were established: correct, error 1, error 2 and omissions. More specifically, responses which were counted as correct were only responses which were morphologically correct past participle forms of the test items (e.g. *liest – ge-lesen*, 'reads – read'). Responses that were labelled as type 1 error, were responses which were morphologically incorrect past participle forms of the test items (e.g. *gelese instead of *gelesen*, 'read'). Moreover, responses which were categorised as type 2 errors, were responses which were morphologically correct past participle forms of verbs that were not test items (e.g. *gegessen*, 'ate' instead of *gelesen*, 'read'). All type 2 errors were morphologically correct past participle forms, that is, participants never used morphologically incorrect past participle forms of other verbs than test item verbs. Finally, some responses were counted as omissions. This category includes non-finite forms of test items (e.g. *geht weg – gehen*, 'goes away' – 'to go'), present tense finite forms of test items (e.g. *steht – steht*, 'stands' - 'stands'), non-finite forms of other verbs than test items (e.g. *liest – kleben*, 'reads' - 'sticks'), and finite forms of other verbs than test items (e.g. *schiebt – klebt*, 'pushes' - 'sticks'). Also, responses that were nouns or noun phrases were counted as omissions (e.g. *liest – über a Buch*, 'reads' – 'about a book').

5.3.4 Lexicon

5.3.4.1 Materials and procedure

Participants' vocabulary size was measured in two ways. First, a vocabulary size questionnaire; Marschik, Einspieler, Vollmann and Einspieler's (2005) *Austrian Communicative Development Inventory (ACDI) 1* and/or *2,* was/were distributed and filled out by participants' relatives before or after testing. The *ACDI 1* and *2* were originally developed for typically developing children aged up to 18 months (*ACDI 1*) and between 16-26 months (*ACDI 2*) respectively. Nevertheless, they were chosen because no other tests measuring vocabulary size in German have been developed so far.

Second, as such questionnaires may be unreliable, vocabulary size was estimated by analysing participants' picture story '*Frog Where are You?*' by Mercer Mayer (1969).

5.3.4.2 Coding

Each picture story was coded for lemmata, types and token. Additionally, a type-token ratio was calculated. A lemma was defined as a “group of wordforms that are related by being inflectional forms of the same base word“ (McEnery & Hardie, 2012, p. 245). For example, all instances of *go, goes* and *went* were coded and counted as one instance of the verb lemma *go*. A type was defined as “a particular, unique wordform“ (McEnery & Hardie, 2012, p. 50). As such, all instances of *go*, *goes* and *went* were coded and counted as three word types. A token was defined as “any instance of a particular wordform in a text“ (McEnery & Hardie, 2012, p. 50). For example, all instances of *go* were coded separately and added together. The type-token ratio was calculated by dividing the total number of types by the total number of tokens used in each story. Note that the type-token ratio is a problematic measure in the present study. This is because some stories were very short compared to others in the corpus. As such, the stories could not easily be compared.

5.3.5 Utterances

Each picture story was coded for utterances. An utterances was defined by one of the following criteria:

(1) a phrase including one verb

(2) an intonation pattern that marks a stretch of meaning

The first criterion is illustrated in the following example. Verbs are highlighted in bold.

Example (1):

Participant:

*Ok, ahm. Also das **ist** in der Nacht.*	utterance 1
*Und ähm der Bub Martin ärm **hat** einen Frosch **gefunden** im Teich*	utterance 2
*und **hat** ihn in einem Glas Wasser **hineingesetzt**.*	utterance 3
*Danach **kommt** sein Hund Rex*	utterance 4
*und **tut herumschnuppern***	utterance 5
*wie der Frosch **riecht**.*	utterance 6
*Danach **schläft** der Bub Martin mit seinen Hund Rex in seinem Bett.*	utterance 7

'OK, erm. So this **is** at night.
And erm the boy Martin erm **has found** a frog in the pond
and he **has put**it in a glass of water.
Then his dog Rex **comes**
and **sniffs**around
how the frog **smells**.
Then the boy Martin **sleeps**with his dog Rex in his bed.'

The second criterion is exemplified in utterance 2 in the extract below.

Example (2):

Participant:
*Da **sitzt** Katzen Hund.* utterance 1
Interviewer:
Mhm.
Participant:
Der Mond und Nacht und Hunden und Mond. utterance 2
Und da und **schläft**. utterance 3

Participant:
Here **sits** cats dog.
Interviewer:
Mhm.
Participant:
The moon and night and dogs and moon.
And here and **sleeps**.

5.3.6 Story telling task

5.3.6.1 Material

Mercer Mayer's (1969) '*Frog Where are You?*' picture story was used to elicit participants' narrative skills. Two test versions were developed. The first version was the full length story. It was administered to participants with more developed language skills and a higher attention span. The second version was a shortened version consisting of 16 pictures (pictures 1, 2, 3, 4, 8, 9, 10, 14, 15, 16, half of picture 17, 20, 21, 22, 23 and 24). Story versions were shown four pictures at a time in order to enhance narration.

5.3.6.2 Procedure

The following prompt was used to elicit narrative samples: *Das ist die Geschichte von einem Buben, einem Hund und einem Frosch. Schau dir die Bilder an, und erzähl, was in der Geschichte passiert*. ('This is the story about a boy, a dog and a frog. Look at the pictures and tell what happens in the story'.). The examiner did not intervene during story production. However, she used unspecific enhancers if necessary: *Wen siehst du?* 'Who do you see?', *Mh. Und was passiert dann?* 'Mh. What happens then?', *Was geschieht hier?* 'What happens here?', *Noch etwas?* 'Anything else?'. In general, care was taken not to emphasize single characters or objects, but the story plot. Both, the interviewer and the participant looked at the picture book. They therefore had mutual knowledge of the story.

5.3.6.3 Coding

First, participants' data were divided into utterances (see Chapter 5.3.5). Afterwards, referential expressions were analysed. Based on Bamberg (1987, 1994), the nominal, pronominal, and

correct or incorrect zero forms used to introduce, maintain and switch between characters, that is the boy, the dog, the frog and other animals (e.g. the bees, the owl, the deer, the frog family), were coded. A total score for all characters taken together was also calculated. Examples (1) and (2) below illustrate the coding procedure. They both refer to the first four pictures of the story.

Example (1): Participant ID 17

*Also, da vor dem Bett ist **ein Kind***	So, here in front of the bed is **a child**
introducing boy: indefinite article + noun	
*erm da seh ich **einen Hund***	erm here I see **a dog**
introducing dog: indefinite article + noun	
***er** nimmt was in den Mund.*	**it** is taking something into the mouth.
maintaining dog: er	
Das seh ich gerade.	This is what I'm seeing at the moment.
*Da ist ein Glas mit **einem Frosch***	Here is a glass with **a frog**
introducing frog: indefinite article + noun	
und da ist ein Henkel	and here is a handle
*und **der Hund** nimmt den nimmt den Henkel*	and **the dog** is taking the handle
switching dog: definitve article + noun	
*also **er** greift den Henkel an*	well, **it** grabs the handle
maintaining dog: er	
*Also er **er** würde's sehr gerne aufhängen*	well, **it** would like to hang it up
maintaining dog: er	
*ah wo drinnen **ein Frosch** ist.*	ah, where **a frog** is inside.
Switching frog: indefinite article + noun	
Dann ist auf dem Bett ein Licht.	Then there is light on the bed.'

Example (2): Participant ID 4

Ein Bub.	A boy.
Introducing boy: indefinite article + noun	
Ein Hund.	A dog.
Introducing dog: indefinite article + noun	
Frosch.	Frog.
Introducing frog: noun	
Steckt.	Is stuck in.
Switching dog: incorrect zero form	

The utterances were then subdivided into descriptive and non-descriptive utterances. The following criteria were used for the analysis:

Descriptive:

- absence of interpretations, inferences, comments
- absence of progress in the action
- use of present tense
- occurrence of deictic elements (e.g. *da* 'here', *dort* 'there')
- lack of connective elements

Non-descriptive:

- occurrence of adequate interpretations, inferences, comments (e.g. das Kind springt vom Fenster hinunter, 'the child jumps off the window')
- narration of characters' emotional states (e.g. *der Hund hat Angst,* 'the dog is scared') (see Bamberg & Damrad-Frye, 1991; Veneziano, 2009)
- narration of mental states or activities (e.g. *der Bub denkt nach,* 'the boy is thinking') (see Bamberg & Damrad-Frye, 1991; Lorusso, et al., 2007; Veneziano, 2009)
- intentional states (e.g. *der Hund wollte auf den Baum klettern,* 'the dog wanted to climb the tree') (see Veneziano, 2009)
- physical states, like perceptions (e.g. **ein Hund sieht fünf Frösche kommt,* 'a dog sees five frogs coming') (see Veneziano, 2009)
- modal verbs (e.g. *aber mitnehmen darf er [der Bub] das [den Frosch] nicht,* 'but he [the boy] is not allowed to take this [the frog] with him')
- occurrence of negations (e.g. *der Frosch ist nicht da,* 'the frog isn't here') (see Bamberg & Damrad-Frye, 1991)
- content of the sentence indicates progress in the action
- occurrence of past tense
- occurrence of connective elements (e.g. *und* 'and', *dann* 'then', *danach* 'after that', (see Bamberg & Damrad-Frye, 1991; Lorusso, et al., 2007)
- no occurrence of deictic elements

5.4 Statistical analysis

Statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) Version 19 for Mac OS X (IBM Corp., 2010). The Kolmogorov-Smirnov test and non-parametric correlations using Spearman's Rho were performed.

6 Results

6.1 Participants' characteristics

30 participants with Down Syndrome took part in the study. The sample included 15 males and 15 females respectively. Their age at the time of testing ranged from 7.8 to 30.2 years (M=16, SD=6). However, 11 participants were excluded from data analysis, because either their language skills were too poor to complete all tasks, or they suffered from psychological conditions, such as autism. The remaining 19 test participants were also aged between 7.8 and 30.2 years (M=16.6, SD=6.3). The Kolmogorov-Smirnov test revealed that age D(14)=0.27, p=.008 was significantly non-normal.

IQ at the 50° percentile ranged between 40 and 65 points (M=47.92, SD=7.87). The Kolmogorov-Smirnov test showed that IQ D(14)=0.22, p=.071 was normally distributed. Concerning ID-classes, 8 individuals belonged to the moderate ID-class, and 6 to the mild ID-class. The IQ for the remaining 5 participants could not be assessed as they were not able to complete all required tests. Performing Spearman's test between IQ and chronological age, no significant correlation could be observed, r_s=-.16, p=.584. Participants were coded with an ID number. This was based on correct responses on the plural test without zero plurals (see below).

6.2 Plural test

6.2.1 Statistical analysis

Data analysis was carried out using non-parametric correlations (Spearman's Rho). A p-value less than 0.05 was considered significant for all tests reported.

6.2.1.1 Plural test: overview of responses

Table 8 shows an overview of participants' responses in the plural test. In general, there were 9.4% of responses where participants didn't say anything or which were unintelligible. The majority of responses, 46.2%, were repetitions of singular forms. That is, plural marking was omitted. 8.8% of responses were erroneous plural forms and 35.7% were correct plural forms of test items.

response	number	percent
other error	N=32	9.4%
omission	N=158	46.2%
error	N=30	8.8%
correct	N=122	35.7%
total	N=342	100%

Table 8: Overview of responses on the plural test.

6.2.1.2 Plural test: responses and participant characteristics

This general result was further analysed. In a subject analysis, participants' responses (other error, omitted, error, correct) were correlated with factors such age and IQ (general, language comprehension, logical thinking, working memory and processing speed).

As presented in Chapter 8.1.1 in the appendix, some results on the plural test correlated significantly with: age, language comprehension and working memory. Thus, age significantly correlated with the percentage of correct plural forms, r_s=.67, p=.002, and the percentage of other errors, r_s=-.57, p=.012. This indicates that older participants produced more correct plural forms and less unintelligible or no responses than younger participants.

Working memory also showed a significant correlation, as correct plural forms correlated significantly with working memory, r_s=.62, p=.010. Moreover, omitted plural markers correlated significantly with working memory, r_s=-.60, p=.014. This indicates that participants with a higher working memory produced significantly more correct plural forms and less omissions than participants with a lower working memory.

Plural test: responses per participant

As shown in Chapter 8.1.1 in the appendix and illustrated in the diagram below, many participants show an individual profile. However, four major response patterns can be distinguished. There are participants whose responses were sometimes unintelligible and who produced many omissions of plural markers, but no errors or correct plural forms (i.e. participant 1-7). Then, there were participants who mostly omitted plural marking, but also made errors and produced some correct responses (i.e. participants 8-10). Moreover, there were participants who mostly produced correct responses, but still produced a high number of omissions or errors (i.e. participants 11, 13, 14). Finally, there were participants who showed no or one omission of plural marking, one or two erroneous plurals and mostly correct plural forms (e.g. participants 15-19).

In sum, it can be noted that after participants started producing correct plural forms, they also start edproducing errors. Errors increased steadily till participants reached 50% correct responses (with the exception of participant 11). The error rate dropped dramatically, when participants reached above 50% correct plural forms. Omissions showed a less clear trend. Omissions increased as other errors decreased. They then dropped as correct responses and errors started to be produced. However, there was no clear downward trend. Finally, other errors decreased sharply as omissions started to be produced. Nevertheless, some remained even when participants produced correct responses.

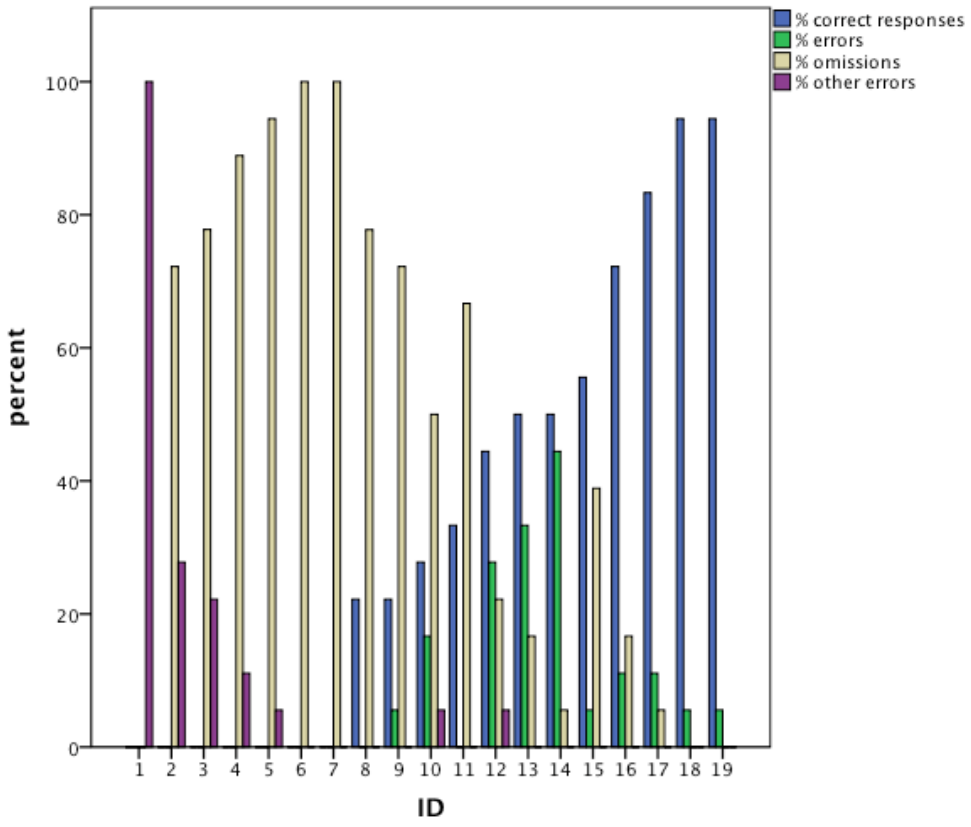


Diagram 1: % of correct responses, errors, omissions and other errors on the plural test per participant.

Plural test: responses and age

Age significantly correlated with correct responses and no or unintelligible responses (=other error). These data and further trends are reported in Chapter 8.1.3 in the appendix and illustrated in the diagrams below.

It can be seen that the total number of no responses or unintelligible responses decreased with age. Likewise, omissions of plural markers decreased with age. Errors were generally low (max. 22.2%). They were not produced at ages 7 and 9, but started occurring around age 11 (with the exception of two participants who dod not produce any errors up to the age of 13 and 15 respectively). Between the ages 12 and 17 a peak in errors could be noted, which decreased with age. As regards correct plurals, they started to be formed around age 11 (again, with the exception of two participants who did not show any errors or correct plurals at the ages of 13 and 15 respectively). Correct plural forms then showed a steady increase as age progressed.

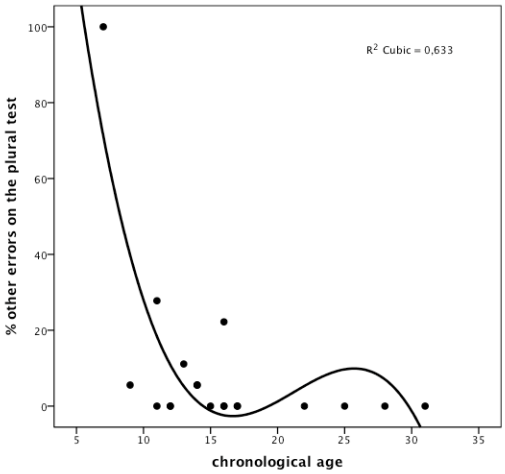


Diagram 2: % of other errors on the plural test per participant by chronological age.

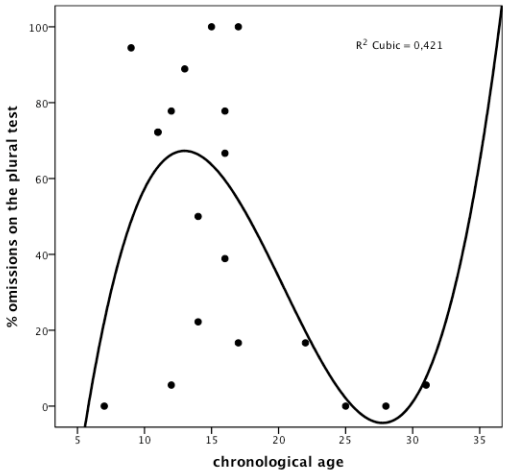


Diagram 3: % of omissions on the plural test per participant by chronological age.

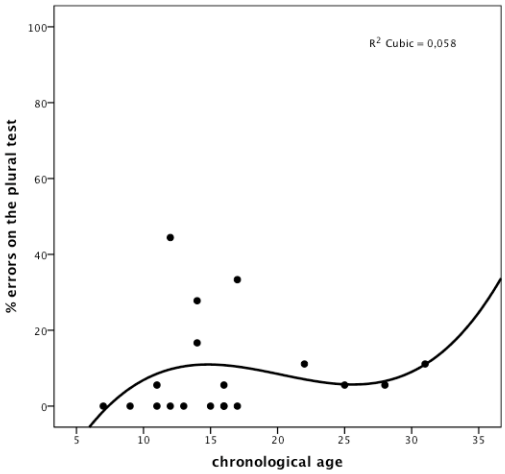


Diagram 4: % of errors on the plural test per participant by chronological age.

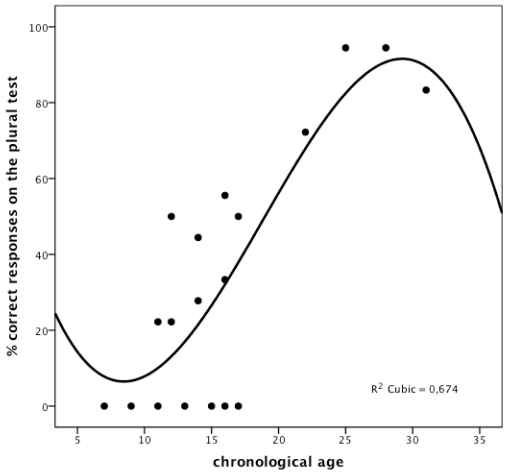


Diagram 5: % of correct responses on the plural test per participant by chronological age.

Plural test: responses and IQ

As previously mentioned, IQ did not significantly correlated with responses on the plural test. However, some trends could be noticed. The data are shown in Chapter 8.1.4 and illustrated in the diagrams below.

In general, few participants did not give a response or an unintelligible response. These participants mainly had an IQ between 40 and 45.

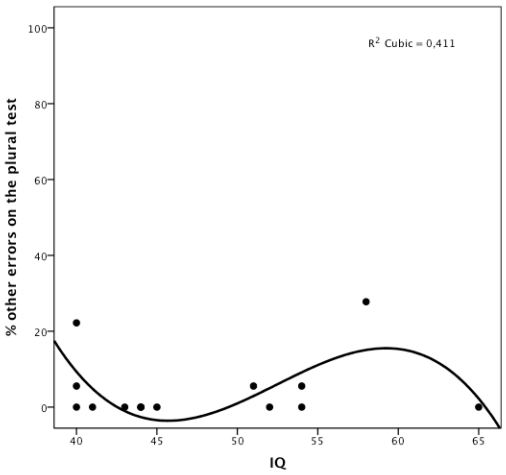


Diagram 6: % of other errors on the plural test per participant by IQ.

As to the omission of plural markers, a high amount of omissions (48.1%-100%) occurs within a wide range of IQs (40-58). Only one participant never omitted plural marking. He had the highest IQ score, namely 65 and was 25 years old. Other two participants showed a low omission rate (5.6%). Their IQs were also in the higher range, namely 52 and 54. However, one participant with an IQ of 58 showed a high omission rate (72.2%). He was also one of the youngest participants (11 years). This suggests that IQ may influence plural formation, but that age is also an important variable.

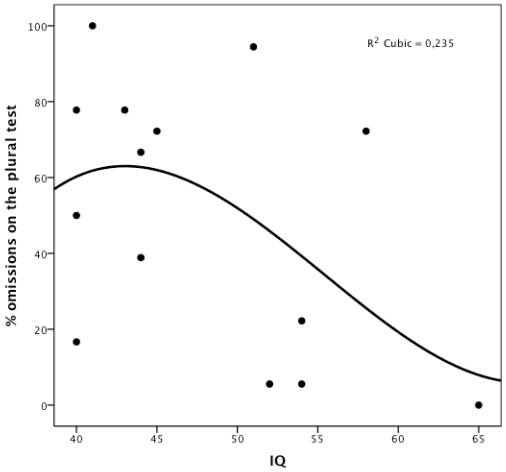


Diagram 7: % of omissions on the plural test per participant by IQ.

As regards erroneous plurals, they occur within the whole range of IQs (40-65). Thus, no relation between IQ and errors can be found (R^2=0.05).

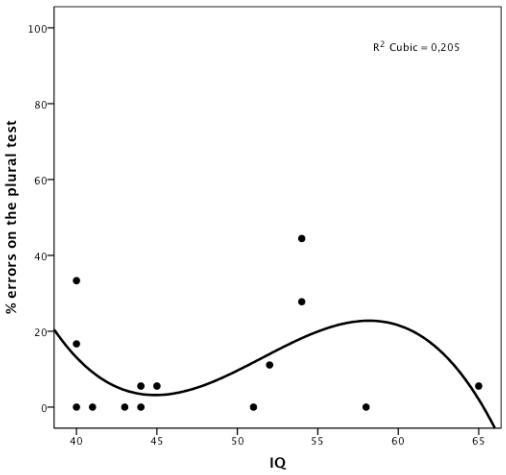


Diagram 8: % of errors on the plural test per participant by IQ

However, the formation of correct plurals might be related with IQ, as an increase of correct plural forms could be found with an increase in IQ. Nevertheless, it has to be noted that two participants did not follow this trend. They had IQs of 51 and 58 respectively. Again, these participants were among the youngest (9 and 11 years). This underpins the assumption that IQ alone cannot explain participants' responses, age has to be taken into account too.

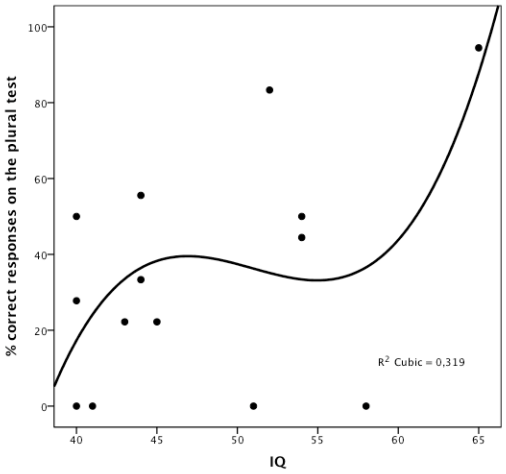


Diagram 9: % of correct responses on the plural test per participant by IQ.

As reported above, general IQ was split in its components (language comprehension, working memory, logical thinking and processing speed).

In Chapter 8.1.5 and the diagrams below, the relation between language comprehension and responses is shown. As can be seen, few participants within the whole range of language comprehension scores (47-71) gave no responses or unintelligible responses (0%-5.6%) with the exception of one participant (with a language comprehension of 59, and unintelligible responses of 27.8%). He was 11 and as such amongst the youngest participants.

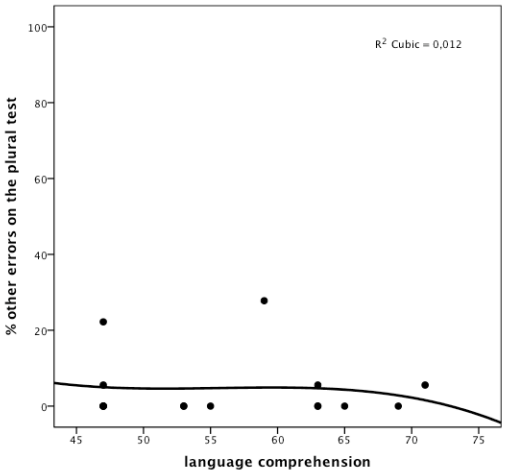


Diagram 10: % of other errors on the plural test per participant by language comprehension.

Concerning omissions, a clear trend could be noted. Omissions decreased with increasing language comprehension. Again, the before mentioned participant stands out, in that he shows a higher number of omissions than would be expected based on his and other participants' language comprehension. Moreover, the participant with the highest language comprehension score (71) is noticeable. She showed more omissions than would be expected. Although she had a relatively high language comprehension, her working memory (54) was relatively low. This might suggest that language comprehension is only one factor in the production of plurals, and that working memory also has an influence.

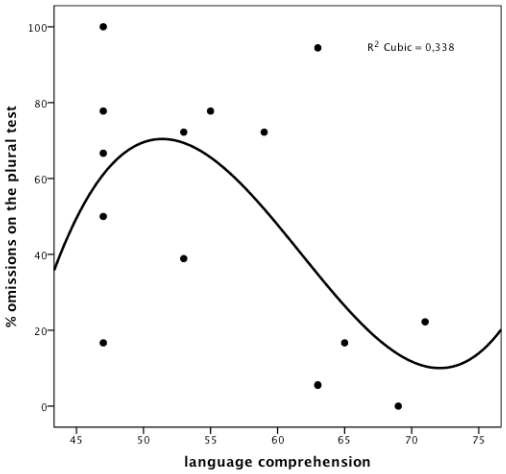


Diagram 11: % of omissions on the plural test per participant by language comprehension.

Regarding errors, it could be noted that the error rate remained below 45% for participants with language comprehension scores between 47-69.

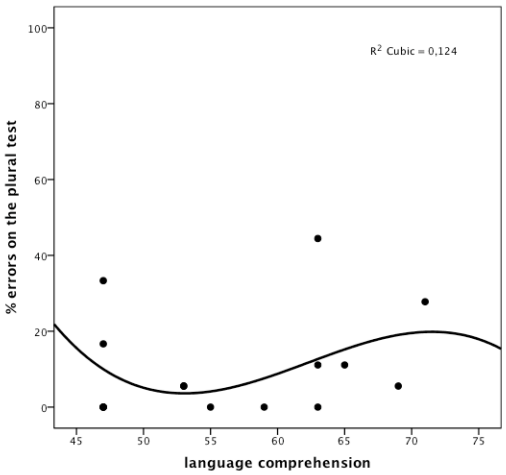


Diagram 12: % of errors on the plural test per participant by language comprehension.

Finally, as concerns correct plurals, a trend could be noted; correct responses increased with language comprehension. Again, the two aforementioned participants did not fit this tendency. The 11 year old participant with a language comprehension of 59 did not produce any correct responses. As such he showed a poorer performance than would be expected based on his language comprehension alone. The participant with the highest language comprehension (71) who had a comparatively low working memory (54) also showed fewer correct responses (44.4%) than would be expected based on her language comprehension alone. This again suggests that language comprehension, age and working memory interact in the production of plurals.

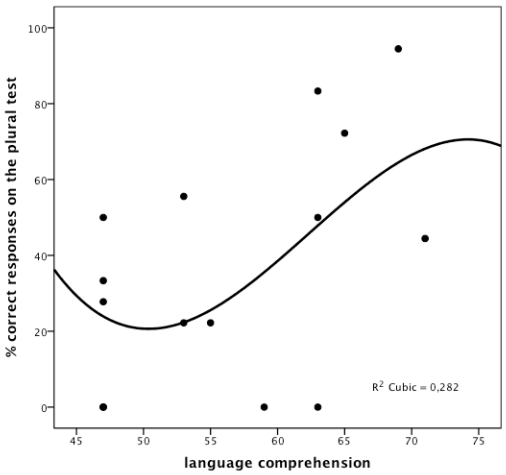


Diagram 13: % of correct responses on the plural test per participant by language comprehension.

The next subcomponent of IQ, logical thinking, did not correlate with responses on the plural test. The percentage of no responses or unintelligible responses was low with the exception of participant ID 2. It was the aforementioned 11 year old boy. He showed a higher rate of other errors, namely 27.8%. This suggests that logical thinking and age may be two interacting factors.

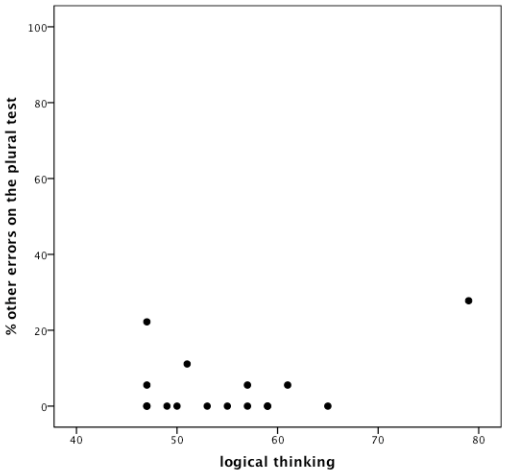


Diagram 14: % of other errors on the plural test per participant by logical thinking.

Concerning omissions, it could be seen that they increased with increasing logical thinking. This is the opposite trend from what has been noted for age, IQ, and language comprehension, and it is different from what will be said about working memory and processing speed. Again, age can explain these results. The four participants with the highest percentage of omissions, who were also responsible for the upward trend, were also amongst the youngest participants. They were 7, 9, 11, and 13 years respectively. This again indicates that age may be an important factor in the production of plurals.

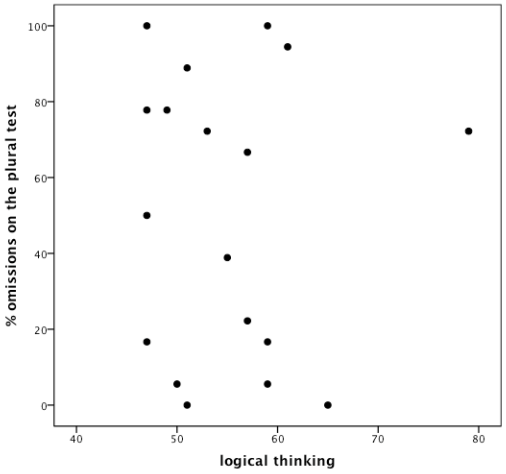


Diagram 15: % of omissions on the plural test per participant by logical thinking.

As regards errors, the error rate remained low. There were seven participants who showed no errors. These were the aforementioned young participants (7-13 years), who only produced other errors and omissions, but no errors or correct responses. This indicates that they were not able to produce errors. Moreover, there was one participant with a logical thinking score of 49, who showed no errors. This was a girl aged 12. She produced 50% omissions and 50% correct responses on the plural test.

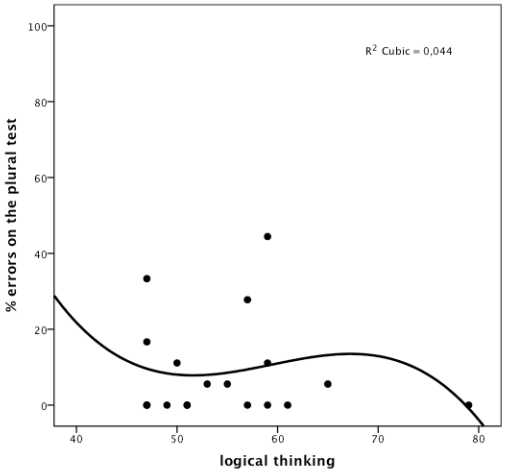


Diagram 16: % of errors on the plural test per participant by logical thinking.

Finally, correct responses increased with increasing logical thinking. This parallels the trends already seen for age, IQ, and language comprehension. Participants with no correct responses were the aforementioned young participants (7-13 years). Participants with the highest number of correct responses, 83.3% and 94.4% were amongst the oldest participants, 31 years and 25 years respectively. Again, this suggests that age is an important factor in the acquisition of plurals.

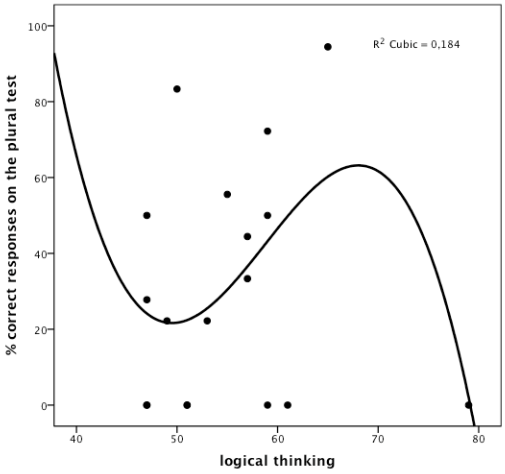


Diagram 17: % of correct responses on the plural test per participant by logical thinking.

The next subcomponent of IQ, working memory, correlated with correct and omitted responses on the plural test. Chapter 8.1.7 in the appendix and the diagrams below show the relation between all responses and working memory.

Throughout the whole range of working memory scores (50-78), there were few participants who gave no response or an unintelligible response. However, one participant with a working memory of 56 stands out. He has already been mentioned in the presentation of results on IQ and language comprehension; it was an 11 year old boy who showed relatively more omissions and errors, and less correct responses than would be expected based on his IQ and language comprehension. Here again, he showed more unintelligible responses than would be expected based on his working memory.

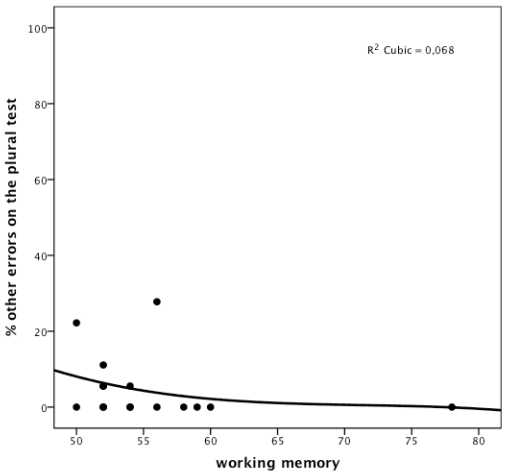


Diagram 18: % of other errors on the plural test per participant by working memory.

Regarding omissions, there was a clear relation; omissions decreased as working memory increased. This correlation was also significant, r_s=-.60, p=-.014.

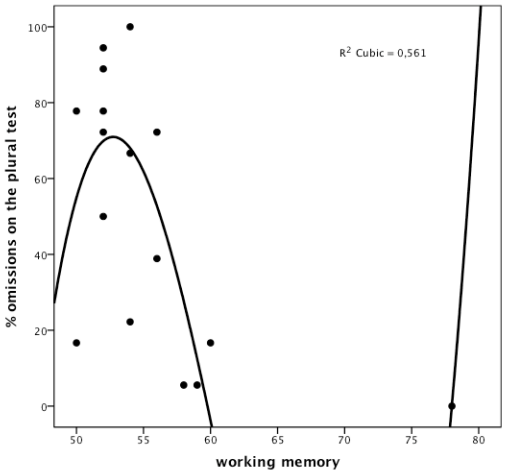


Diagram 19: % of omissions on the plural test per participant by working memory.

As concerns erroneous plurals, it can be noted that the error rate decreases with increasing working memory. However, one participant with a working memory score of 59 stands out; he had an error rate of 44.4% and this is higher than would be expected based on his working memory. It has to be mentioned, however, that he was 12 years old, and as such considerably younger than the participants with a comparable working memory and comparable plural test scores (WM: 58 was 31 years; WM: 60 was 22 years).

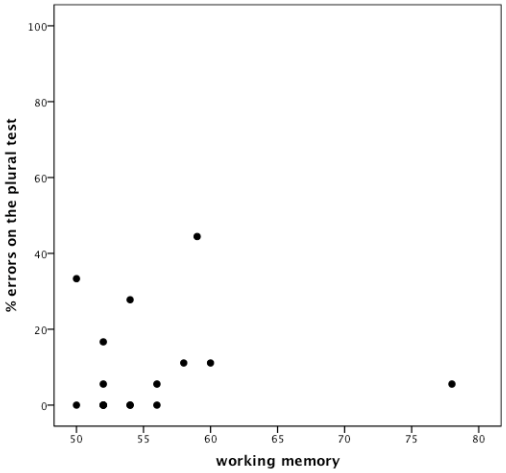


Diagram 20: % of errors on the plural test per participant by working memory.

Finally, concerning correct plural forms, a significant correlation could be noticed; as working memory increased, correct plural forms increased. However, two participants were noticeable. Again, the participant with a working memory of 56 showed fewer correct plurals than would be expected based on his working memory. In contrast, the participant with a working memory of 60 showed more correct responses than would be expected based on his working memory. Again, this could be due to age; the first participant was only 11 years old, while the second participant was 31.

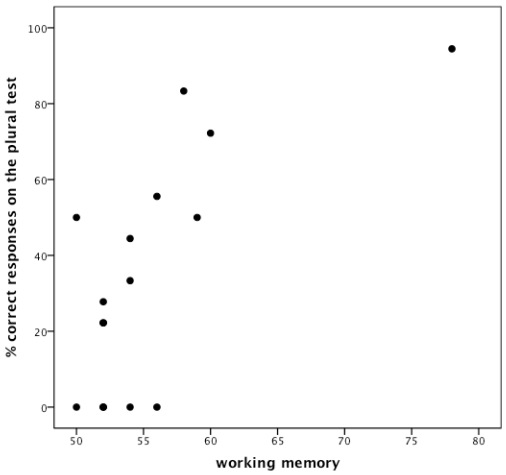


Diagram 21: % of correct responses on the plural test per participant by working memory.

The final IQ measure, processing speed, did not correlate with responses on the plural test, as reported in Chapter 8.1.8 in the appendix. However, some trends can be noticed.

Throughout the whole range of scores on processing speed (50-78), there were few participants who gave no answer or an unintelligible answer.

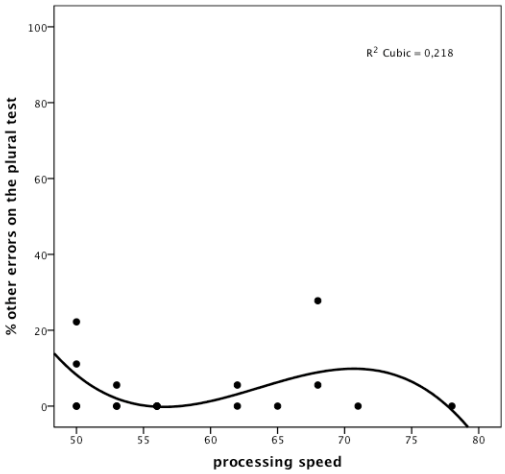


Diagram 22: % of other errors on the plural test per participant by processing speed.

As to omissions, a general trend can be noted; as processing speed increased, omissions of plural markers decreased.

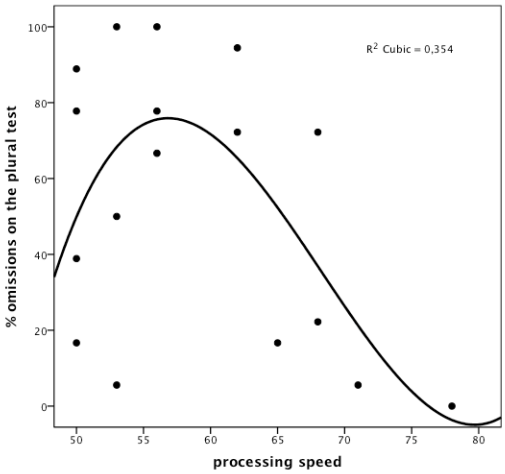


Diagram 23: % of omissions on the plural test per participant by processing speed.

Regarding erroneous plural forms, they remain below 45%, except for one participant with a processing speed of 71, who showed 44.4% of erroneous plural forms, which was more than expected based on his processing speed. This 12 year old participant has already been mentioned in the presentation of results on working memory. There he also had the highest number of errors. The data here suggest once more that age may influence the result; two participants with a relatively comparable processing speed (78, 65) and a comparably low amount of other errors and omissions, were both older, namely 22 and 25 respectively.

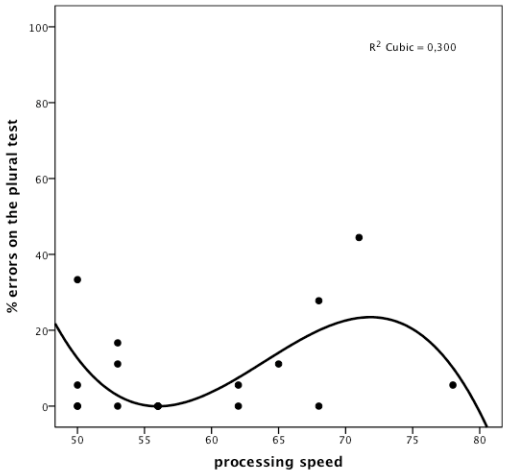


Diagram 24: % of errors on the plural test per participant by processing speed.

Concerning correct plurals, an upward trend could be noticed; as processing speed increased, correct plurals increased. However, three participants showed a lower rate of correct plurals than would be expected based on their processing speed. These were two participants with a processing speed of 62 and one with 68. Again, age may have influenced this result, as all three participants were amongst the youngest with 9 and 11 years.

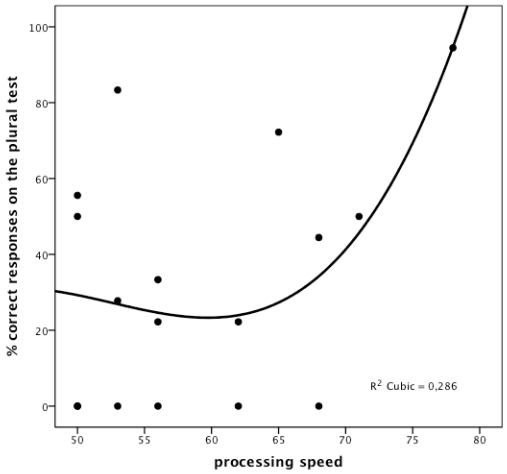


Diagram 25: % of correct responses on the plural test per participant by processing speed.

6.2.1.3 Plural test: responses and item characteristics

In Chapter 6.2.1.2 it has been shown that participant characteristics, such as age, language comprehension and working memory may have a significant influence on the responses of the plural test. On the other hand, item characteristics, such as plural marker, item gender, productivity, and frequency did not correlate with responses (correct – error – omission – other error) (see Chapter 8.2.1 in the appendix for full details).

However, for plural markers a trend could be noted for correct responses. As is shown in Chapter 8.2.2 in the appendix and illustrated in the diagram below, participants produced the highest amount of correct responses for U+e plurals (N=28, 49.1%), followed by U+er (N=25, 43.9%), -e (N=21, 36.8%), -s (N=20, 35.1%), -en (N=15, 26.3%) and pure Umlaut plurals (N=13, 22.8%).

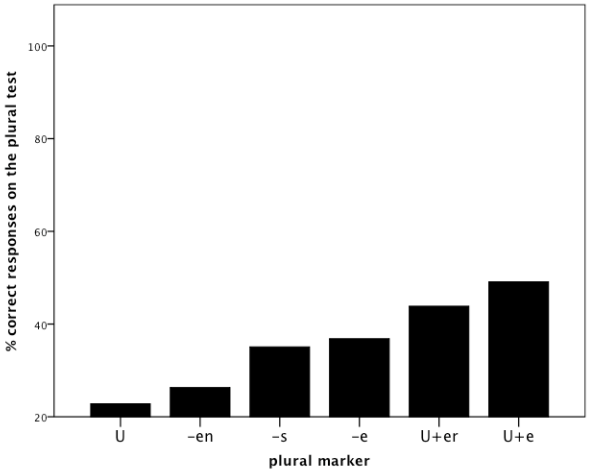


Diagram 26: % of correct responses on the plural test per test item plural marker.

6.2.1.4 Error analysis

Subject analysis: errors

Table 9 lists all participants and the incorrect, but potential plurals they formed. As can be seen 10 out of 19 participants formed 1-10 potential plurals. The remaining 9 do not show any potential or hypercharacterised plurals. This is because they did not yet manage to produce any errors.

As can be seen in the diagram and the table below, each participant shows an individual trend. Particularly striking is participant 4 who produced seven potential plurals using -s marking. He seems to use -s as a default plural marker.

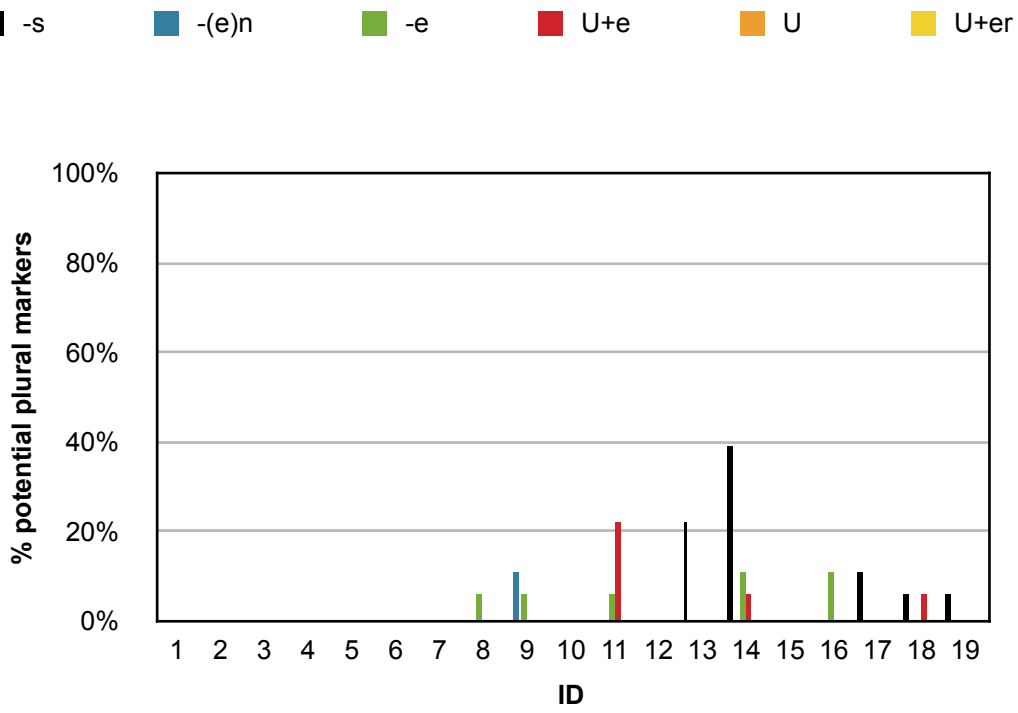


Diagram 27: % of potential plural markers per participant.

	INCORRECT BUT POTENTIAL PLURAL FORMS						
	-s	-e(n)	-e	U+e	U	U+er	Total
ID							N=0
1							N=0
2							N=0
3							N=0
4							N=0
5							N=0
6							N=0
7							N=0
8			Hute N=1, 100%				N=1
9		Manteln, Nageln N=2, 66.7%	Bube N=1, 33.3%				N=3
10							N=0
11			Bette N=1, 20%	Büsse, Bübe, Klöe, Clöwne N=4, 80%			N=5
12							N=0
13	Hammers, Nagels, Pullovers, Messers N=4, 100%						N=4
14	Tigers, Pullovers, Messers, Uhrs, Hammers, Mantels, Nagels N=7, 70%		Bette, Hute N=2, 20%	Büsse N=1,10%			N=10
15							N=0
16			Uhre, Bette N=2, 100%				N=2
17	Uhrs, Kuhs N=2, 100%						N=2
18	Pullovers N=1, 50%			Büsse N=1, 50%			N=2
19	Pullovers N=1, 100%						N=1

Table 9: Incorrect, but productive plural forms per participant.

	HYPERCHARACTERISED PLURAL FORMS	Total
ID		
1		N=0
2		N=0
3		N=0
4		N=0
5		N=0
6		N=0
7		N=0
8		N=0
9		N=0
10		N=0
11		N=0
12		N=0
13	Bettsn, Uhres, Schafes, Kühes	N=4
14	Häuserne	N=1
15		N=0
16		N=0
17		N=0
18		N=0
19		N=0

Table 10: Hypercharacterised plural forms per participant.

Item analysis: errors

Table 11 lists all the test items and the incorrect, but potential plural markers that participants attached to them. The diagram below illustrates the percentage of misattachment per plural marker. As can be seen, there was only one plural marker which did not invite misattachment; U+er plural (e.g. *Schneemänn-er* 'snow men'). All other plural markers showed instances of misattachment. They ranged from 14% in -en, 12% in zero and U plurals respectively, 9% in -e plurals, 5% in U+e plurals and 3.5% in -s plurals.

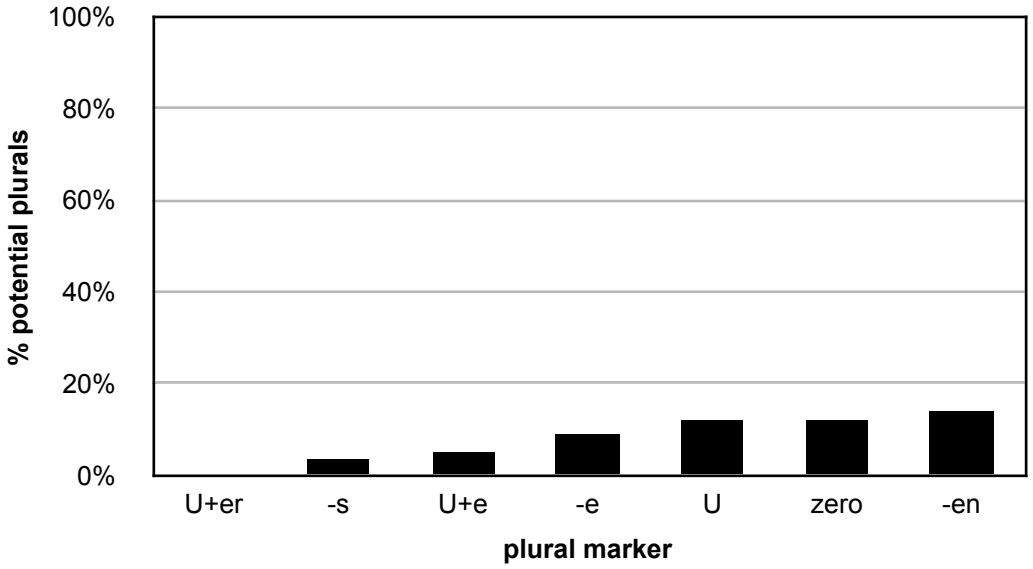


Diagram 28: % of plural markers which were incorrectly formed into potential plural forms.

	INCORRECT BUT POTENTIAL PLURALFORMS					
	-s	**-n**	**-e**	**U+e**	**U**	**U+er**
TESTITEMS						
s-	Clown				Clöwne N=1	
	Klo				Klöe N=1	
	Pizza					
-en	Bett			Bette N=3		
	Bub			Bube N=1	Bübe N=1	
	Uhr	Uhrs N=2		Uhre N=1		
-e	Bus				Büsse N=3	
	Flugzeug					
	Schaf					
U+e	Ball					
	Hut			Hute N=2		
	Kuh	Kuhs N=1				
U	Hammer	Hammers N=2				
	Mantel	Mantels N=1	Manteln N=1			
	Nagel	Nagels N=2	Nageln N=1			
U+er	Haus					
	Schneemann					
	Wurm					
zero	Messer	Messers N=2				
	Pullover	Pullovers N=4				
	Tiger	Tigers N=1				
SUM		**N=15**	**N=2**	**N=7**	**N=6**	

Table 11: Incorrect, but potential plural markers per test item.

The diagram below illustrates the data from another angle. It shows how likely a plural marker is chosen to form an incorrect, but potential plural. As can be seen, -s attachment was preferred in 46.9% of instances. This is followed by 21.9% of -e attachment, 18.8% of U+e attachment, 6.3% -n attachment, and 3.1% of U and U+er attachment respectively. It has to be remembered, however, that there are individual preferences, which are likely to bias this result (see the subject analysis: errors above).

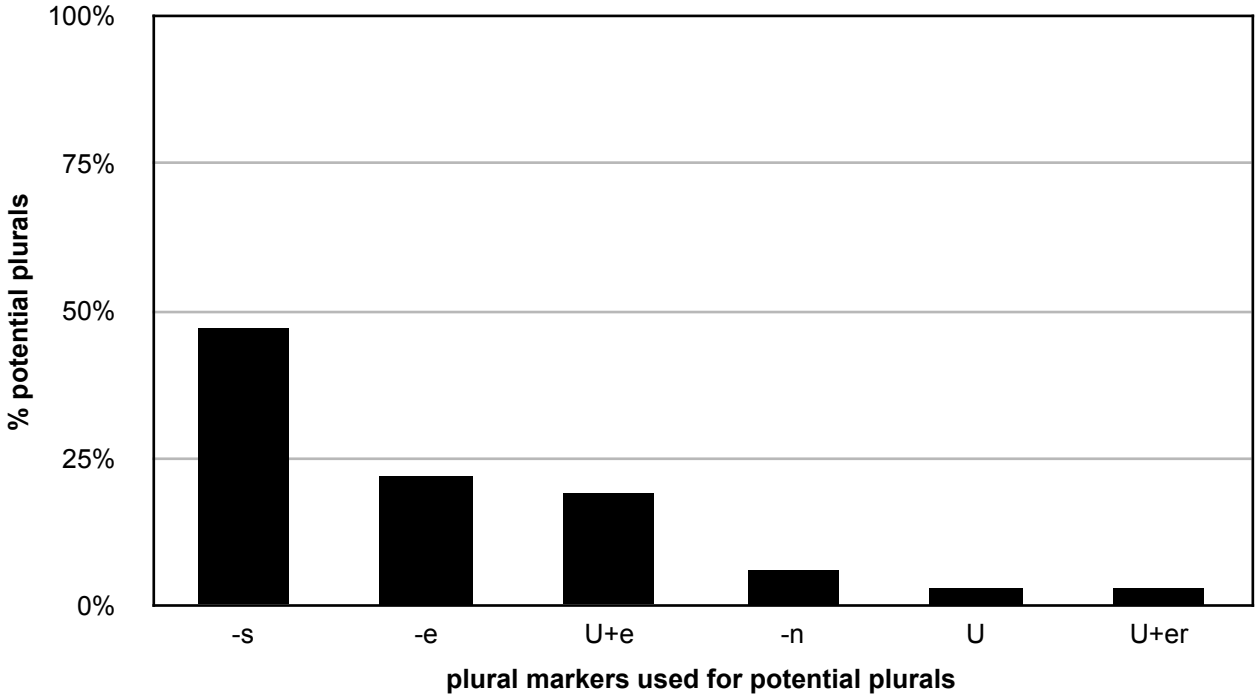


Diagram 29: % of plural markers used for potential plural formation.

Also, there were some instances of hypercharacterised and thus illegal plural forms (N= 5) (see Table 12 below). They account for 2.6% of all errors. Here participants used two plural markers instead of one. Examples include **Schaf-e-s* instead of *Schafe* (pl. 'sheep') and **Küh-e-s* instead of *Kühe* (pl. 'cow'). In these constructions the correct plural marker *-e* was used together with the plural marker *-s.* Another example is **Häus-er-n-e* instead of *Häuser* (pl. 'house') where the correct plural marker *U+er* was used together with the plural marker *-e* and a phonetic connector or third plural marker *-n-*. Also, there were examples of hypercharacterised plurals where none of the two plural markers used, occurs with the given item, as in **Uhr-e-s* instead of *Uhr-en* (pl. *watch/clock) and **Bett-s-n* instead of *Bett-en* (pl. 'bed').

		HYPERCHARACTERISED PLURAL FORMS	Total
PLURALMARKERS			
s-	Clown		
	Klo		
	Pizza		
-en	Bett	Bettsn	N=1
	Bub		
	Uhr	Uhres	N=1
-e	Bus		
	Flugzeug		
	Schaf	Schafes	N=1
U+e	Ball		
	Hut		
	Kuh	Kühes	N=1
U	Hammer		
	Mantel		
	Nagel		
U+er	Haus	Häuserne	N=1
	Schneemann		
	Wurm		
zero	Messer		
	Pullover		
	Tiger		
SUM			**N=5, 100%**

Table 12: Illegal hypercharacterised plural forms.

Finally, there was one instance of a plural which was formed using the non-existing plural marker *-a* in **Uhr-a* (pl. 'watch/clock'). However, this marker might be an a-schwa and stand for the -er plural. So, in general it can be said that participants hardly ever attached non-existing plural markers, but work with the repertoire that is available in the German language.

6.2.2 Discussion

The present analysis looked at responses on the plural test and correlations that show interrelationships between responses and participant characteristics, as well as responses and item characteristics.

Results showed that **participant characteristics**, in particular age, language comprehension and working memory, significantly influenced responses. In general, it can be said that older participants with a higher language comprehension and a higher working memory, produced less

omissions and more *correct responses* than younger participants with a lower language comprehension and a lower working memory. *Other errors* (no responses or unintelligible responses) and errors were generally low, therefore no significant correlations were found.

Concerning **item characteristics**, such as plural marker, item gender, productivity and frequency, no significant correlations were noted.

However, it was observed that correct plurals showed the following trend: participants produced the highest amount of correct responses for U+e plurals, followed by U+er, -e, -s, -en and pure Umlaut plurals. Except for -e plurals this mirrors Laaha et al.'s (2006) results for typically developing children, where participants produced the highest number of correct responses for -e plurals, followed by U+e, U+er, -s, (-e)n and pure Umlaut plurals. The worse performance on -e plurals and the higher performance on U+er and U+e plurals in DS may suggest that participants with DS notice double plural marking better and thus can produce these types of plurals more easily.

Moreover, the present results can be compared to Schaner-Wolles' (1992) results for Down Syndrome children. Schaner-Wolles did not analyse Umlaut plurals together with non-Umlaut plurals. So, an overall trend cannot be estimated. However, it can be said that within non-Umlaut plurals, DS participants performed better for -e plurals than for -s plurals. The same pattern was noted in the present data. Furthermore, Schaner-Wolles‘ DS participants showed more correct responses for U+e and U+er plurals than for pure Umlaut plurals. This is also supported by the present data.

But the present results also differ from previous research. Laaha et al. (2006) found a significant main effect of productivity. This could not be noticed in the present study. However, the present thesis does not wish to suggest that productivity has no influence on plural acquisition/production. First, it has to be remembered that Laaha et al. used a longer test with twice as many items. A test that long was avoided for the present group of subjects, because of a limited attention span. Second, Laaha et al.'s participants were more homogenous as regards the age factor (2 years 6 months-6 years). As has already been discussed, age is an important variable. Thus, future studies should aim to exclude this distractor variable.

As regards the **error analysis**, it is interesting to note that errors were mainly potential plural forms, that is productive plural forms.

6.3 Past participle test

6.3.1 Statistical analysis

6.3.1.1 Past participle test: overview of responses

In general, participants mostly omitted past participles (42.6%). That is, they either responded using a non-finite or present tense verb form, or omitted the verb all together. Omissions were followed by correct responses, which amount to 35.8% of all responses. The third lowest response category were type 2 errors, which reached 20%. Thus, one fifth of all responses were correct past participles of verbs other than the test items. Finally, the lowest response category were type 1 errors. They only occurred 1.6% of the time. So, when a participant tried to form a past participle out of the test item, he/she mostly succeeded.

response	number	percent
correct	N=136	35.8%
error type 1 (=testitem PP error)	N=6	1.6%
error type 2 (=other Verb PP correct)	N=76	20%
omission (=NP, infinitive)	N=162	42.6%
total	N=380	100%

6.3.1.2 Past participle test: responses and participant characteristics

As regards results on the past participle test and participant characteristics (see Chapter 9.1.1), the following significances could be noted. First, there was a significant relation between age and the number of omissions, r_s=-.47, p=.044. This indicates that younger participants produced significantly more omissions of past participles than older participants. Second, there was a significant relation between working memory and omissions, r_s=-.61, p=.012, and between working memory and correct responses, r_s=.56, p=.025. Thus, when working memory was low, significantly more omissions and less correct forms of past participles were produced, in contrast to high levels of working memory.

Responses per participant

As can be seen in Chapter 9.1.2 in the appendix and the diagram below, there were individual differences between participants. Seven participants only showed omissions. They did not produce any errors or correct responses. As participants start producing errors, they also start producing correct answers. Gradually, omissions and errors decrease and correct responses increase.

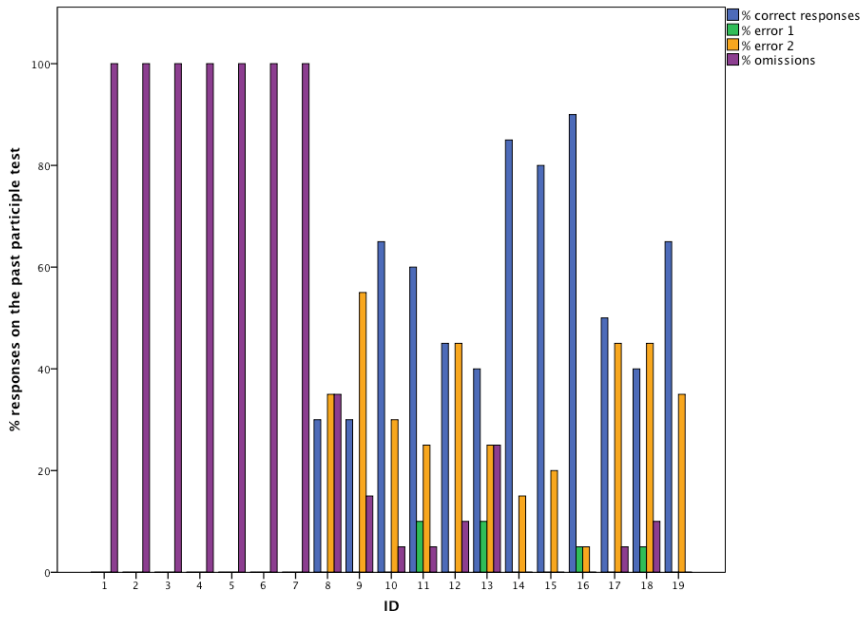


Diagram 30: % of correct responses, error 1, error 2 and omissions on the past participle test per participant.

Responses and age

As reported in Chapter 9.1.1 in the appendix, there was a significant correlation between age and omissions of past participles, r_s=-.47, p=.044. This is illustrated in the diagram below. Here it can be seen that as participants get older, they omit fewer past participles.

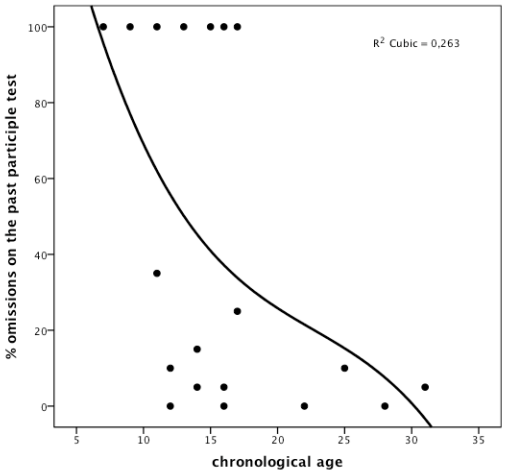


Diagram 31: % of omissions on the past participle test per participant by age.

Other, non-significant trends could be noticed too. The absolute number of Type 2 errors, for example, increase with age. That is, as participants get older, they produced more correct past participle forms of other verbs than the test item. An exception was a female participant aged 22. She produced fewer Type 2 errors than might be expected based on the other participants' results. This is because she had 90% correct responses.

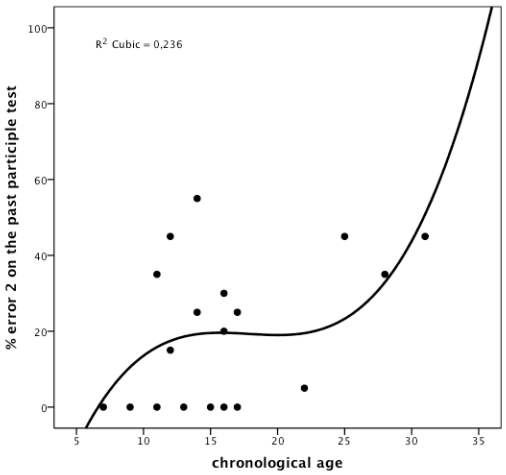


Diagram 32: % of error 2 on the past participle test per participant by chronological age.

Type 1 errors are, as already mentioned, very low and thus did not show a trend.

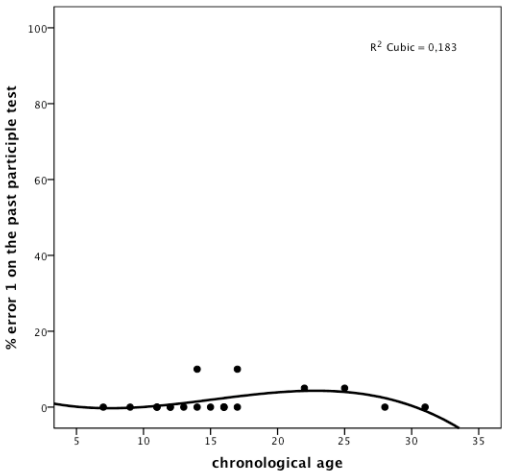


Diagram 33: % of error 1 on the past participle test per participant by chronological age.

Correct responses, again increase with age. Again the aforementioned female participant aged 22 stands out in that she produced the highest number of correct past participles. The high number of correct past participles might be explained by the fact that she had the third highest language comprehension (65) and the second highest working memory (60). This might indicate that other factors, such as language comprehension and working memory, together with age influence the acquisition/production of past participles.

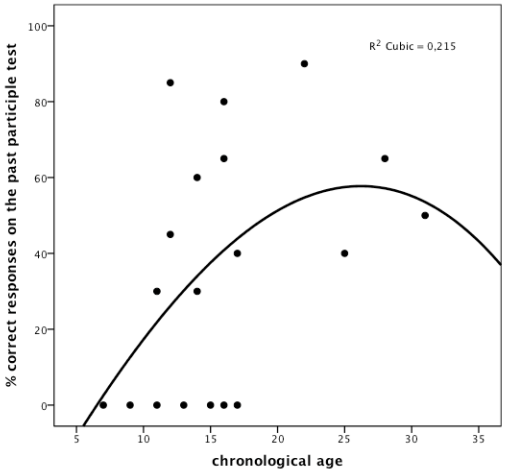


Diagram 34: % of correct responses on the past participle test per participant by chronological age.

Responses and IQ

There was no significant correlation between general IQ and responses. However, with IQ the same trends can be noted as for age. Omissions of past participles decrease with increasing IQ. However, two participants stand out, as they show a higher percentage of omissions than would be expected based on their IQ alone. These were our youngest participants, a girl with an IQ of 51. She was 9 years old, and a male participant with an IQ of 58. He was 11 years old. As with their results on the plural test, this suggests an interdependence between age and IQ.

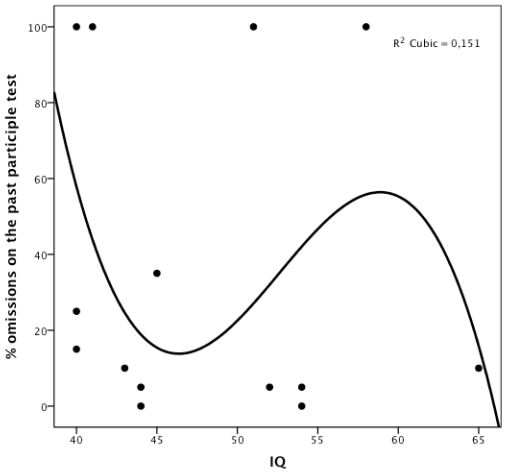


Diagram 35: % of omissions on the past participle test per participant by IQ.

Type 2 errors (correct past participles of other verbs) increase with increasing IQ. Again, the two previously mentioned young participants stand out, as they did not manage to produce any type of errors.

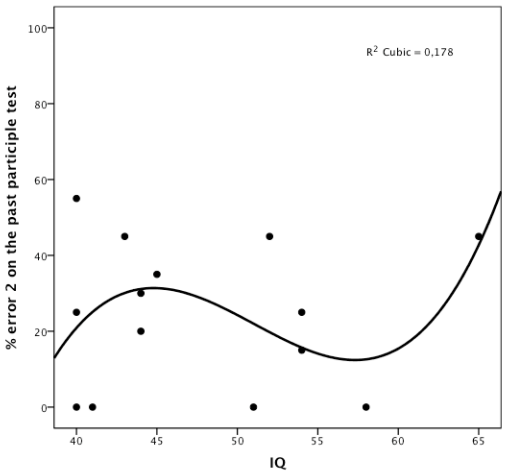


Diagram 36: % of error 2 on the past participle test per participant by IQ.

Type 1 errors (erroneous past participle forms of test items) are generally very low. They range between 0 and 2 errors per participant. Therefore, no trend can be seen.

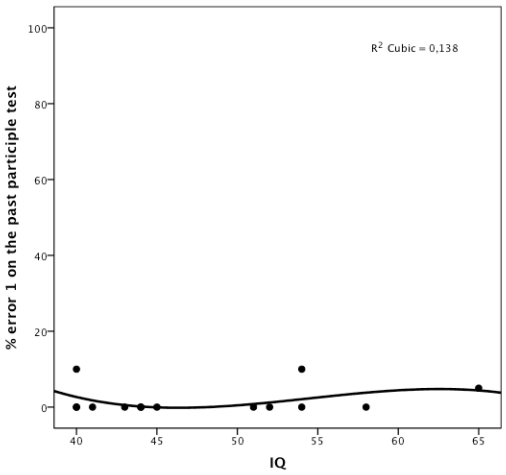


Diagram 37: % of error 1 on the past participle test per participant by IQ.

Correct responses also increase with increasing IQ. Once more, the previously mentioned young participants stand out as they do not produce any correct responses, although their IQs would be high enough. This shows again, that IQ may be a factor in responses on the past participle test, but that age is the overriding factor.

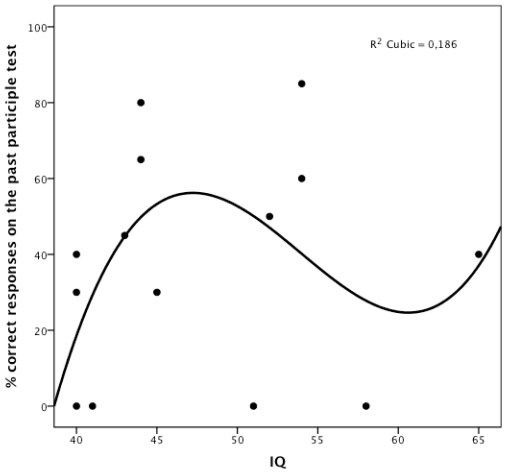


Diagram 38: % of correct responses on the past participle test per participant by IQ.

Taking a closer look at language comprehension, it could be noted that there was no significant correlation between language comprehension and responses. However, various trends could be noted. As is illustrated in the diagrams below, omissions decreased with increasing language comprehension. Here one participant stood out. It was the previously mentioned, 11 year old male participant. He only produced omissions, although his language comprehension was 59 and thus in the middle range.

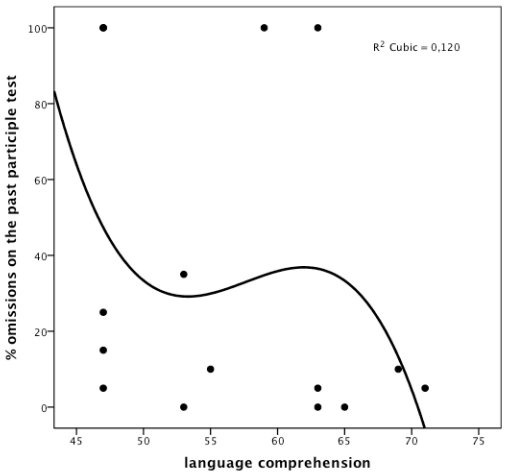


Diagram 39: % of omissions on the past participle test per participant by language comprehension.

Type 2 errors (correct past participles of other verbs) did not show a clear cut trend. They ranged between 0% and 58% of all responses. Two participants stood out. The first participant was the aforementioned 11 year old male participant with a language comprehension of 59. He had a language comprehension score of 59 and produced no errors as he only produced omission. The second participant was a 22 year old female participant with a language comprehension of 65. She showed less errors than might be expected, because she had 90% correct answers.

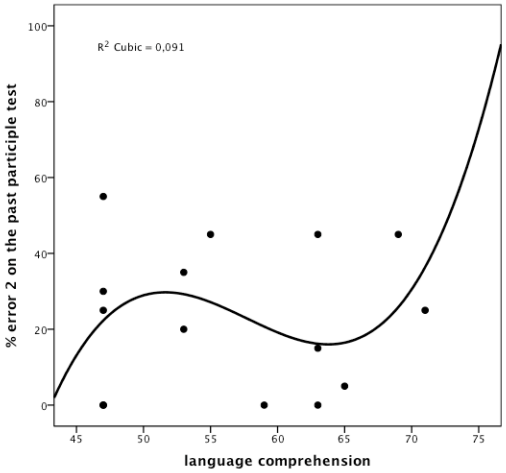


Diagram 40: % of error 2 on the past participle test per participant by language comprehension.

As regards Type 1 errors (erroneous past participles of test items), they were generally very low, between 0%-10% of all responses. They increased with increasing language comprehension.

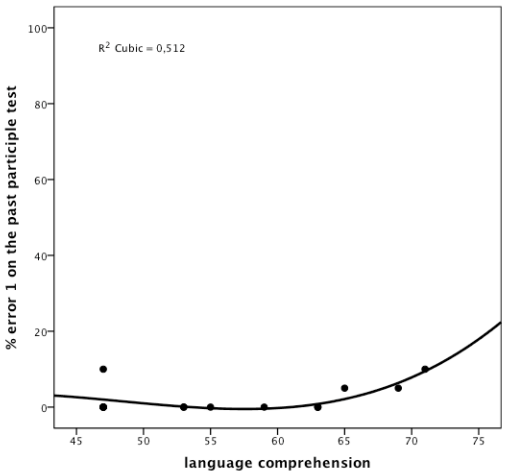


Diagram 41: % of error 1 on the past participle test per participant by language comprehension.

Concerning correct past participles of test items, they increased with increasing language comprehension. However, as already mentioned, the 11 year old male participant with a language comprehension of 59 did not produce any correct past participles.

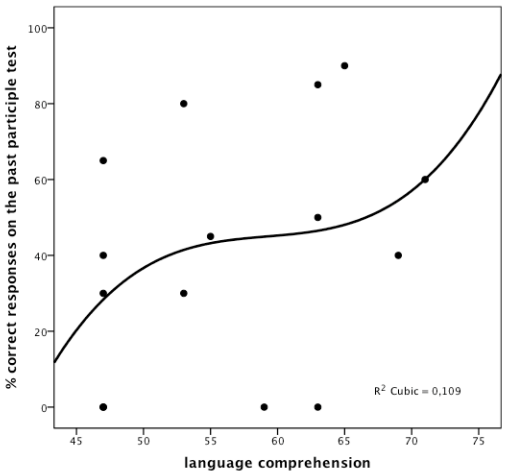


Diagram 42: % of correct responses on the past participle test per participant by language comprehension.

Another subcomponent of IQ was logical thinking. The correlation between responses on the past participle test and logical thinking were not significant. For omissions a downward trend could be noted. That is, participants with higher logical thinking omitted fewer past participle forms. However, the participant with the highest score on logical thinking (=80) distracted the picture. It is the already mentioned 11 year old boy. He showed 100% omissions. This suggests that age is an important variable in the acquisition/production of past participle forms. The importance of age as a factor in acquisition/production was also supported by the results on the plural test.

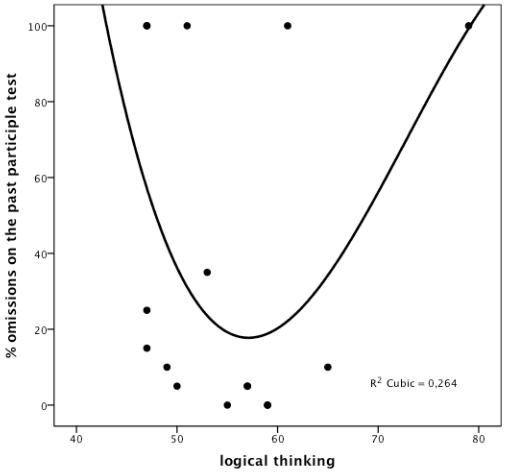


Diagram 43: % of omissions on the past participle test per participant by logical thinking.

Concerning Type 2 errors a downward trend could also be noted. Thus, when logical thinking was higher, less Type 2 errors (correct past participles of other verbs than the test items) were produced. At a logical thinking score of 65 an outlier could be found. It was a 25 year old male participant. He produced 10% other errors, 45% Type 2 errors, 5% Type 1 errors and 40% correct responses. This might indicate that because of his age and IQ, he understood the test, but did not know the past participle forms of all test items. Thus, he employed a strategy of avoidance resulting in this high percentage of Type 2 errors.

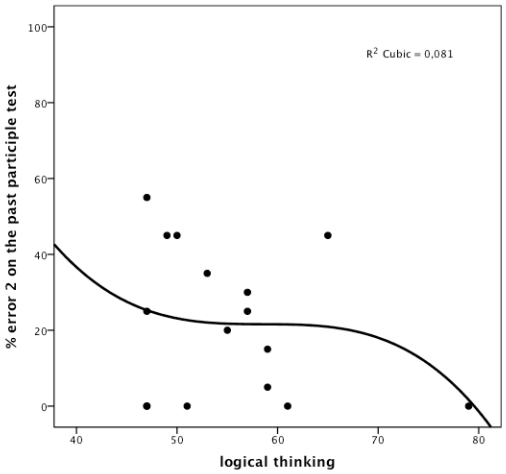


Diagram 44: % of error 2 on the past participle test per participant by logical thinking.

As regards Type 1 errors, they were generally very low. This shows that participants only rarely produced erroneous test item past participles. Instead they rather produced correct past participles of other verbs. Future studies might investigate whether Type 2 errors occurred because of a general avoidance strategy, or because participants did not fully understand the past participle test.

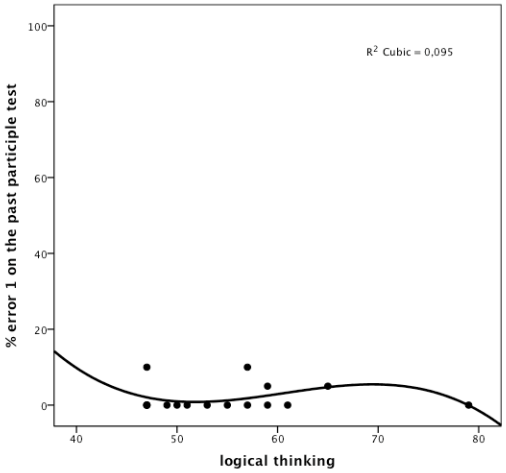


Diagram 45: % of error 1 on the past participle test per participant by logical thinking.

Finally, correct past participles increased with increasing logical thinking. However, as could be seen in the diagram below, the aforementioned 11 year old participant with a logical thinking score of 79 again distracted the results. He did not produce any correct responses and thus is below the expected rate for his logical thinking. Likewise, a nine year old girl with a logical thinking score of 61 biased the results, as she too produced no correct responses. Results of these two participants again indicate that age has an important impact on the production of past participles.

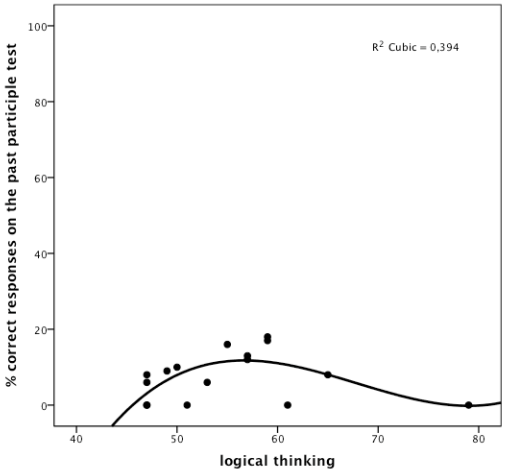


Diagram 46: % of correct responses on the past participle test per participant by logical thinking.

Regarding working memory and responses, it was mentioned that there was a significant relation between working memory and omissions of past participles, r_s= -.61, p=.012. This suggests that omissions of past participles decreased with increasing working memory. However, there was an outlier with a working memory score of 78. He was one of the older participants aged 25. His omission rate was slightly higher (10% of all responses) than might be expected based on the other participants' results.

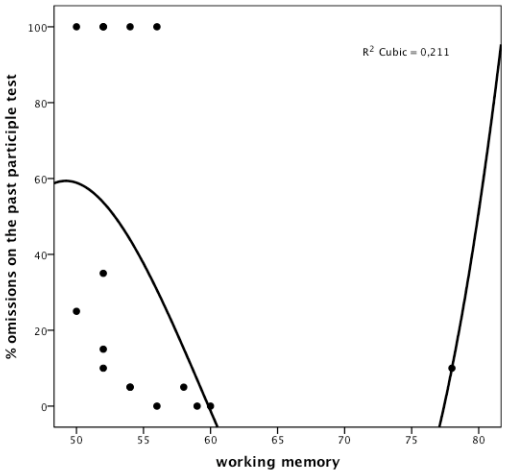


Diagram 47: % of omissions on the past participle test per participant by working memory.

Regarding Type 2 errors (correct past participles of other verbs than the test items), results suggest that these errors increase with an increasing working memory. There was one outlier. One could be found at a working memory of 58. It was a male, 31 year old participant. He showed a higher number of correct past participles of other verbs than the test items. This suggests that age may be interrelated with working memory.

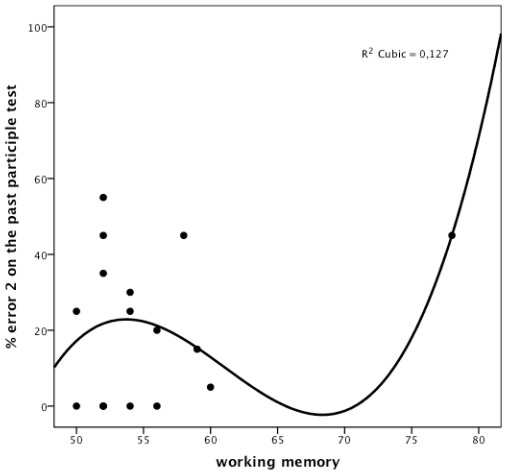


Diagram 48: % of error 2 on the past participle test per participant by working memory.

As concerns the percentage of erroneous past participles of test items, no clear trend can be noticed, as has already been mentioned before.

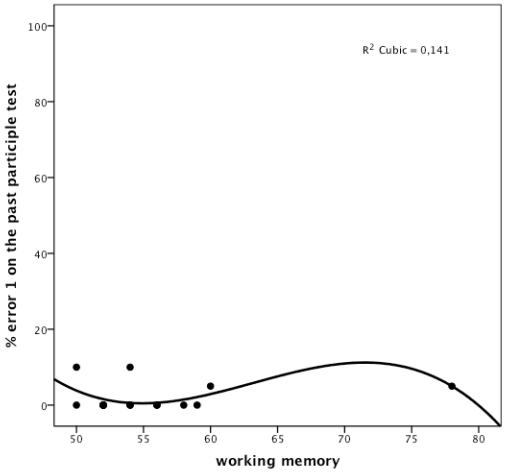


Diagram 49: % of error 1 on the past participle test per participant by working memory.

The percentage of correct past participle forms of other verbs significantly increased with increasing working memory (r_s=.56, p=.025). However, there was one outlier, namely the above mentioned participant with a working memory score of 78, who was aged 25. He produced less correct past participle forms than would be expected based on the other participants' results.

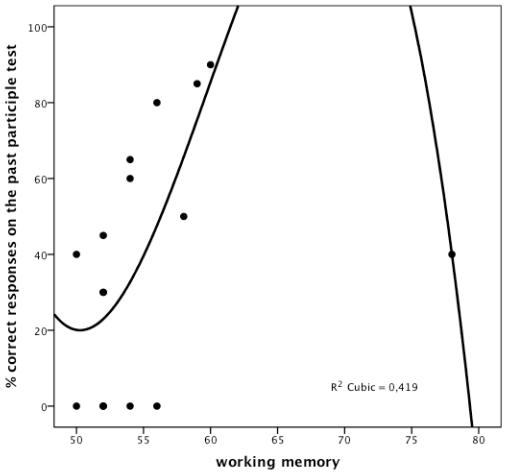


Diagram 50: % of correct responses on the past participle test per participant by working memory.

Next, some trends could be noticed for the relation between responses and processing speed. For example, as processing speed increased, omissions of past participles decreased.

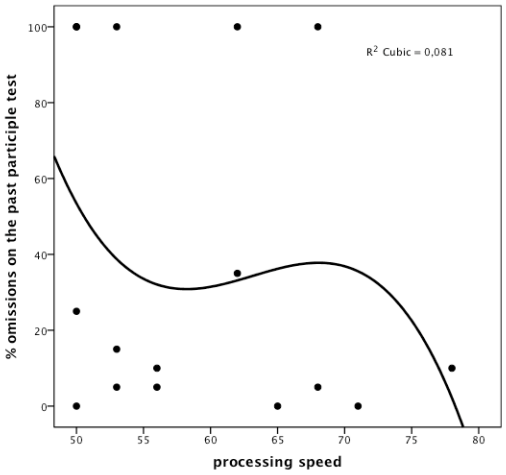


Diagram 51: % of omissions on the past participle test per participant by processing speed.

Similarly, as processing speed increased, correct past participles of other verbs decreased. Again, there was an outlier with a score of 78. It was the before mentioned male participant aged 25. He showed a higher number of correct past participles of other verbs than would be expected when compared with the other participants.

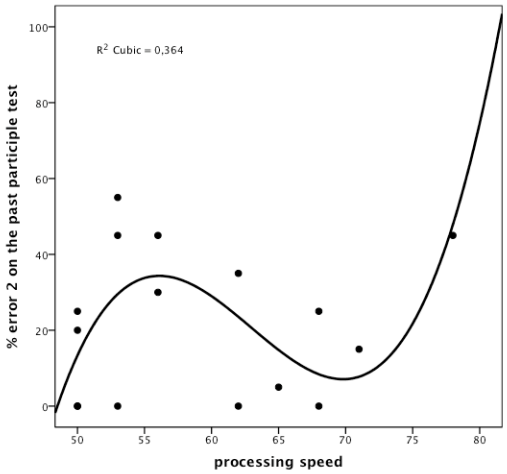


Diagram 52: % of error 2 on the past participle test per participant by processing speed.

As concerns erroneous past participles, no clear trend could be noted, as has already been mentioned.

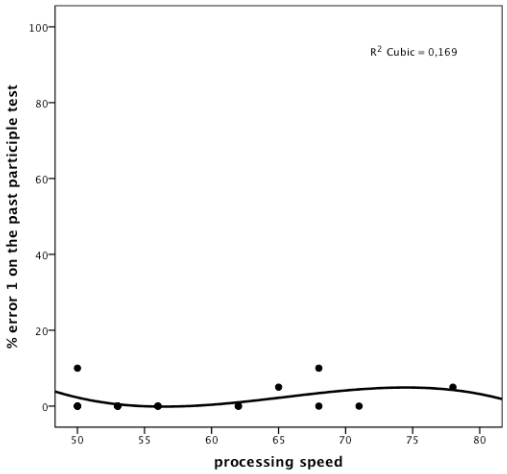


Diagram 53: % of error 1 on the past participle test per participant by processing speed.

Besides, there was a non-significant relation between the percentage of correct past participles and processing speed; as processing speed increased, the percentage of correct past participles increased, again with the exception of the above mentioned outlier who showed a lower percentage of correct past participles than would be expected.

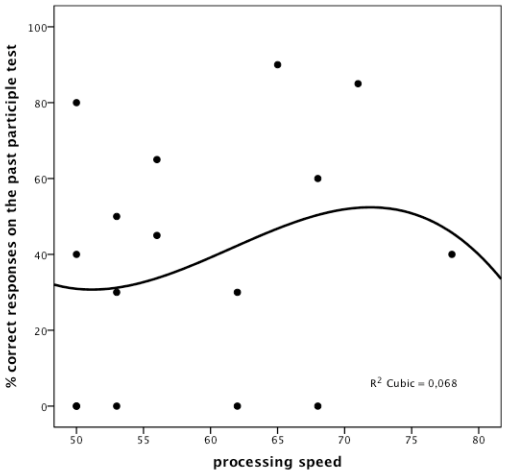


Diagram 54: % of correct responses on the past participle test per participant by processing speed.

6.3.1.3 Past participle test: responses and item characteristics

When comparing item characteristics, such as verb class (strong vs. weak verbs), and frequency, there was no significant correlation. This means that there was no significant difference between responses to strong or weak verbs. However, the percentage of correct forms was higher for strong forms than for weak forms (see the pie diagrams below). Moreover, frequency (including stem frequency, spoken and written frequency of the past participle in the CELEX database) was not significantly related with responses. This suggests that participants' responses were not significantly influenced by test item characteristics.

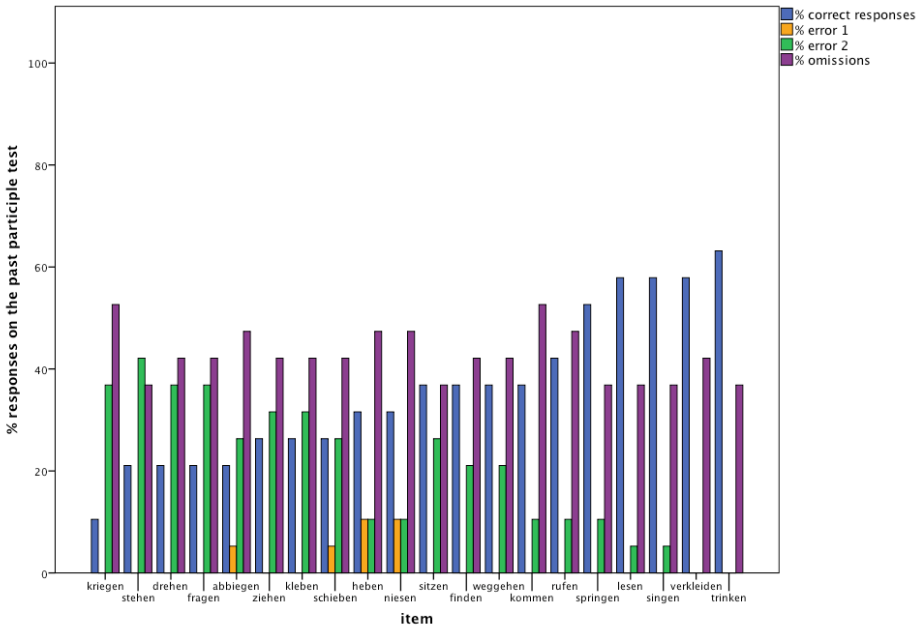


Diagram 55: % of omitted, erroneous and correct past participles per test item.

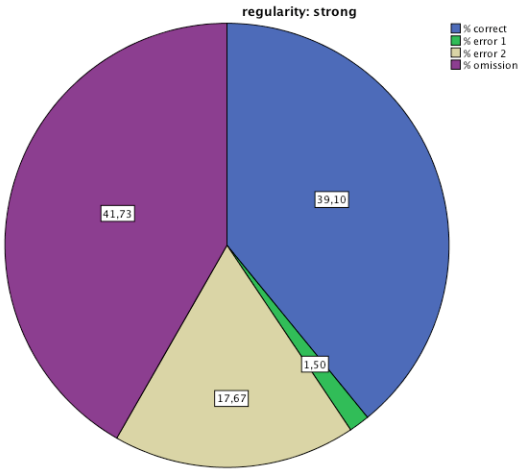


Diagram 56: % of correct responses, error 1, error 2 and omissions of strong test items.

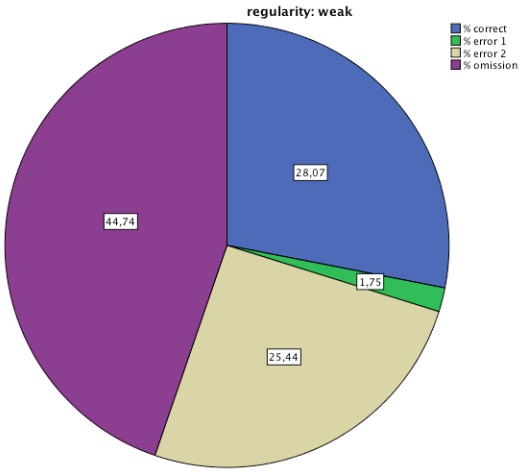


Diagram 57: % of correct responses, error 1, error 2 and omissions of weak test items.

6.3.1.4 Error analysis

Item analysis: errors

As can be seen in Table 13; within omissions, infinitives of test items are rare. Likewise, finite forms of the test items and finite forms of other verbs are rare. On the other hand, infinitives of other verbs and nouns or phrases are more frequent. This indicates that some participants did not understand the test. In particular, it can be noticed that the verb *gehen*, 'to walk' was often used. It is likely that this form was chosen, because the word starts with *ge-*. This is the last syllable in the test sentence. It marked the beginning of the expected past participle (e.g. *Auch gestern ist Hans ge-?*, 'Yesterday Hans has also -ed?'). Concerning nouns and phrases, it seems they were associations to test items (e.g. *liest*, 'reads' → *über a Buch*, 'about a book'). These trends were noticed for both strong and weak forms.

Omissions on the past participle test		**infinitive**	**finite form**	**other infinitive**	**other finite form**	**nouns and phrases**
TESTITEMS						
strong	liest			kleben		über a Buch
						Buch
						Reh
	schiebt				klebt	ge Papier
					fahre	
	sitzt			gehen		ge Stockerl
	singt			gehen		
	hebt			gehen (2)		ge Sessel
						Gewichta
	springt					Schnur gehen
						ge Esse kaufen
	steht		steht	gehen		Bein
						Bein ge Fuß
	kommt		kommt			Hans spät
						Hose
						nach Hause
	biegt ab			gehen	Geh!	Schaf
	findet					Mütze nicht
						Mütze ge Haare nass
	ruft			gehen		ge Schule
	geht weg	gehen (2)		schimpfen		Autobus
	zieht			kleben		
				gehen		
	trinkt			ge gehn		Bär
				gehen		
						Papier

Table 13: Error analysis of omissions on the past participle test: strong forms.

Omissions on the past participle test		infinitive	finite form	other infinitive	other finite form	nouns and phrases
TESTITEMS						
weak	klebt					Uhu
	dreht			schrauben		Papier
						Arbeit
	verkleidet			anziehn		
	kriegt					ge Freunde
						zum
	fragt			gehn	Ge geh!	
	niest			gehn		Schnupfen

Table 14: Error analysis of omissions on the past participle test: weak forms.

Error analysis: type 1 error

In comparison to omissions, Type 1 errors were very rare. They were errors in the past participle form of the test item. As could be seen above, Type 1 errors only occurred with participants who showed 40% correct past participles of test items or more.

		response: type 1 error	number
TESTITEMS			
strong	liest	gelese	N=1
	schiebt	geschieben	N=1
	sitzt		
	singt		
	hebt	gehebt	N=1
		geheben	N=1
	springt		
	steht		
	kommt		
	biegt ab	abgebiegen	N=2
	findet		
	ruft		
	geht weg		
	zieht		
	trinkt		
weak	klebt		
	dreht		
	verkleidet		
	kriegt		
	fragt		
	niest		
SUM			**N=6**

Table 15: Error analysis of type 1 errors on the past participle test.

Error analysis: error type 2

Type 2 errors made up 20% of all responses. These were correct past participle forms, but they were counted as erroneous, because they were past participle forms of other verbs than test items. Per item, regardless if it were a strong or a weak verb, there were between N=1 and N=3 Type 2 errors. There was only one item, *verkleiden* 'dress up' which did not invite Type 2 errors.

		response: error type 2	number
TESTITEMS			
strong	liest	gegessen	N=1
	schiebt	geklaut	N=1
		gefahren	N=3
		gerissen	N=1
		geführt	N=1
	sitzt	gestürzt	N=1
		gefahren	N=1
		gegangen	N=1
		genommen	N=1
		gesprungen	N=1
	singt	gegessen	N=1
	hebt	gehaut	N=1
		gegessen	N=1
	springt	gehüpft,	N=1
		gefangen	N=1
	steht	gehüpft	N=2
		gestürzt	N=1
		gehumpelt	N=1
		gesprungen	N=3
		geflogen	N=1
	kommt	gegangen	N=1
		gefahren	N=1
	biegt ab	abgeholt	N=1
		gegangen	N=2
		gefallen	N=1
		abgegangen	N=1
	findet	gesucht	N=1
		gekauft	N=1
		verloren	N=1
		genommen	N=1
	ruft	gefragt	N=1
		gesprochen	N=1
	geht weg	gelaufen	N=2
		aufgestanden	N=1
		gegangen	N=1
	zieht	geschoben	N=2
		genommen	N=1
		gerissen	N=1
	trinkt	genommen	N=1
SUM			**N=47**

Table 16: Error analysis of type 2 errors on the past participle test: strong forms.

		response: error type 2	number
TESTITEMS			
weak	klebt	gegessen	N=1
		geschmissen	N=1
		gefaltet	N=1
		gerissen	N=1
		gezeichnet	N=1
		geschnitten	N=1
	dreht	getauscht	N=1
		geschraubt	N=3
		gearbeitet	N=1
		genagelt	N=1
		rumgeknallt	N=1
	verkleidet		N=0
	kriegt	gewonnen	N=1
		gekauft	N=1
		geschenkt	N=1
		bekommen	N=3
		gebracht	N=1
		gebastelt	N=1
	fragt	geweint	N=1
		gerufen	N=2
		gefunden	N=1
		gesteckt	N=1
		geschimpft	N=1
		gelaufen	N=1
	niest	gehustet	N=1
SUM			**N=29**

Table 17: Error analysis of type 2 errors on the past participle test: weak forms.

6.3.2 Discussion

Individuals with DS mostly omitted past participle marking and produced infinitives of test items or other words and noun phrases which seemed to be associations to the test item. These omissions were significantly correlated with age and working memory, in that older participants with a higher working memory used less omissions than younger participants with a lower working memory.

After a developmental phase of omissions, individuals started producing errors. As soon as they started producing errors (to be more precise, correct past participle forms of other items), they also started producing some correct forms. Errors of test items were generally very low. They occured in individuals who showed 40% or more correct responses.

Participants' characteristics (i.e. age and IQ) did but rarely correlate with responses. As already mentioned, omissions correlated with age and working memory. Apart from that numerous trends could be noted, which indicated that omissions decreased with increasing IQ, type 2 errors (correct past participles of other word items) increased with increasing IQ, type 1 errors were very low, and correct responses increased with increasing IQ.

Item characteristics, such as regularity (i.e. strong vs. weak inflection), frequency, or productivity did not correlate with performance on the past participle test (i.e. correct – error – omission).

The **error analysis** revealed that there was a higher percentage of errors for weak (=productive) than strong (unproductive) past participle test items. Because of the lower number of participants no statistically significant differences were obtained between weak (e.g. gefallen (‘fell’)), subregular (e.g. geschoben (‘pushed’), gesessen (‘sat’), gezogen (‘pulled’)), and irregular (e.g. gegangen (‘went’), gestanden (‘stood’)) test items.

6.4 Lexicon (ACDI and picture story)

Participants' vocabulary size was estimated using a variety of measures (see Chapter 5.3.4). These include the vocabulary size questionnaire by Marschik, Vollmann & Einspieler (2004), the *Austrian Communicative Development Inventory (ACDI) 1* and/or *2.* This is the Austrian version of the English-language MacArthur Communicative Development Inventories (Fenson et al. 1994). Furthermore, vocabulary size was estimated by analysing participants' picture story '*Frog Where are You?*' by Mercer Mayer (1969). Lemmata, types and token were counted for each individual participant, and a type-token ratio was calculated. Finally, the total number of utterances per participant was calculated.

6.4.1 Statistical analysis

6.4.1.1 ACDI 1 and ACDI 2

As shown in Chapter 10.1.1 in the appendix, ACDI raw scores for 14 participants were available. For the ACDI 1 they ranged between 193-687 (M=521, SD=197) out of 688 test items, and for the ACDI 2 they ranged between 391-698 (M=624, SD=103) out of 698 test items. These results could not be compared against typically developing Austrian German speaking children, as the test has not been standardised up to the date of printing of the present thesis.

6.4.1.2 Types, token, type-token ratio

Additionally, a type-token analysis of participants' picture stories was carried out. The results are summarised in Chapter 10.1.2 in the appendix. The total number of words (token) used for telling a picture story, ranged from 15-556 (M=159, SD=173). Within these, the total number of different words (types) used, ranged from 6-169 (M=60, SD=56).

Next, a type-token ratio was calculated. Usually, the type-token ratio is calculated with the formula: (types * 100)/*n* token. *n* may stand for 100 tokens of text, or 500, 1000, etc. However, in the present sample participants' story telling abilities were very diverging. Therefore, no representative and reliable *n* value could be chosen. So, the type-token ratio was calculated by the formula: (types * 100)/token. The resulting type-token ratio ranged from 18.75-71.79 (M=45, SD=15).

In order to find a reliable measure of vocabulary size, a Spearman's Rho correlation analysis was carried out. It is reported in Chapter 10.2 in the appendix and illustrated in the diagrams below. It can be seen that types and tokens correlated significantly, r_s=.93, p=.000. This shows that the higher the total number of tokens was, the higher the total number of types was and vice versa.

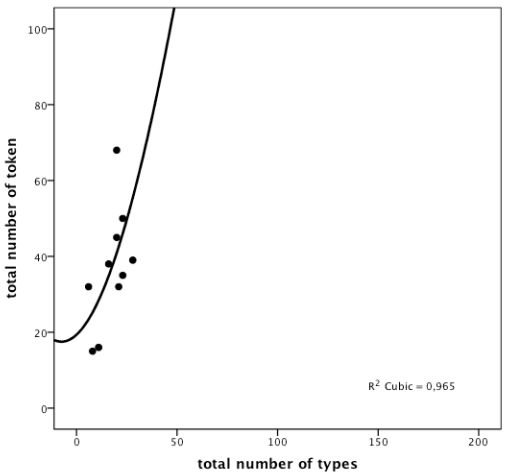


Diagram 58: Total number of token per participant by total number of types.

Also, the total number of tokens used was significantly correlated with the type-token ratio, r_s=-.60, p=.007. As can be seen in the diagram below, this negative correlation demonstrates that the more tokens were used, the lower the type-token ratio was. Two outliers could be noted; these were participants 4 and 7. Both showed a low number of types (N=6, N=20) and tokens (N=32, N=68). In order to have a higher type-token ratio, they would have needed more types. At the same time, they had zero points on the plural and past participle test, which already shows that they have grammar difficulties. Moreover, both participants were unable to complete the language comprehension task for the IQ test (HAWIK-IV, see Chapter 5.3.1).

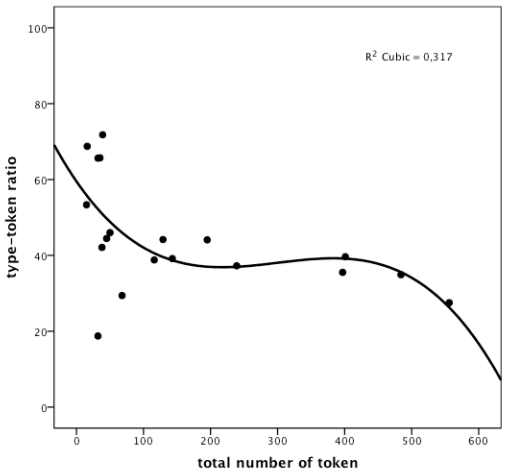


Diagram 59: Type-token ratio per participant by total number of token.

The type-token ratio did not significantly correlate with the total number of types used. Nevertheless, the same trend as for the relation between the type-token ratio and token could be noted (see the diagram below).

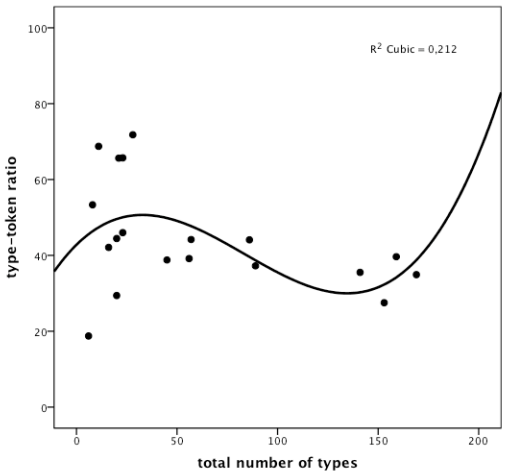


Diagram 60: Type-token ratio per participant by total number of types.

6.4.1.3 Lemmata

As a next step in estimating a reliable measure of vocabulary size, the total number of lemmata used in the picture story was counted. The number ranged from 6-146 (M=53, SD=47). The lemmata were then correlated with the type-token ratio, the total number of types and the total number of tokens (see Table 18). Lemmata showed no significant correlation with the type-token ratio. However, they were significantly correlated with the number of types (r_s=.99, p=.000) and tokens (r_s=.95, p=.000).

Spearman's Rho		LEMMATA
TYPE-TOKEN RATIO	Correlation Coefficient	-.368
	Sig. (2-tailed)	.121
	N	19
types	Correlation Coefficient	**.994****
	Sig. (2-tailed)	**.000**
	N	19
token	Correlation Coefficient	**.948****
	Sig. (2-tailed)	**.000**
	N	19

Table 18: Correlations between the type-token ratio, types, token and lemmata.

6.4.1.4 Total number of utterances

A final lexical measure that was calculated out of participants' picture stories, was the total number of utterances. Results showed that the total number of utterances ranged between 12 and 88 (M=37, SD=23).

6.4.1.5 Overview: lexicon

Chapter 10.2 in the appendix summarises the vocabulary size measures. As can be seen, the number of token, types, lemmata and utterances showed high correlations. For example, there was a significant correlation between the total number of token and the total number of types, r_s=. 93, p=.000. Similarly, there was a significant relation between the total number of lemmata and the total number of types, r_s=.99, p=.000. Moreover, there was a significant correlation between the total number of token and the total number of lemmata, r_s=.95, p=.000. Additionally, there was a significant relationship between the total number of token and the total number of utterances, r_s=. 87, p=.000. Likewise, there was a significant relationship between the total number of lemmata and the total number of utterances, r_s=.75, p=.000. In sum, this suggests that the more different words participants used (token, lemmata), the more morphologically rich they were (types), and vice

versa. Also, the more different words participants used (lemmata, token), the more utterances they produced when telling the picture story.

Furthermore, results showed that the total number of types significantly correlated with the total number of utterances, r_s=.74, p=.000. This indicates that the more morphologically rich participants' speech was, the more utterances they produced, and vice versa.

Finally, there was a significant relationship between the total number of lemmata and the ACDI 2, r_s=.61, p=.048. This shows that both vocabulary size estimates yield similar results for the six participants tested.

As such, types, token, lemmata and utterances will be reported in further analyses. Moreover, the type-token ratio will be included in further analyses. The ACDI 1 and ACDI 2 will not be reported in further analyses as they do not seem to provide a reliable measure for the participants tested here. Moreover, not all participants returned the questionnaire and thus could not be included in an analysis.

6.4.1.6 Lexicon and participants' characteristics (age, IQ)

The analysis of participants' lexicon as used in a picture story showed various significant correlations between the total number of types, token, lemmata, as well as utterances, and participant characteristics such as age, language comprehension and working memory (see Chapter 10.1.3 in the appendix). As such, these results can be compared to the results on the plural and past participle tests, where age, language comprehension and working memory also yielded significant correlations with participants' responses.

To be more precise, there were significant correlations between age and the number of types (r_s=.53, p=.019), age and token (r_s=.63, p=.004), age and lemmata (r_s=.54, p=.018) and age and utterances (r_s=.68, p=.001). These results indicate that older participants produced more words (token), more different words (types) and longer picture stories (total number of utterances) than younger participants.

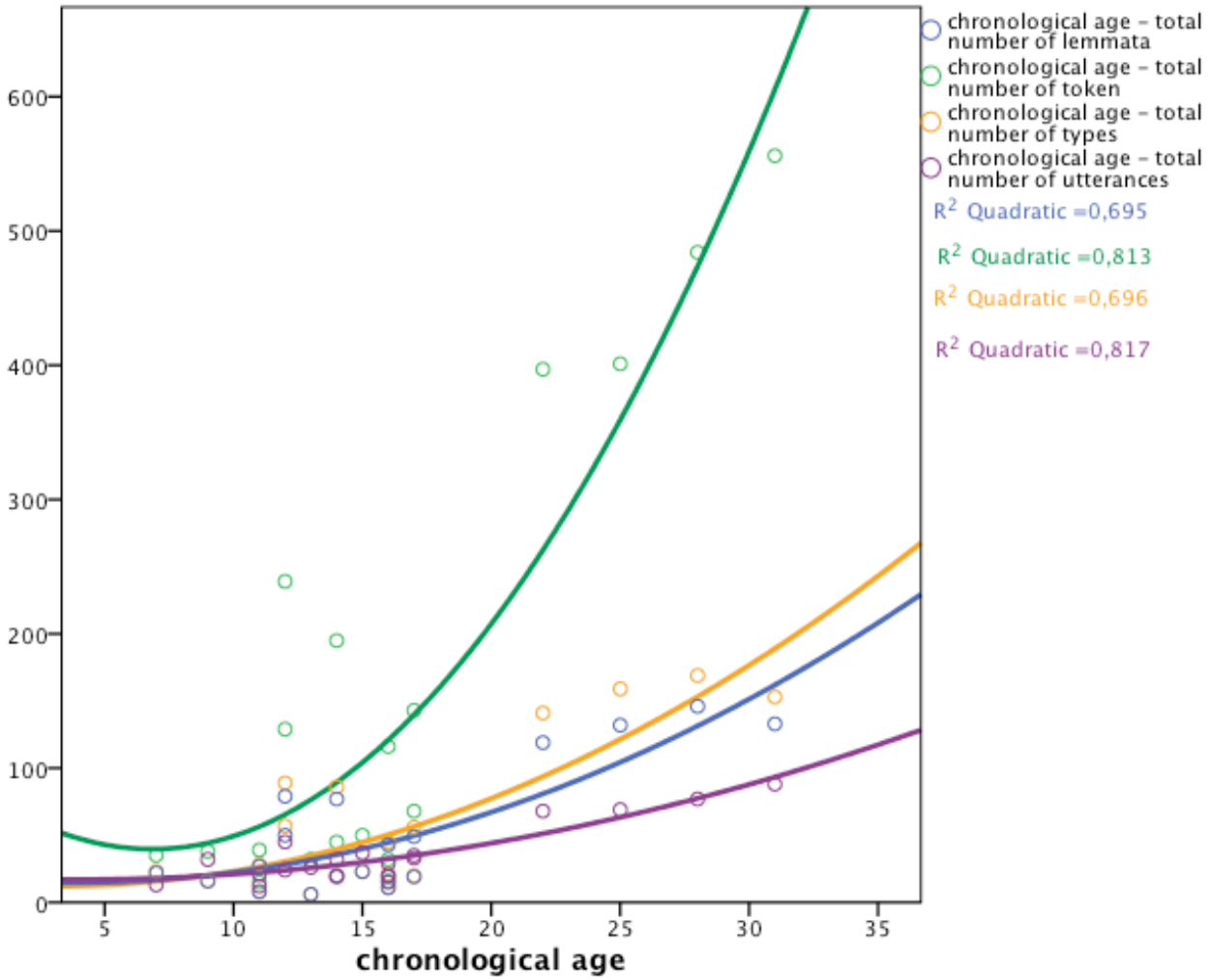


Diagram 61: % of lemmata, token, types and utterances per participant by age.

Furthermore, there were no significant correlations between lexical measures and general IQ. However, significant correlations could be noted between lexical measures and subcomponents of IQ (i.e. language comprehension and working memory). To be more specific, there was a significant correlation between language comprehension and types (r_s=.57, p=.025), token (r_s=.52, p=.046), and lemmata (r_s=.55, p=.034). Moreover the same trend could be noted for language comprehension and utterances. It did not, however, reach significance, r_s=.50, p=.056. These results suggest that participants with a higher language comprehension produced more words, more different words and more utterances when telling pictures stories compared to participants with lower language comprehension.

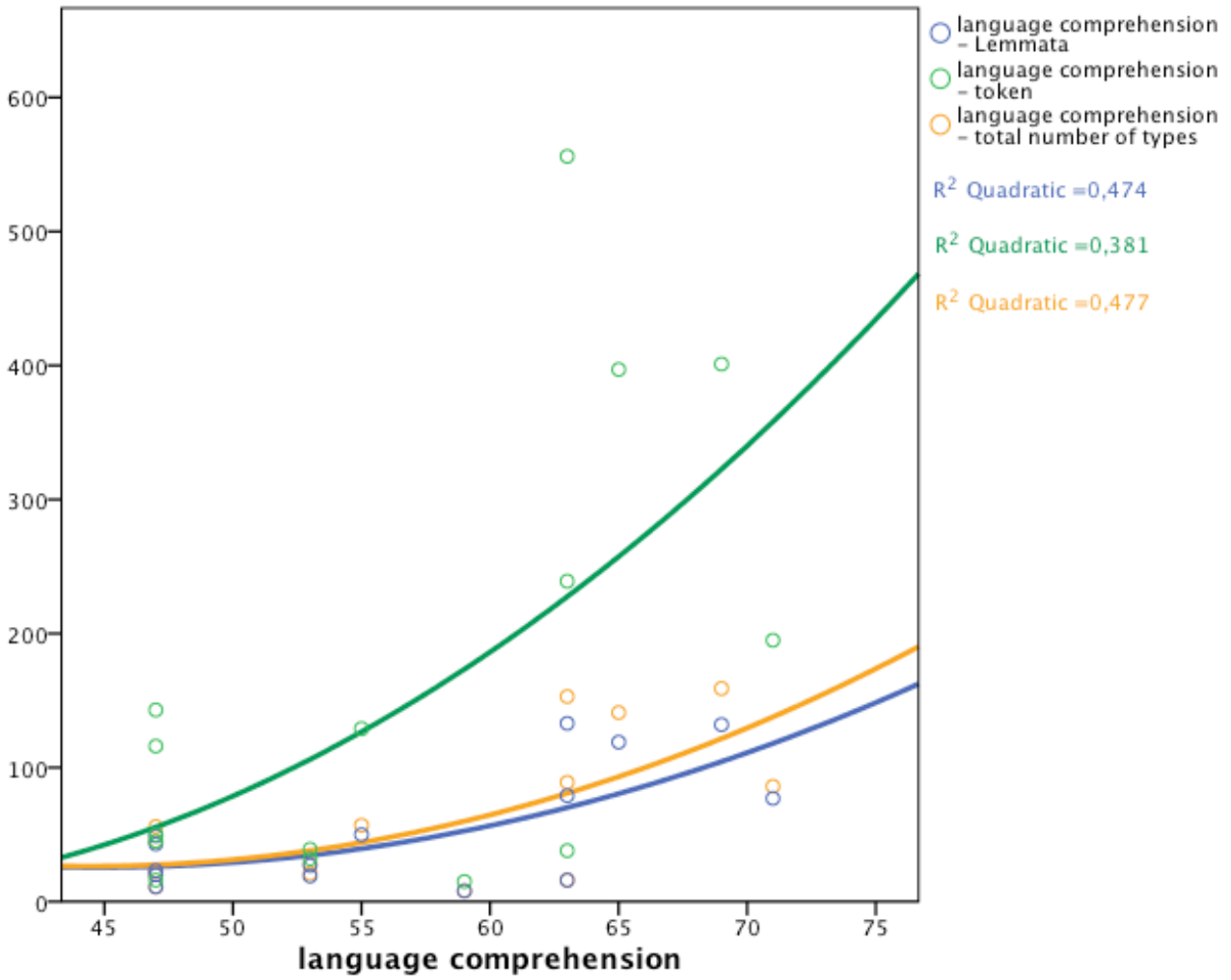


Diagram 62: % of lemma, token, types per participant by language comprehension.

Finally, as concerns working memory, significant correlations were found between working memory and types (r_s=.59, p=.017) token (r_s=.52, p=.038), and lemmata (r_s=.56, p=.025) and utterances (r_s=.54, p=.032). These results show that participants with a higher working memory produced more words (token), more different words (types, lemmata) and more utterances when narrating a picture story than participants with a lower working memory.

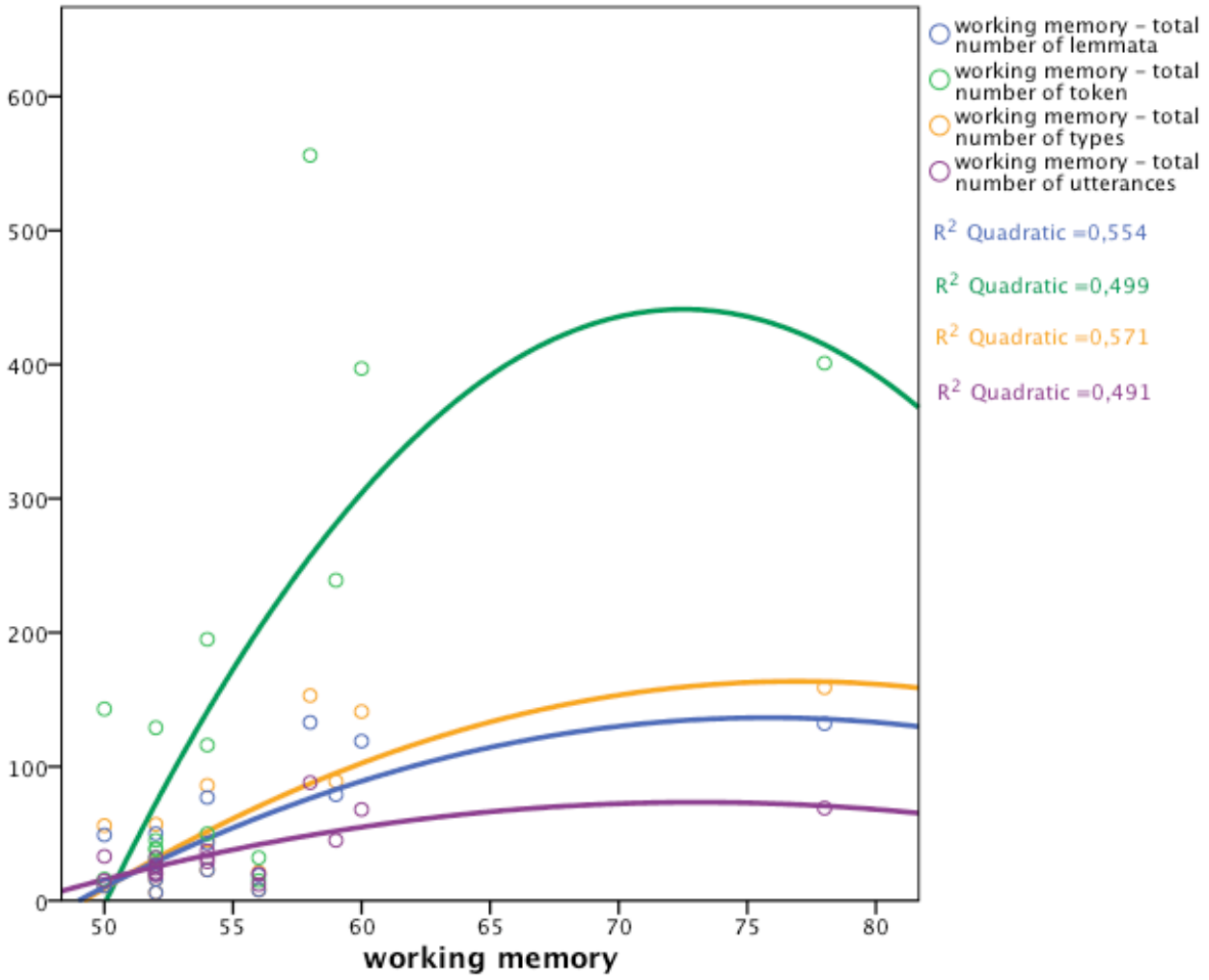


Diagram 63: % of lemmata, token, types, utterances per participant by working memory.

6.5 Story telling task

6.5.1 Statistical analysis

Data analysis was carried out using Spearman's Rho Correlations. A p-value less than 0.05 was considered significant for all tests reported.

6.5.1.1 Group analysis: introducing, maintaining, switching

Remember that the task instruction for this test included a pre-mentioning of the main characters (see Chapter 5.3.6.2). Thus, it is textually correct to introduce them with a definite article + noun. However, a skilled adult narrator would still use the indefinite article + noun.

Introducing

The percentage of referential devices used for introducing the boy, the dog, the frog, the other animals and all characters together, are shown in Chapter 11 in the appendix and illustrated in the diagrams below. Taken together, story characters were mostly introduced by use of an indefinite article + noun (e.g. *ein Hund*, 'a dog') (40%), followed by the incorrect use of a noun only (e.g. *Hund*, 'dog') (37.9%), a definite article + noun (e.g. *der Hund*, 'the dog') (17.9%), an incorrect zero form (e.g. *steckt*, 'is stuck') (3.1%), and a pronoun (*er*, 'he') (1.1%) which is pragmatically wrong.

Looking at the characters separately, however, diverse trends could be noted. As concerns the boy, he was the only character who was predominantly introduced by a definite article + noun (38.9%). This was shortly followed by an indefinite article + noun construction (33.3%). A noun or a zero form were rarely chosen to introduce the boy (11.1% respectively), as was the pronoun *er* ('he') (5.6%).

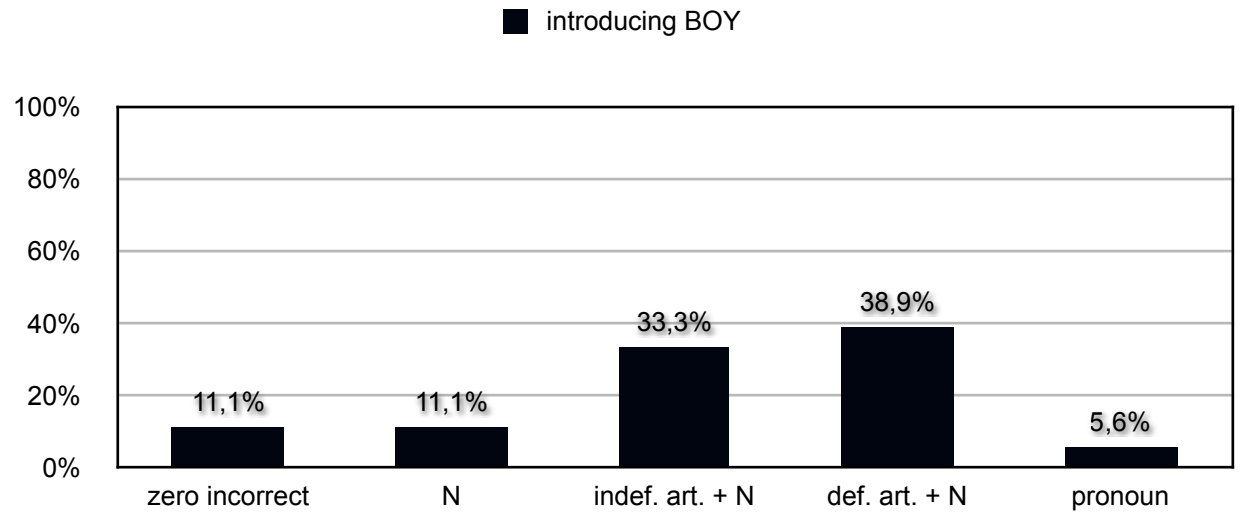


Diagram 64: % of nouns, indefinite articles + nouns, definite articles + nouns, incorrect zero forms and pronouns when introducing the boy.

Contrary to the boy, the dog was mostly introduced by an indefinite article + noun (50%). This was followed by a single noun (31.3%), and only in third place the definite article + noun construction (18.7%). Zero forms or pronouns were never used to introduce the dog.

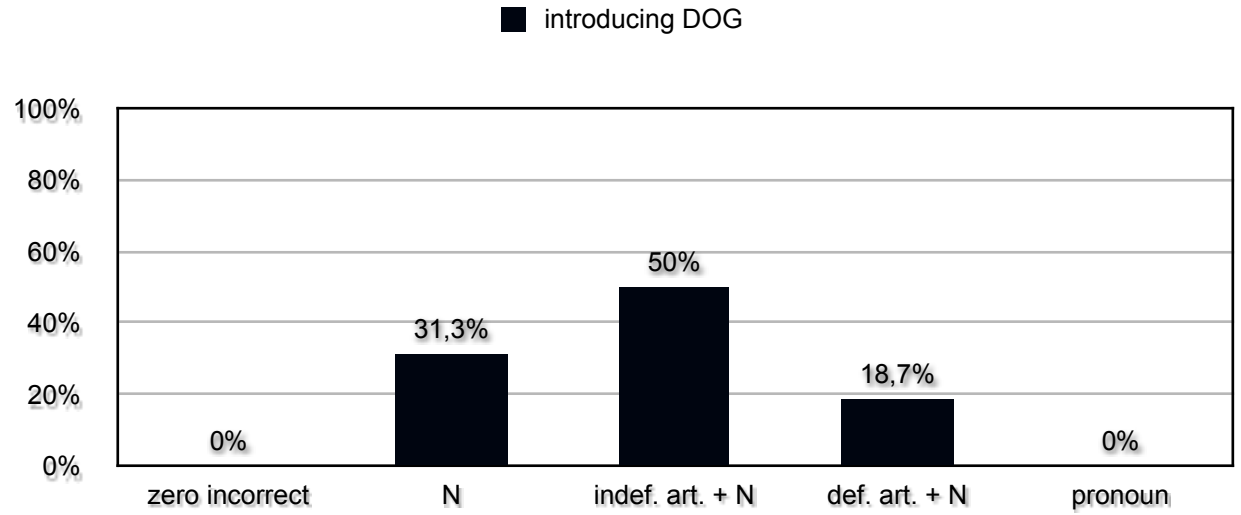


Diagram 65: % of nouns, indefinite articles + nouns, definite articles + nouns, incorrect zero forms and pronouns when introducing the dog.

The frog and the other animals show very similar trends; they were most frequently introduced by a noun only (47.4%, 47.6% respectively). The indefinite article + noun was the second most frequent construction (42.1%, 38.1%). The definite article + noun was seldomly chosen (10.5%, 11.9%). The incorrect zero form was only chosen once (2.4%) for introducing the gopher. The frog was never introduced by a zero form. Moreover, a pronoun was never used to introduce the frog or other animals (e.g. the bees, the deer, the frog family).

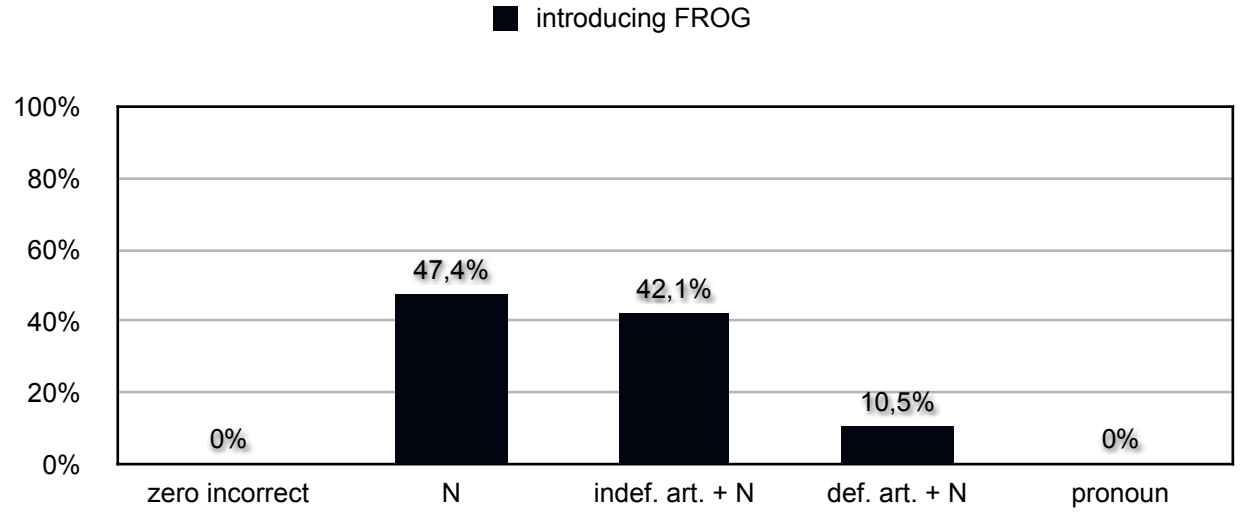


Diagram 66: % of nouns, indefinite articles + nouns, definite articles + nouns, incorrect zero forms and pronouns when introducing the frog.

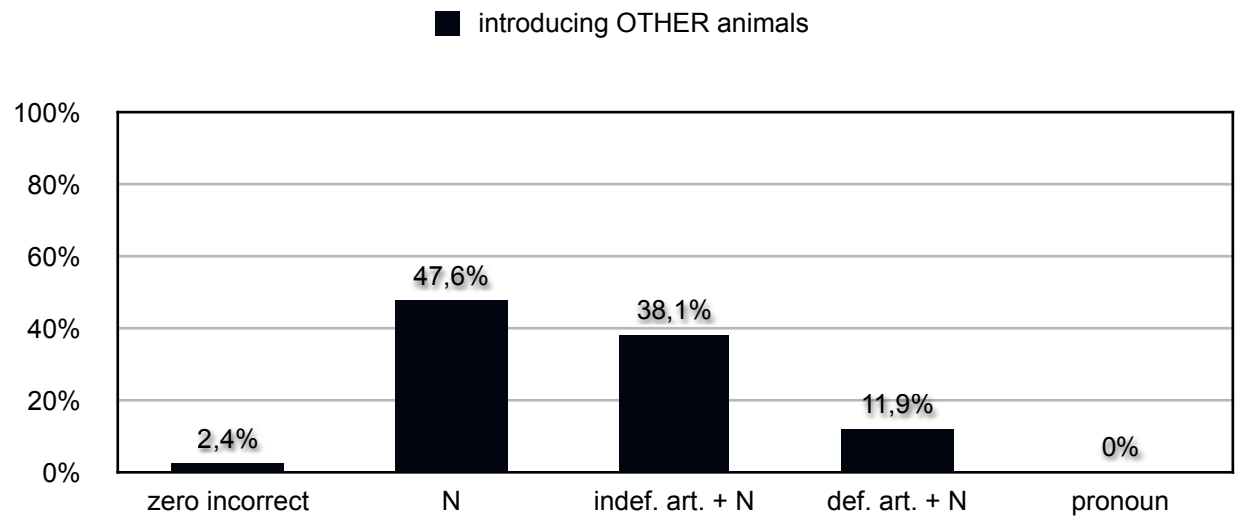


Diagram 67: % of nouns, indefinite articles + nouns, definite articles + nouns, incorrect zero forms and pronouns when introducing the other animals.

Maintaining

When maintaining reference to a character, more instances of reference were observed and thus more types of reference were coded than for introducing characters. In the majority of cases, characters were maintained by the pronoun *er* ('he') (29.5%). However, it has to be stressed, that a considerable number of these cases included references to the boy. Definite article + noun (e.g. *der Bub*, 'the boy') was second most likely to be chosen when maintaining reference (19%). This was followed by correct zero forms (e.g. **Der Bub schaut hinaus und denkt irgendwas nach*. *'The boy looks out and thinks something.') (14%), which were shortly followed by incorrect zero forms (e.g. *Ein Frosch. Nicht.* 'A frog. Not.') (12.8%) and bare nouns (e.g. *Stein, Baum, Frosch.* 'Stone, tree, frog.') (11.5%). The pronoun *der* ('this one') (e.g. **Die Junge is im Wasser und der spielt mit den Fröschen*. '*The boy is in the water and this one is playing with the frogs') was rarely chosen when maintaining reference (6.6%), as was the indefinite article + noun, which is pragmatically incorrect (e.g. **Ein Hund und eine Bub hat einen gläsernen Frosch drinnen und es ist Nacht und ein Bub schläft.* *'A dog and a boy have a glass frog inside and it is night a boy is sleeping.') (4%). The least likely type of reference for maintaining characters was a possessive pronoun. It was only used for the boy (e.g. *Sein Hund Rex und der Bub Martin suchen, wo der Frosch sein könnte*. 'His dog Rex and the boy Martin are searching, where the frog could be.') (2.6%). In this example the boy and the dog were individualised by giving them names.

As reference to specific characters was maintained with distinct types of reference, it is worthwhile looking into each character separately. The boy was most likely to be maintained using the pronoun *er* ('he') (30%). The second most likely type of reference was definite article + noun (18%). This was shortly followed by incorrect zero forms (16.7%), and correct zero forms (13.3%). The pronoun *der* 'this one' was rarely used (8%) as were bare nouns (5.4%), indefinite articles + nouns (4.6%) and possessive pronouns (4%).

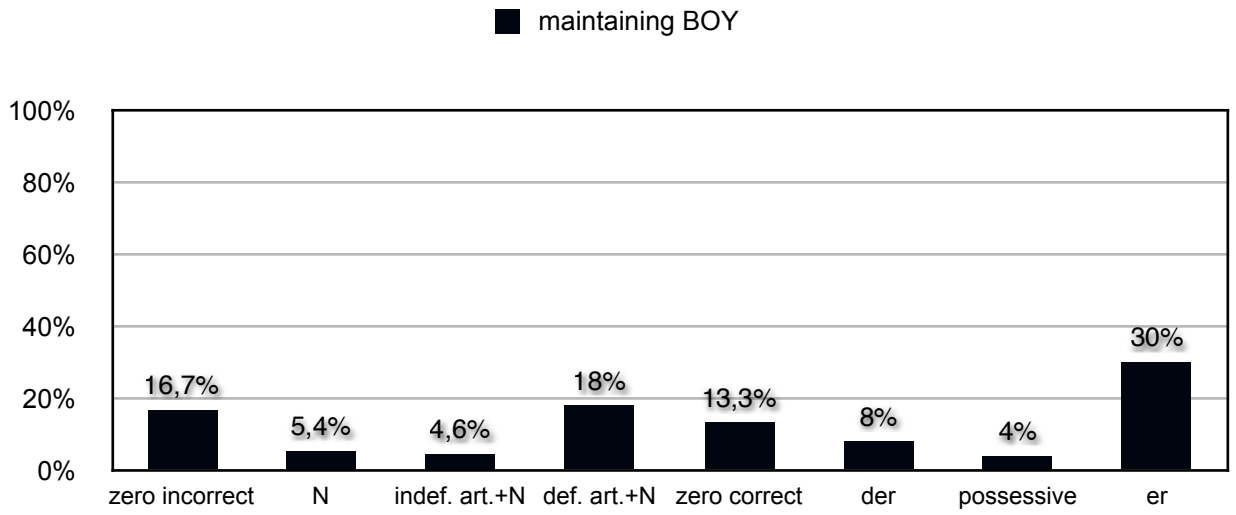


Diagram 68: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when maintaining the boy.

When looking at the dog, it can be noted that it too is most likely maintained by using the pronoun *er* (36.6%). However, the dog is more likely than the boy to be maintained by bare nouns (19.5%) and correct zero forms (19.5%). It is as likely to be maintained by a definite article + noun construction (17.1%) and an indefinite article + noun construction (4.9%). However, it is hardly ever maintained by incorrect zero forms (2.4%) and never maintained by *der* 'this one' or a possessive pronoun.

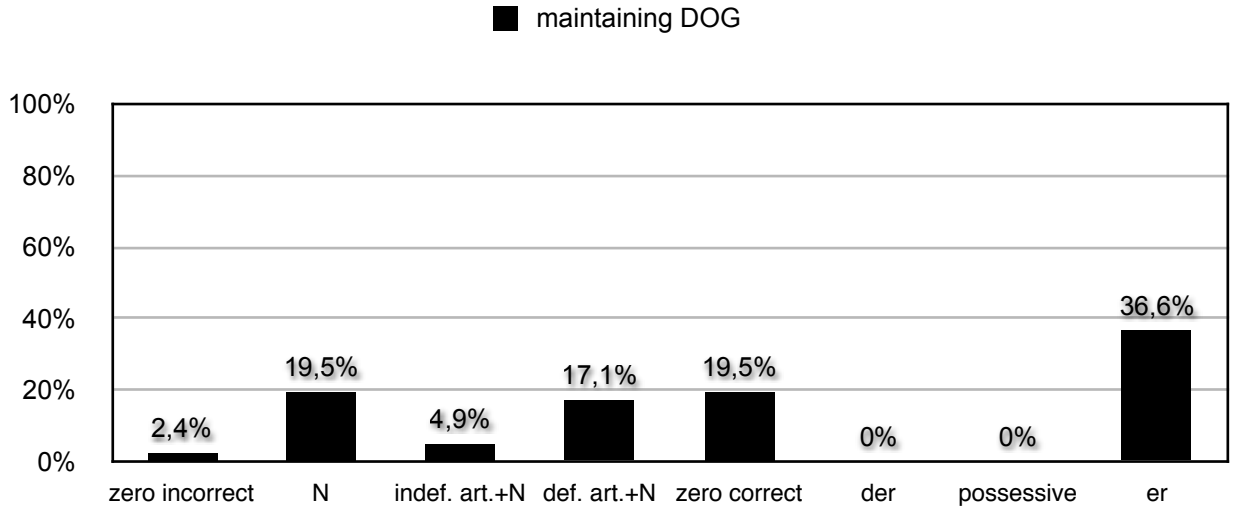


Diagram 69: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when maintaining the dog.

Concerning the frog, a distinct pattern of maintaining devices could be noted. Nouns were predominantly used to talk about the frog in consecutive utterances (42%). These were equally followed by the construction definite article + noun (21.1%) and the pronoun *er* (21.1%). Also, some incorrect zero forms could be noted (10.5%) and one instance of the pronoun *der* 'this one' (5.3%). In line with the referential devices used for the dog, no possessive pronoun was used to maintain reference to the frog. Contrary to the boy and the dog, no instance of a correct zero form or indefinite article + noun could be noticed for the frog.

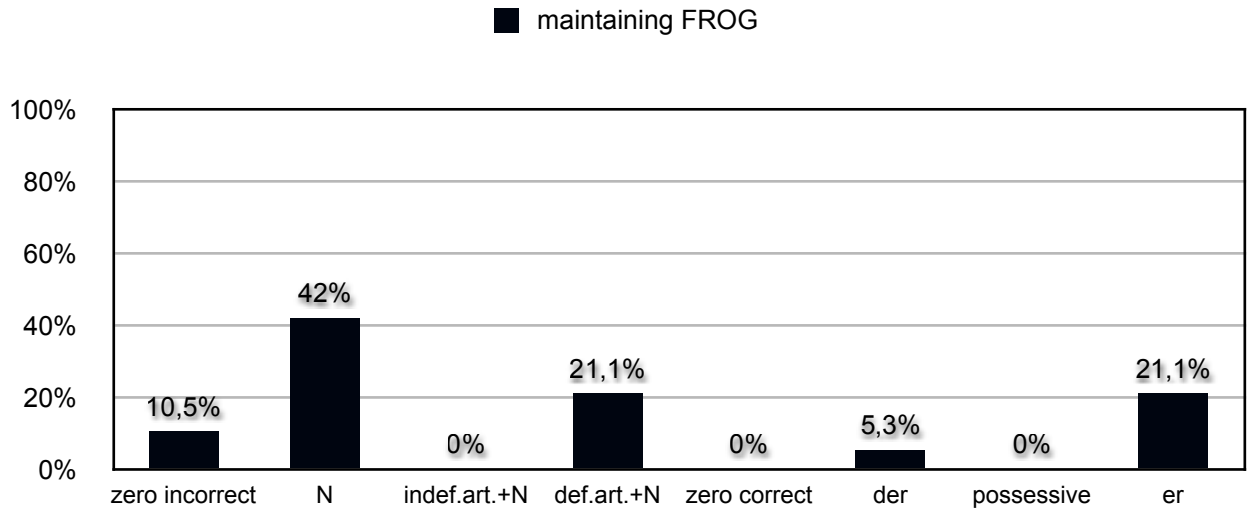


Diagram 70: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when maintaining the frog.

The maintaining devices for the other animals (e.g. the gopher, the bees, …) again showed a distinct pattern of use. So, the other animals showed the highest percentage of definite articles + nouns (29.4%), and correct zero forms (23.5%) as maintaining devices. This was followed by the pronoun *er* (17.6%), which was used to a lesser degree than for the other characters. Next, bare nouns and the pronoun *der* were used equally often to maintain reference to the other animals (11.8%). Few instances of incorrect zero forms could be noted (5.9%) and no instances of indefinite articles + nouns or a possessive pronoun occurred. This is rather in line with the other characters, where these types of reference were also low or not present.

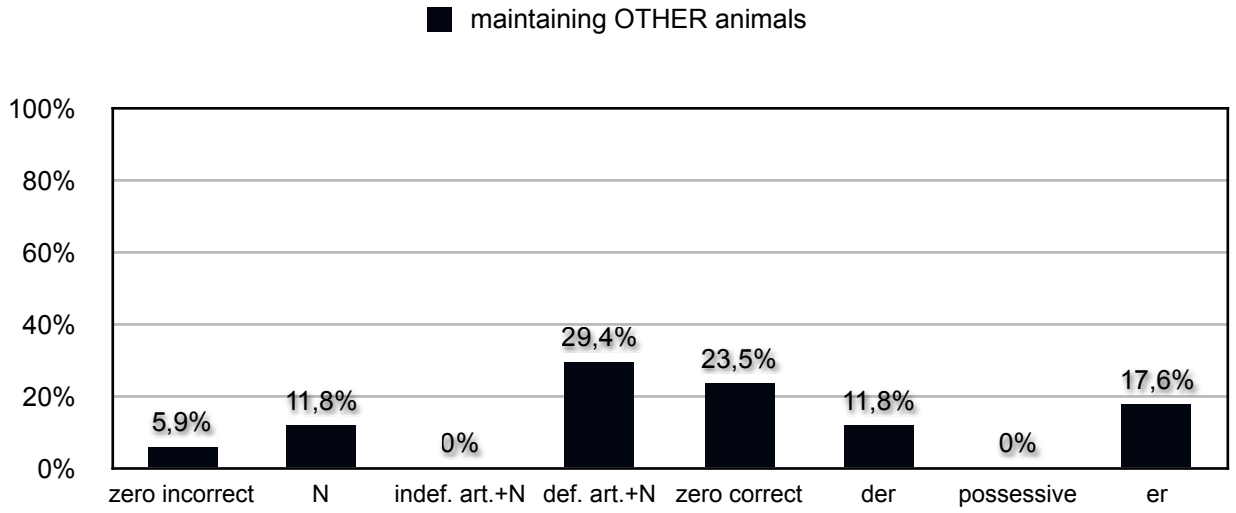


Diagram 71: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when maintaining the other animals.

Switching

When switching reference to a character (see Chapter 11.3 in the appendix), participants mostly used a definite article + noun (e.g. **Der Frosch ist nicht in Glas. Der Bub musst anziehn*. *'The frog is not in glass. The boy must dress.) (48%). This construction is the only grammatically and pragmatically correct choice in German. However, participants also used grammatically and pragmatically incorrect forms. For example, they used a bare noun to switch reference (e.g. **Bub wartet. Frosch.* *'Boy waiting. Frog.') (32.4%). Also, they used an indefinite article + noun (e.g. **Hund. Ein Frosch*. *'Dog. A frog.') (7.1%), an incorrect zero form (e.g. **Fels. Suchen ein Frosch.* *'Rock. Look for a frog.') (6.1%), the pronoun *er* (e.g. *Weg ist der Frosch. Er zieht sich an.* 'The frog is gone. He dresses himself.') (4.1%), the pronoun *der* (2%), or a possessive pronoun (e.g. **Wirft den Frosch am Gras, daher. Das ist seine Familie*. 'Throws the frog on the grass, here. This is its family.') (0.3%).

As regards switching to the boy, participants most frequently used the grammatically and pragmatically correct definite article + noun (47.2%). However, sometimes they also used a bare noun (27.6%), an incorrect zero form (9.4%), the pronoun *er* (8.7%), the demonstrative pronoun *der* (3.9%) or an indefinite article + noun (3.2%). They never used a possessive pronoun + noun to switch reference to the boy.

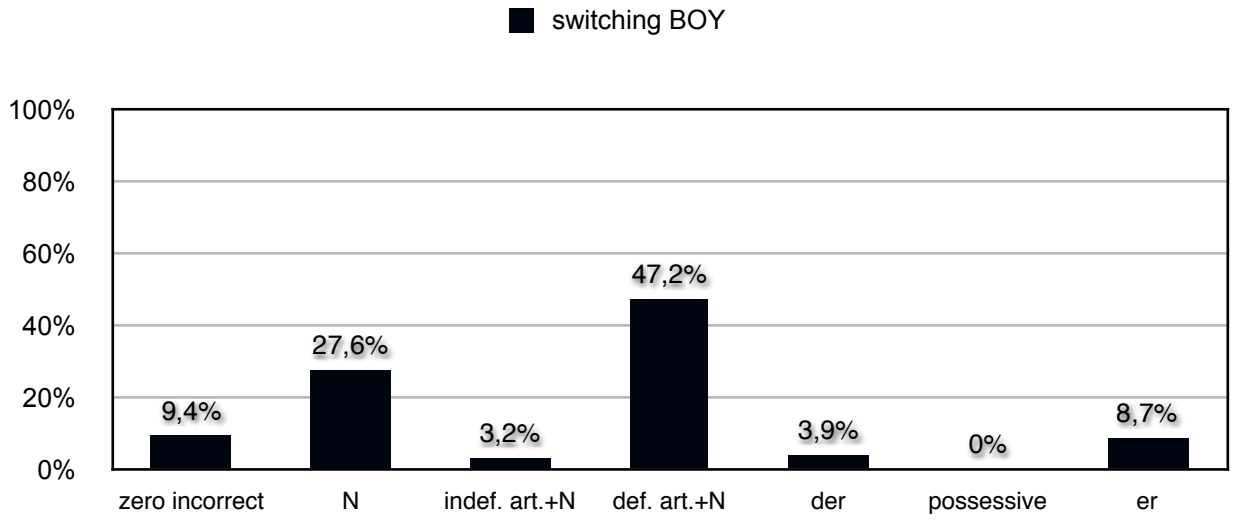


Diagram 72: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when switching to the boy.

Concerning the switching of reference to the dog, a similar trend emerged. The dog was most frequently switched to by use of a definite article + noun. This amounted to 50%. The second most frequent type of reference was the bare noun (36.8%). The indefinite article + noun was rarely used (9.7%) as was an incorrect zero form (3.5%). Pronouns (*er*, *der*, possessive) were never used.

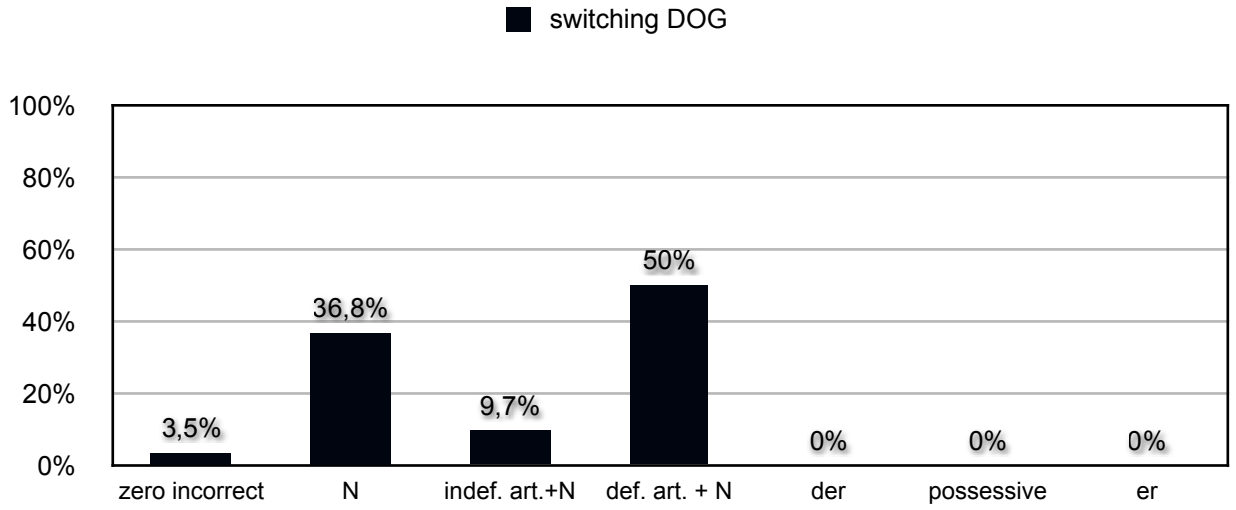


Diagram 73: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when switching to the dog.

Coming to the frog, a somewhat different trend could be noticed. Participants most frequently switched to the frog using the grammatically and pragmatically incorrect bare noun (40.6%). This was shortly followed by the correct definite article + noun (34.5%). The third most frequent type of reference was an indefinite article + noun (15.6%). As for the other characters, the remaining types of reference were rarely used. The pronoun *er*, the possessive pronoun and an incorrect zero form were used in 3.13% of instances. The pronoun *der* was never used.

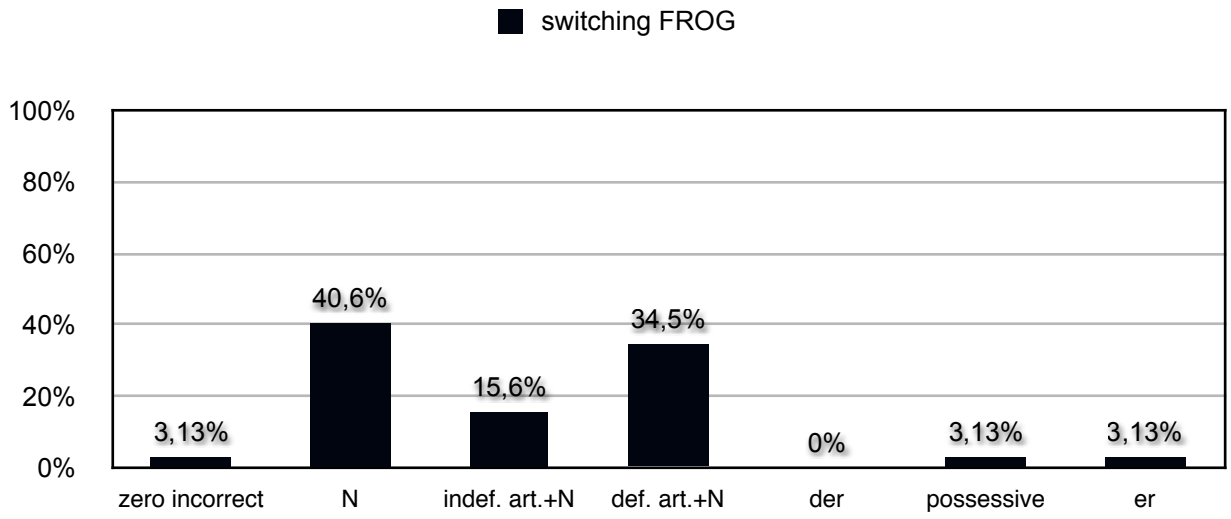


Diagram 74: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when switching to the frog.

Finally, switching to other animals (e.g. the gopher, the bees, …) again mirrored the trend already described for the boy and the dog. Switching was most frequently done using a definite article + noun (61%). This was followed by bare nouns (26.1%). The remaining types of reference were rare. Participants used an indefinite article + noun, the pronoun *der* and an incorrect zero form in 4.3% of instances. They never used the pronoun *er* or a possessive form.

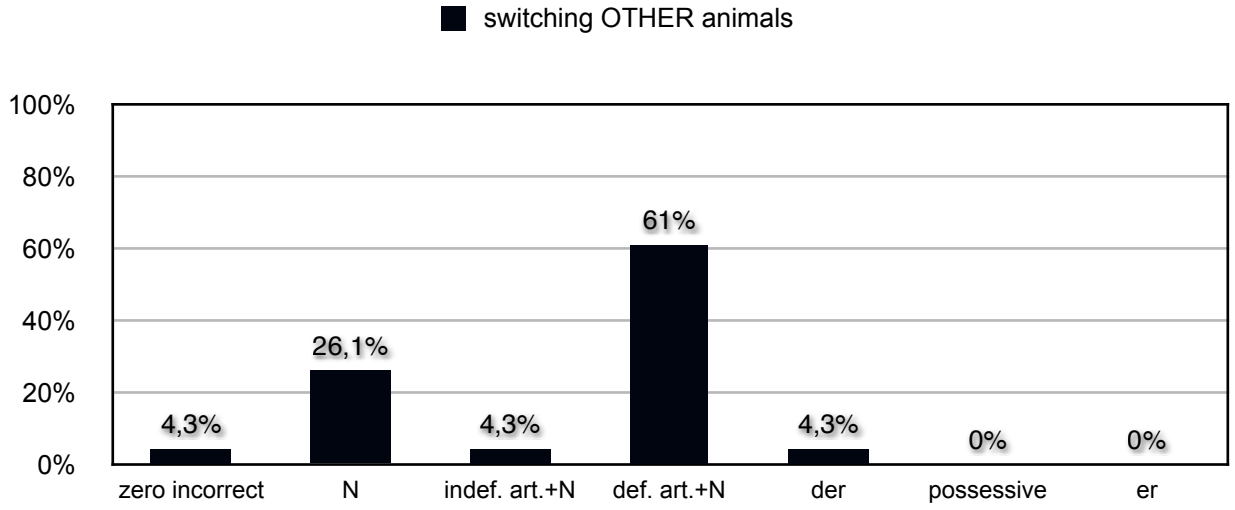


Diagram 75: % of nouns, indefinite articles + nouns, definite articles + nouns, 'er', 'der', incorrect zero forms, correct zero forms and possessives when switching to other animals.

6.5.1.2 Correlations between referring expressions

As the data on referring expressions used for each story character are scarce, the data were collapsed. The data were not normally distributed. Due to restrictions of space, this will not be reported here. Thus, the non-parametric Spearman's Rho correlations were calculated. A p-value less than 0.05 was regarded significant.

Introducing

There was a significant correlation between (1) introducing characters with a bare noun and introducing characters with an indefinite article + noun, r_s=-.81, p=.000, and (2) introducing characters with a bare noun and introducing them with a definite article + noun, r_s=-.55, p=.015. This indicates that participants who predominantly introduce characters by a bare noun, do not introduce characters by an indefinite article + noun or a definite article + noun, and vice versa (see the diagram below).

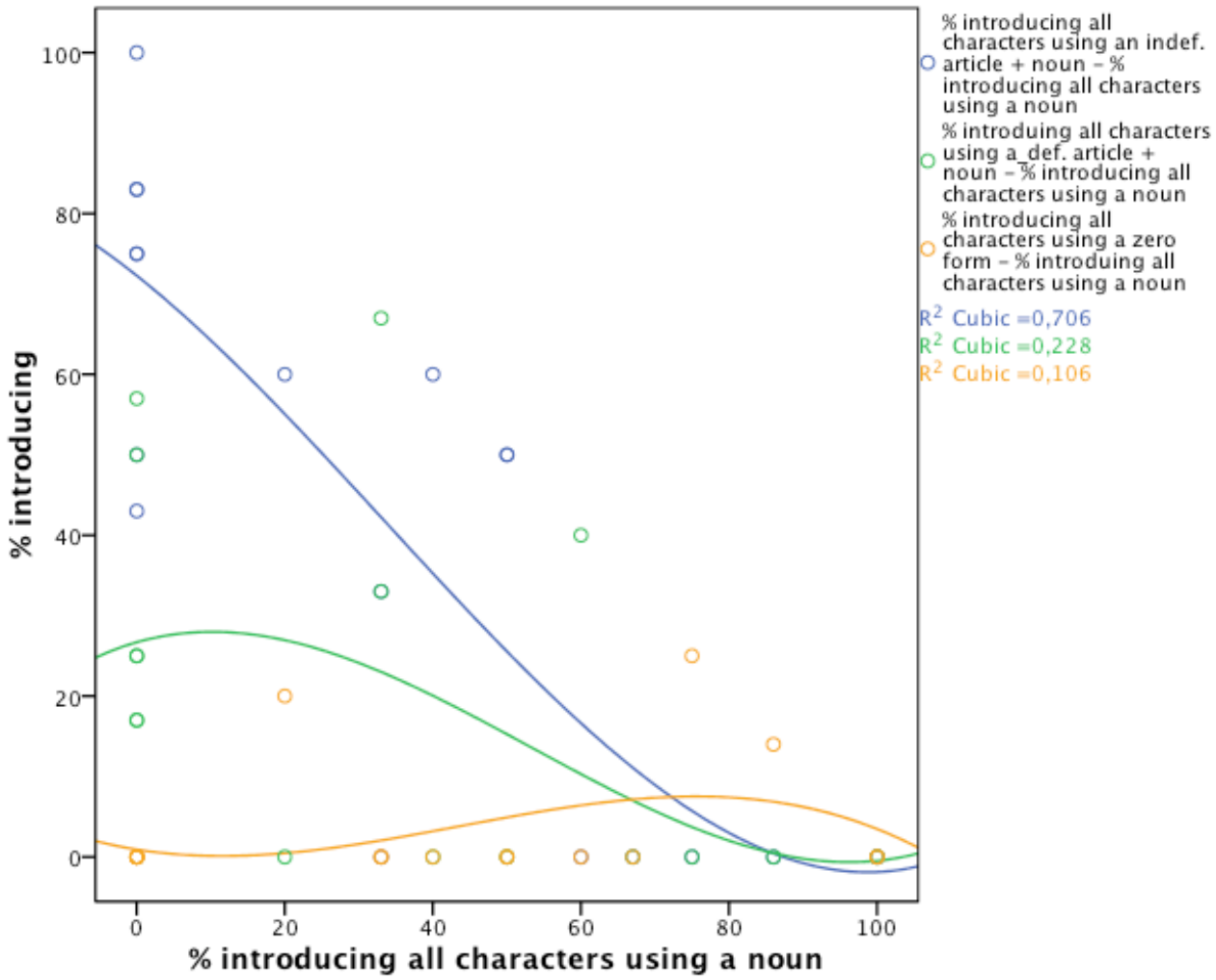


Diagram 76: % of introducing all characters using an indef. article + N, def. article + N, or zero form per participant by % of introducing all characters using a bare noun.

Introducing and maintaining

Moreover, there was a significant correlation between (1) introducing characters with a bare noun and maintaining characters by the pronoun *er*, r_s=-.75, p=.000, (2) introducing characters with a bare noun and maintaining characters with a correct zero form, r_s=-.60, p=.006, (3) introducing characters with a bare noun and maintaining reference to characters by a definite article + noun, r_s=-.78, p=.000, and (4) introducing characters with a bare noun and maintaining reference to characters by using a bare noun, r_s=.69, p=.001. This suggest that participants who mostly introduce characters with a bare noun, tend not to maintain characters using the pronoun *er*, correct zero forms or a definite article + noun. They use bare nouns to maintain reference to characters. Put differently, participants who maintain characters using the pronoun *er*, correct zero forms or a definite article + noun to maintain story characters, tend not to use bare nouns to introduce them. However, participants who maintain characters using a bare noun, also introduce them with a bare noun.

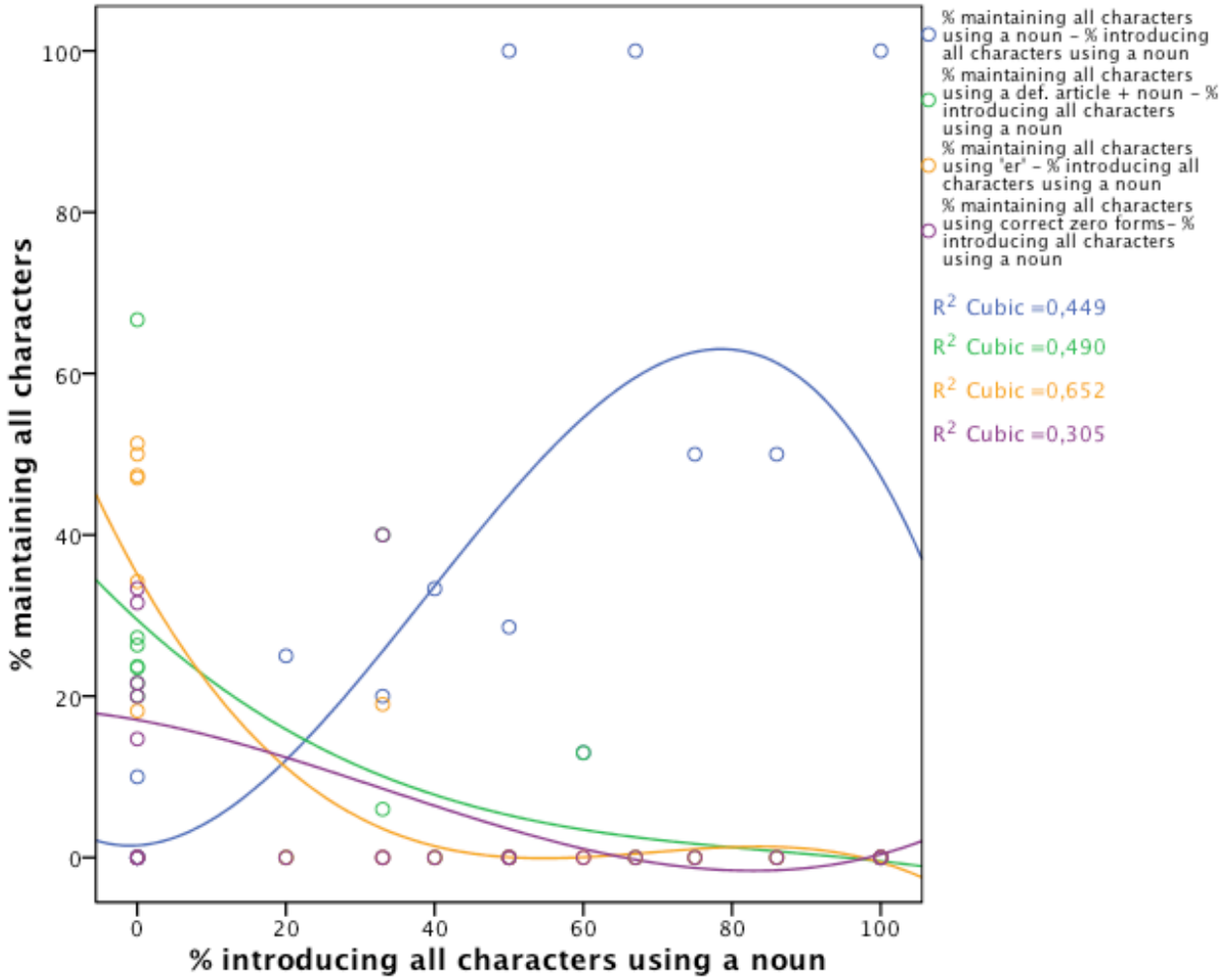


Diagram 77: % of maintaining all characters using a bare noun, def. article + N, pronoun `er´, or correct zero form per participant by % of introducing all characters using a bare noun.

Also, there was a significant correlation between (1) introducing all characters using an indefinite article + noun and maintaining all characters using the pronoun *er*, r_s=.57, p=.012, (2) introducing all characters using an indefinite article + noun and maintaining all characters using a definite article + noun, r_s=.49, p=.035, and (3) introducing all characters using an indefinite article + noun and maintaining characters using a bare noun, r_s=-.53, p=.021. This indicates that participants who predominantly introduce characters with an indefinite article + noun also maintain reference with the pronoun *er* or a definite article + noun. They do not tend to maintain reference to characters with only a noun, which would be grammatically incorrect (see the diagram below). Put differently, participants who maintain reference to characters by the pronoun *er* or a definite article + noun, also introduce characters with an indefinite article + noun. However, participants who predominantly maintain reference to characters by a bare noun, do not show a tendency to introduce characters by an indefinite article + noun.

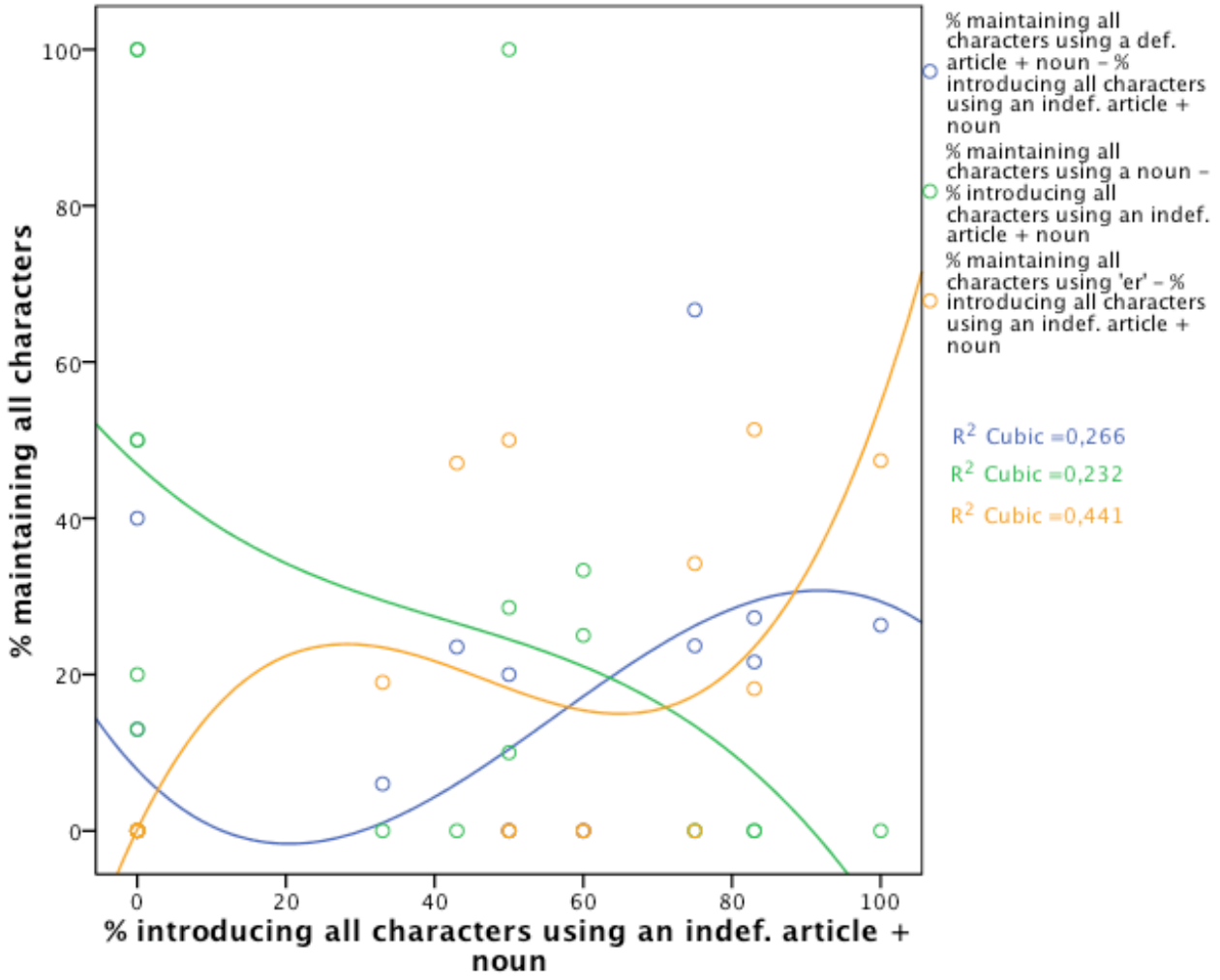


Diagram 78: % of maintaining all characters using def. article + N, bare noun or pronoun `er´ per participant by % of introducing all characters using an indef. article + N.

Furthermore, there was a significant correlation between (1) introducing all characters with a definite article + noun and maintaining all characters with correct zero forms, r_s=.71, p=.001, (2) introducing all characters with a definite article + noun and maintaining all characters with a definite article + noun, r_s=.73, p=.000, and (3) introducing all characters with a definite article + noun and maintaining all characters with a bare noun, r_s=-.54, p=.017. As illustrated in the diagram below, this suggests, that participants who introduce characters with a definite article + noun rarely maintain characters with a noun only. Rather, they use a definite article + noun, or a correct zero form. Looking at these results from the opposite perspective, this shows that participants who maintain characters with a bare noun, do not tend to introduce characters with a definite article + noun. It is rather participants who maintain characters with a definite article + noun, correct zero forms, and/or the pronoun *er*, who introduce characters with a definite article + noun.

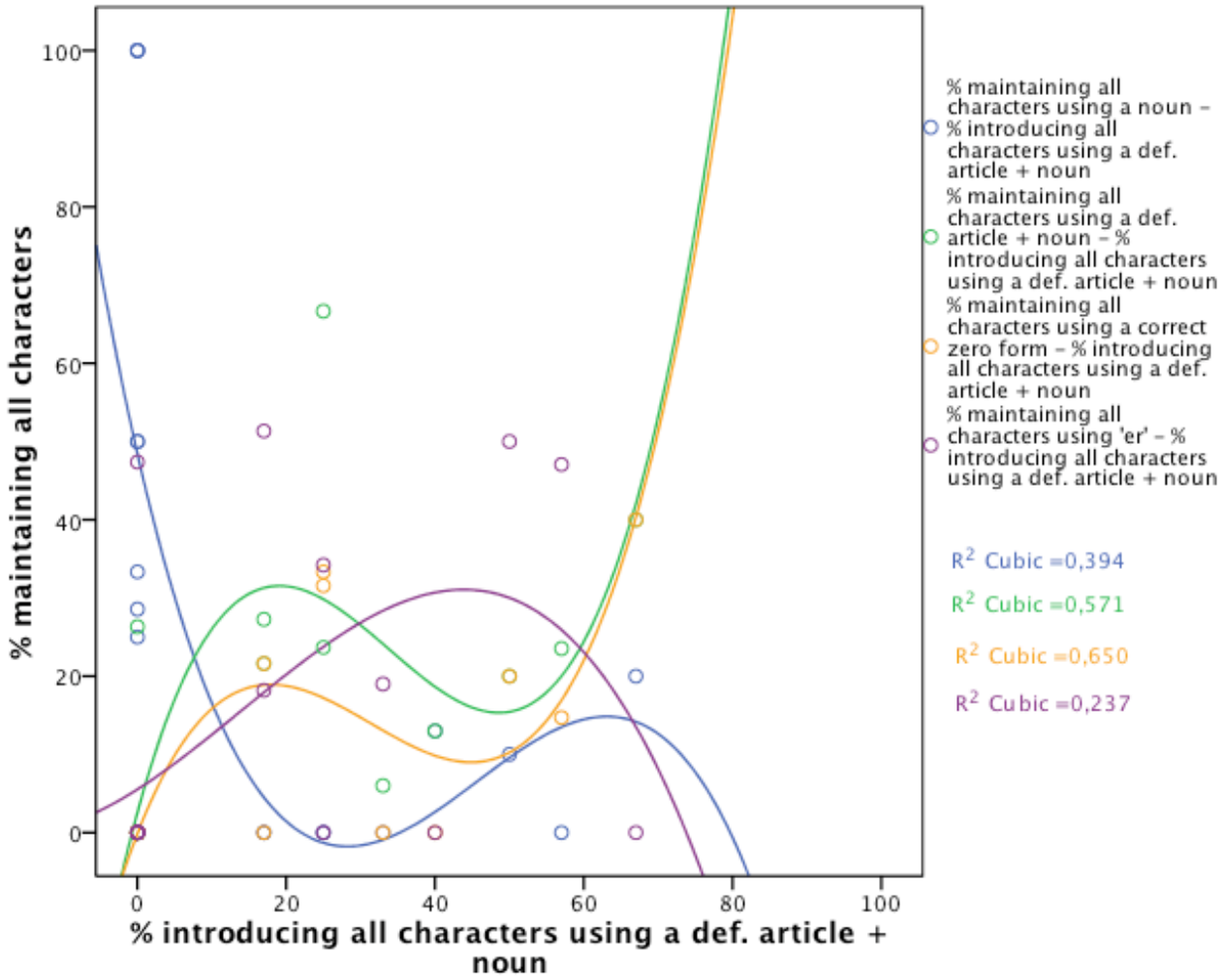


Diagram 79: % of maintaining all characters using a bare noun, def. article + N, correct zero form or pronoun `er´ per participant by % of introducing all characters using a def. article + N.

Introducing and switching characters

As regards the introducing and switching of characters a similar picture emerges. There was a significant correlation between (1) introducing all characters with a bare noun and switching to characters with a definite article + noun, r_s=-.93, p=.000, (2) introducing all characters with a bare noun and switching to characters with the pronoun *er*, r_s=-.52, p=.024, (3) introducing all characters with a bare noun and switching to characters with a bare noun, r_s=.81, p=.000, and (4) introducing all characters with a bare noun and switching to characters with an incorrect zero form, r_s=.50, p=.029. This suggests that participants who predominantly introduce story characters with a bare noun, frequently switch to a character using grammatically incorrect and pragmatically ill-formed types of reference, such as a single noun or an incorrect zero form. Moreover, they do not use a definite article + noun or the pronoun *er* to switch reference (see the diagram below). Put in other words, this suggests that participants who tend to switch to a character using the grammatically incorrect form of a bare noun, or incorrect zero forms, also introduce characters using a bare noun. However, participants who use a definite article + noun or the pronoun *er* to switch reference, do not tend to introduce characters by a bare noun.

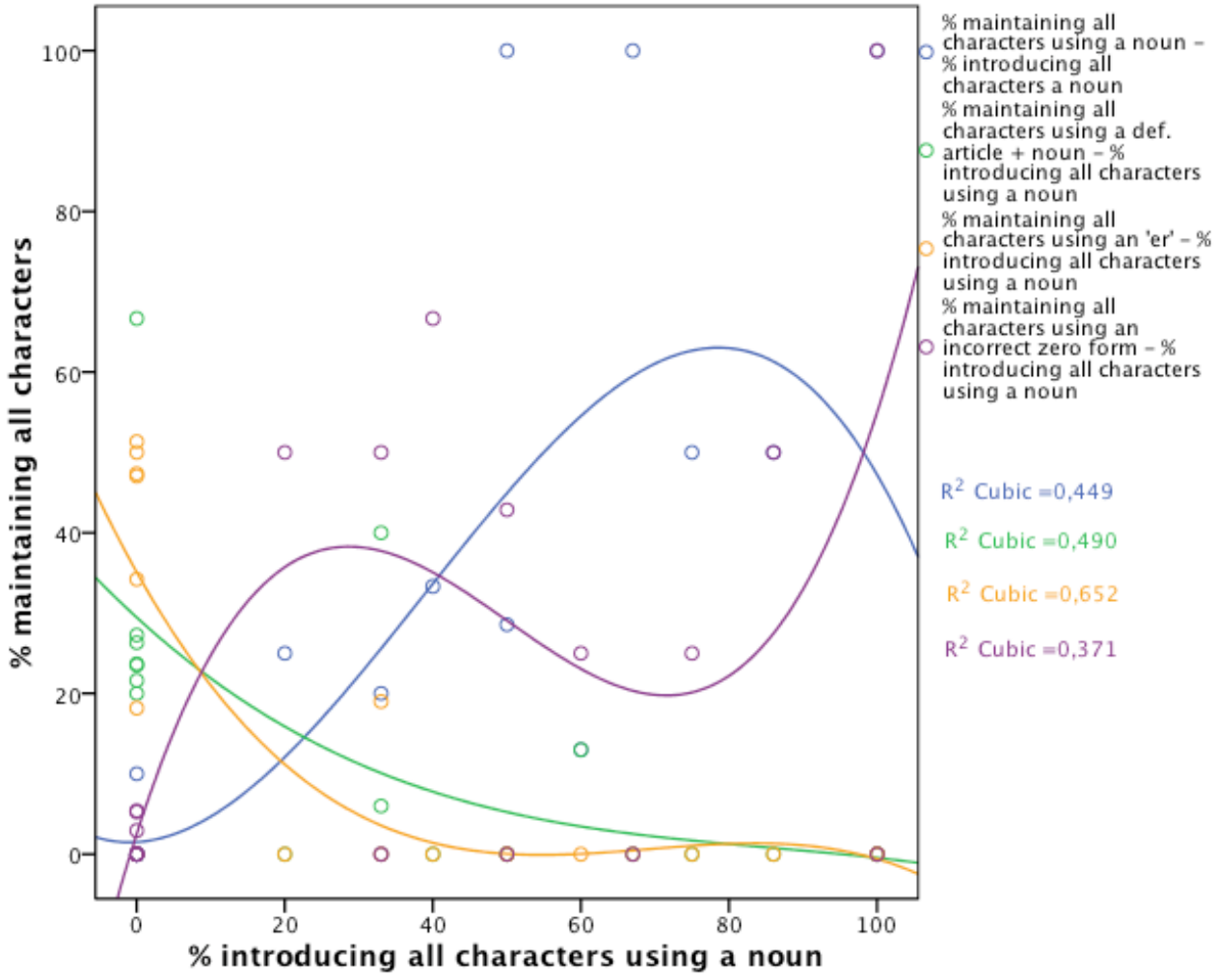


Diagram 80: % of maintaining all characters using a bare noun, def. article + N, pronoun `er´, or incorrect zero form per participant by % of introducing all characters using a bare noun.

There was also a significant correlation between (1) introducing all characters with an indefinite article + noun and switching to characters with a definite article + noun, r_s=.72, p=.001, and (2) introducing all characters with an indefinite article + noun and switching to characters with a bare noun, r_s=.-65, p=.003. These results are illustrated in the diagram below. There it can be seen that participants who introduce characters using an indefinite article + noun 75% of the time or more, use a definite article + noun to switching characters and do not use a bare noun construction. Looking at this from the opposite perspective, it can be said that participants who predominantly switch characters using bare nouns, rather do not introduce characters with an indefinite article + noun.

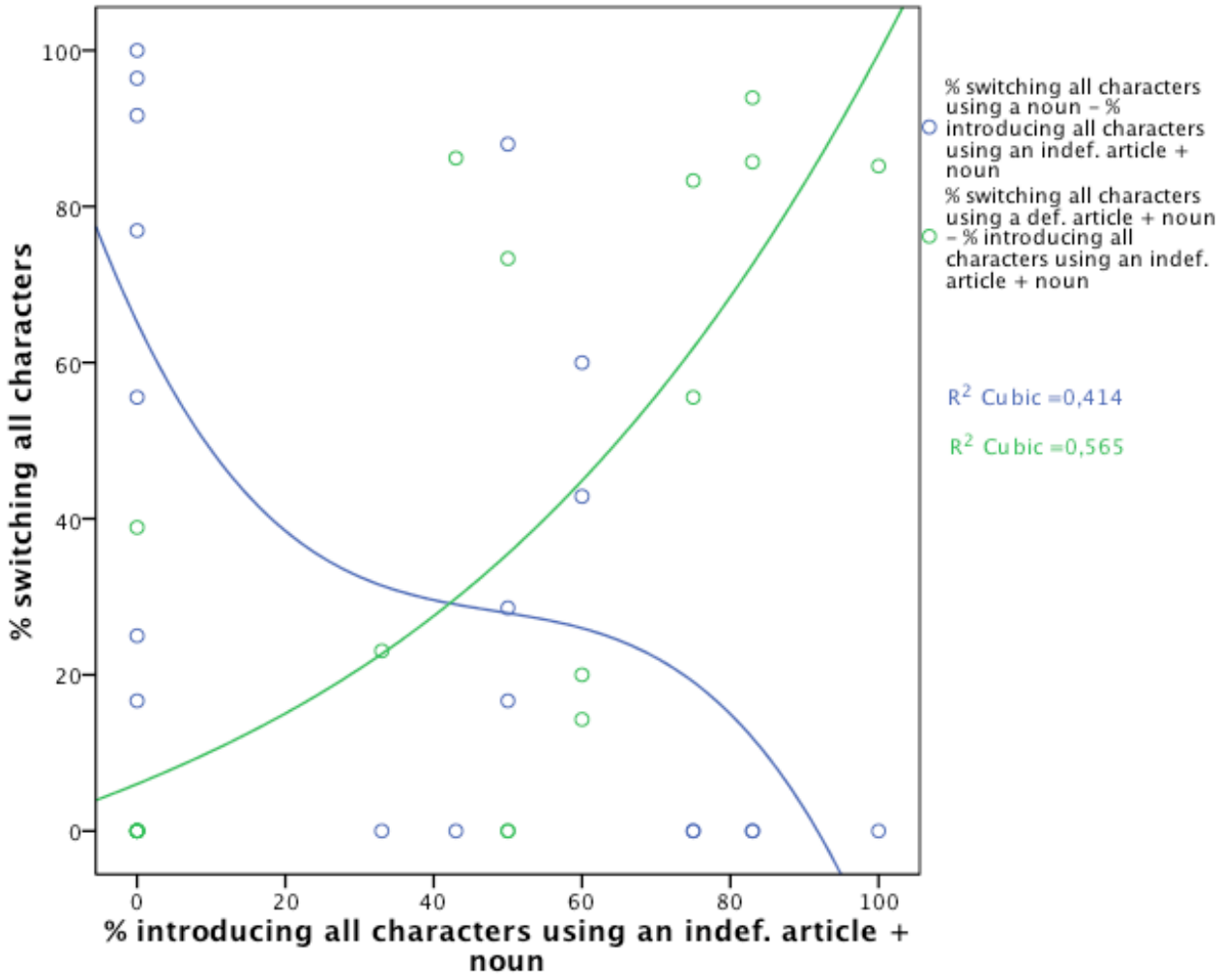


Diagram 81: % of switching all characters using a bare noun, or def. article + N per participant by % of introducing all characters using an indef. article + noun.

Finally, there was a significant correlation between (1) introducing characters with a definite article + noun and switching to characters with a definite article + noun, r_s=.56, p=.012, (2) introducing characters with a definite article + noun and switching to characters with the pronoun *der*, r_s=.75, p=.000, and (3) introducing characters with a definite article + noun and switching to characters with a bare noun, r_s=-.57, p=.011. This indicates that participants who introduce story characters with a definite article + noun also use a definite article + noun or the pronoun *der* to switch characters. However, they do not tend to switch to a character using a bare noun. Put differently, participants who switch characters using a definite article + noun or the pronoun *der*, also introduce characters using definite article + noun. However, participants who only use a bare noun for switching, do not tend to introduce a character with a definite article + noun.

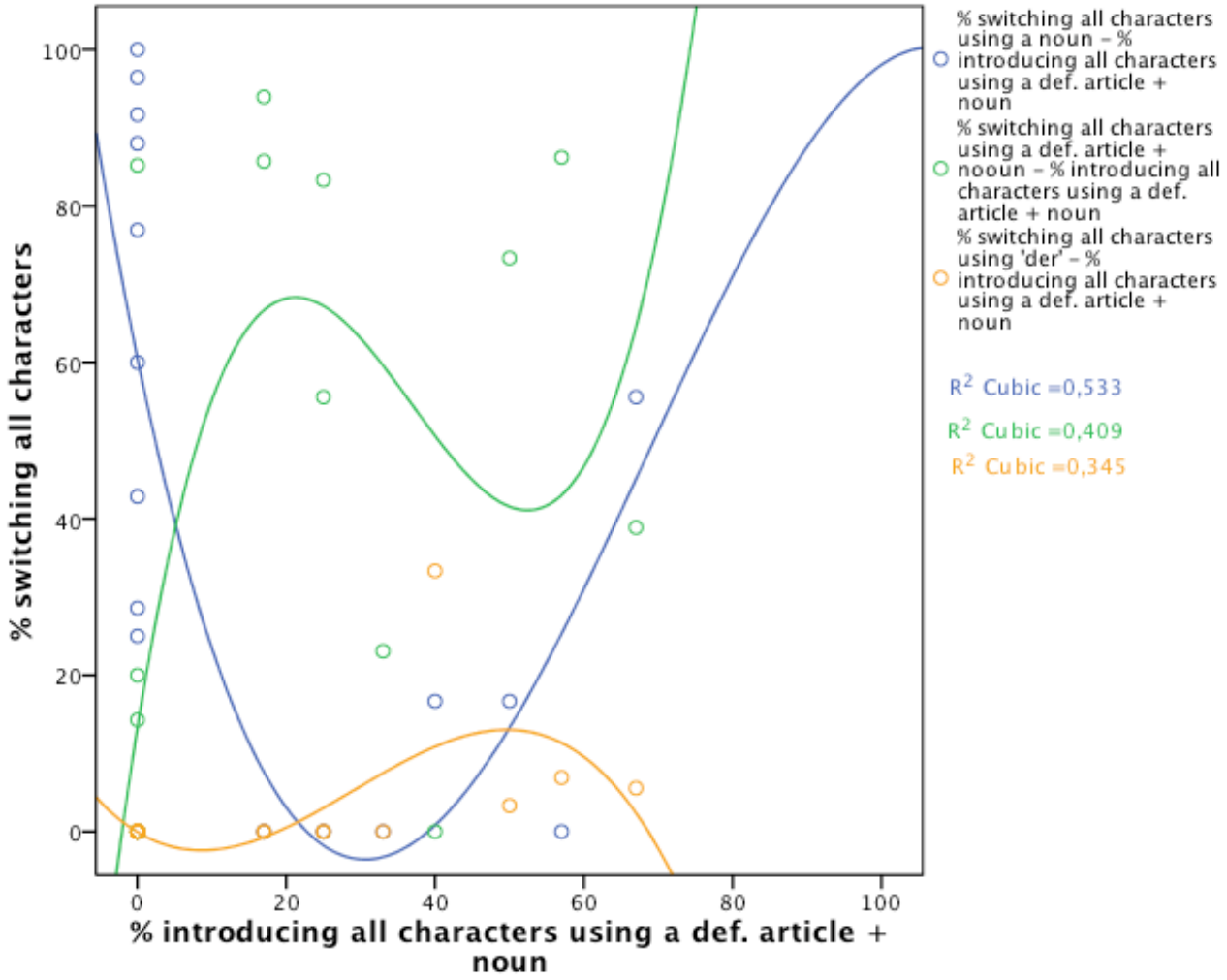


Diagram 82: % of switching all characters using a bare noun, def. article + N, pronoun `der´ per participant by % of introducing all characters using a def. article + N.

Maintaining characters

As regards the maintaining of characters, there was a significant correlation between (1) maintaining reference to characters by using a bare noun and maintaining reference to characters using a definite article + noun, r_s=-.72, p=.000, and (2) maintaining reference using a bare noun and maintaining reference using the pronoun *er*, r_s=-.66, p=.002. These results are illustrated in the diagram below. Participants who used bare nouns to maintain reference to all characters 25% of the time or more, did not use any definite articles + nouns to maintain reference to characters. Instead, they used the legal, but pragmatically ill-formed indefinite article + noun, or grammatically illegal and pragmatically incorrect zero forms.

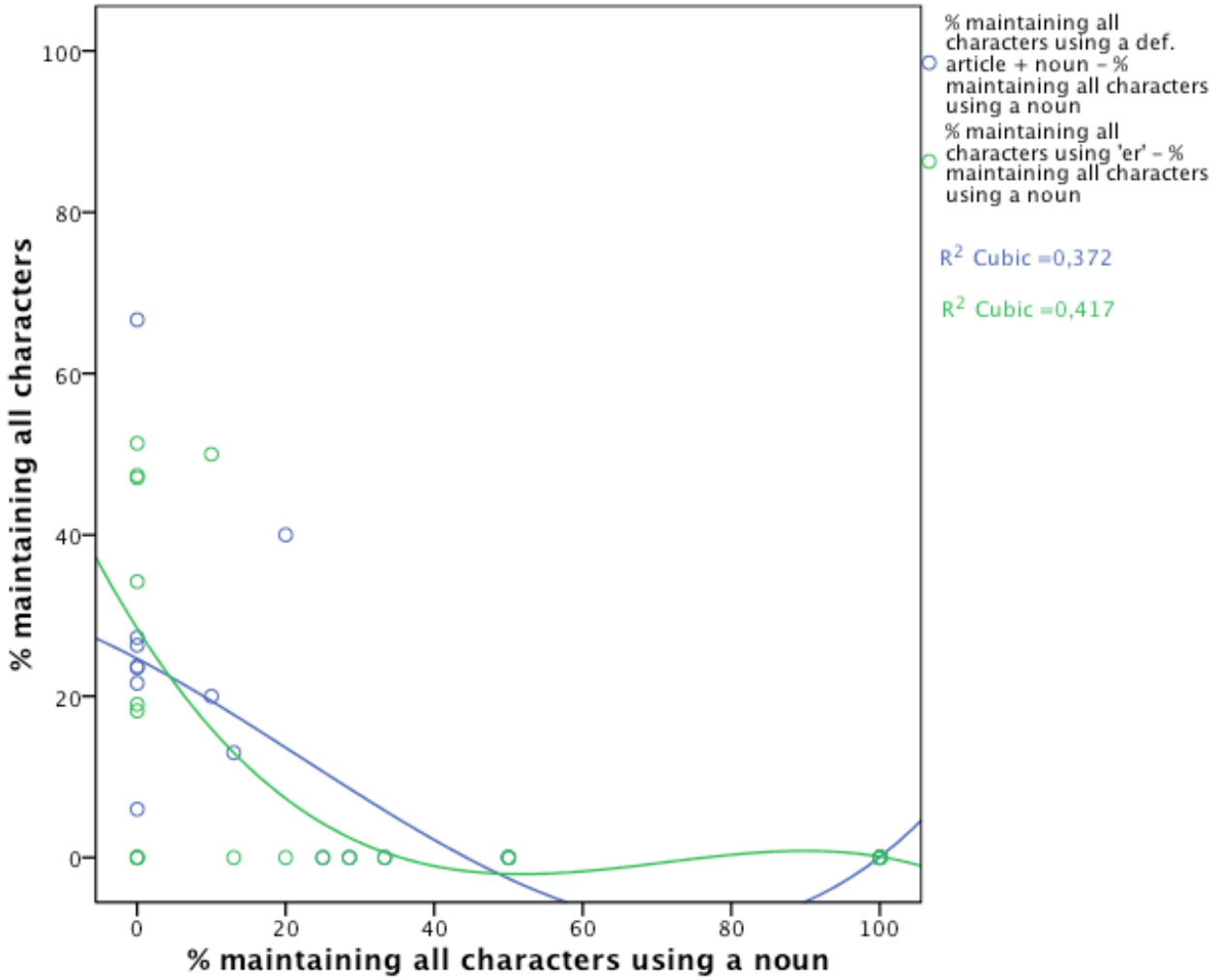


Diagram 83: % of maintaining all characters using a def. article + N, or pronoun `er´ per participant by % of maintaining all characters using a bare noun.

Moreover, there was a significant correlation between (1) maintaining reference to all characters using a definite article + noun and maintaining reference using the pronoun *er*, r_s=.54, p=.018, (2) maintaining reference to all characters using a definite article + noun and maintaining reference using correct zero forms, r_s=.71, p=.001, and (3) maintaining reference to all characters using a definite article + noun and maintaining reference using incorrect zero forms r_s=-.51, p=.026. This suggests that participants who maintained reference to story characters by using definite article + noun, also used the pronoun *er* or correct zero forms. And they used few grammatically and pragmatically incorrect zero forms.

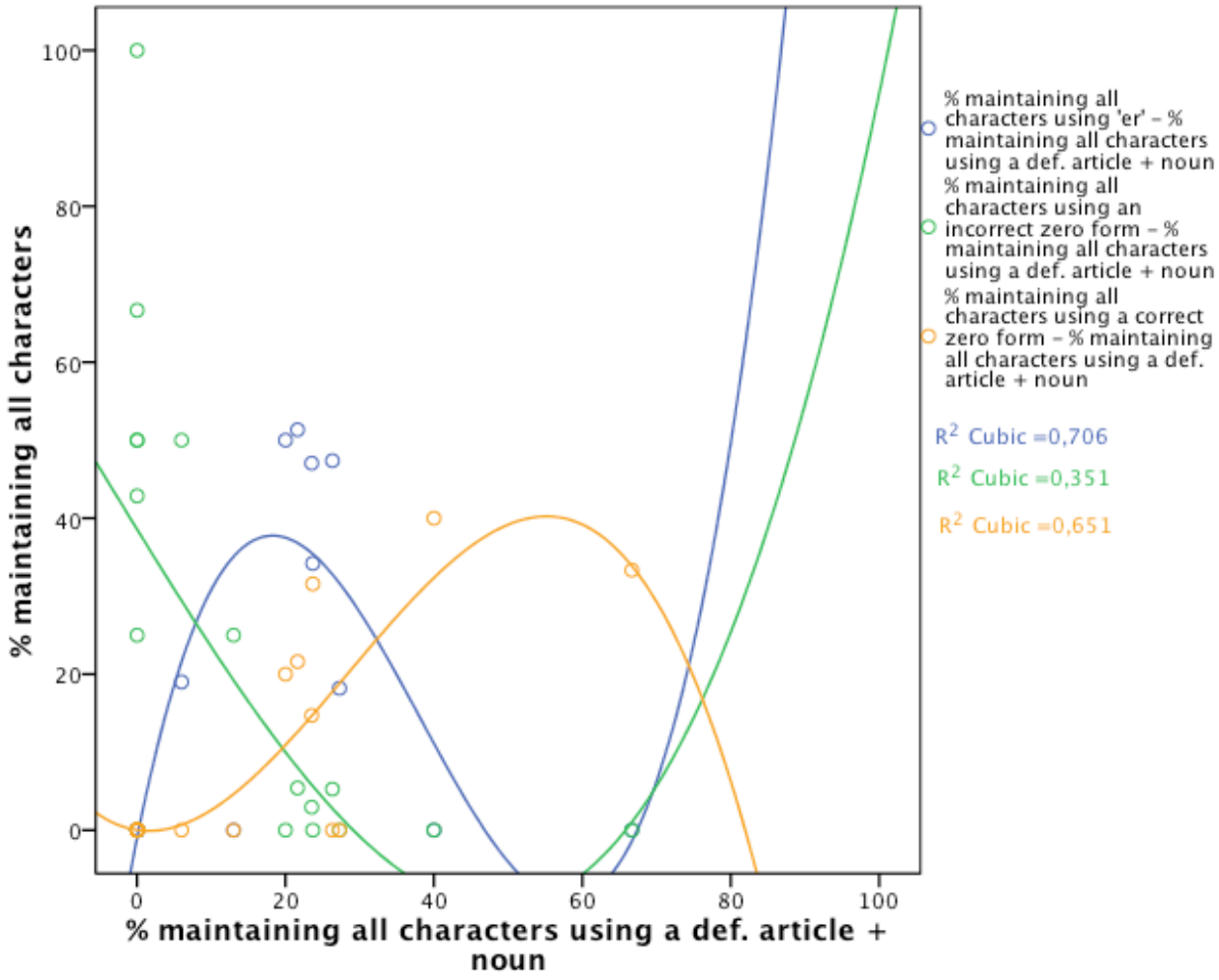


Diagram 84: % of maintaining all characters using the pronoun `er´, an incorrect zero form, or correct zero form per participant by % of maintaining all characters using a def. article + N.

Finally, there was a significant correlation between maintaining characters using grammatically correct zero forms and maintaining characters using incorrect zero forms, r_s=-.50, p=.031. This suggests that participants who use correct zero forms to maintain reference, do not tend to use incorrect zero forms, and vice versa.

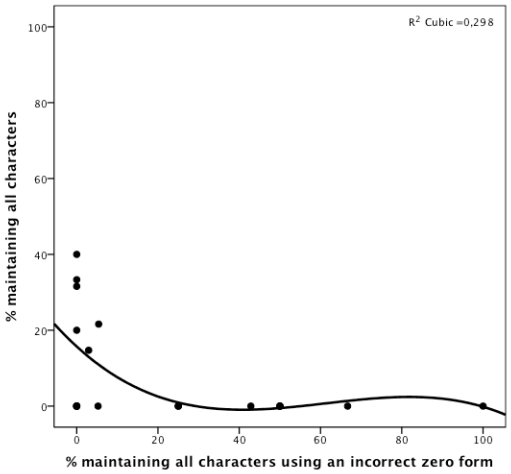


Diagram 85: % of maintaining all characters using a correct zero form per participant by % of maintaining all characters using an incorrect zero form.

Maintaining and switching characters

As concerns the maintaining and switching of characters, a similar pattern could be observed. There was a significant correlation between (1) maintaining characters with a bare noun and switching characters with a definite article + noun, r_s=-.76, p=.000, (2) maintaining characters with a bare noun and switching characters with the pronoun *er*, r_s=-.54, p=.018, and (3) maintaining characters with a bare noun and switching characters with a noun, r_s=.80, p=.000. This indicates that participants who maintain characters using a bare noun, do not tend to switch characters using a definite article + noun or the pronoun *er*. Instead, they switch characters using a bare noun. Put differently, participants who switch characters using a definite article + noun or the pronoun *er*, do not tend to maintain characters using a bare noun. On the other hand, participants who switch characters using a bare noun, also maintain characters using a bare noun.

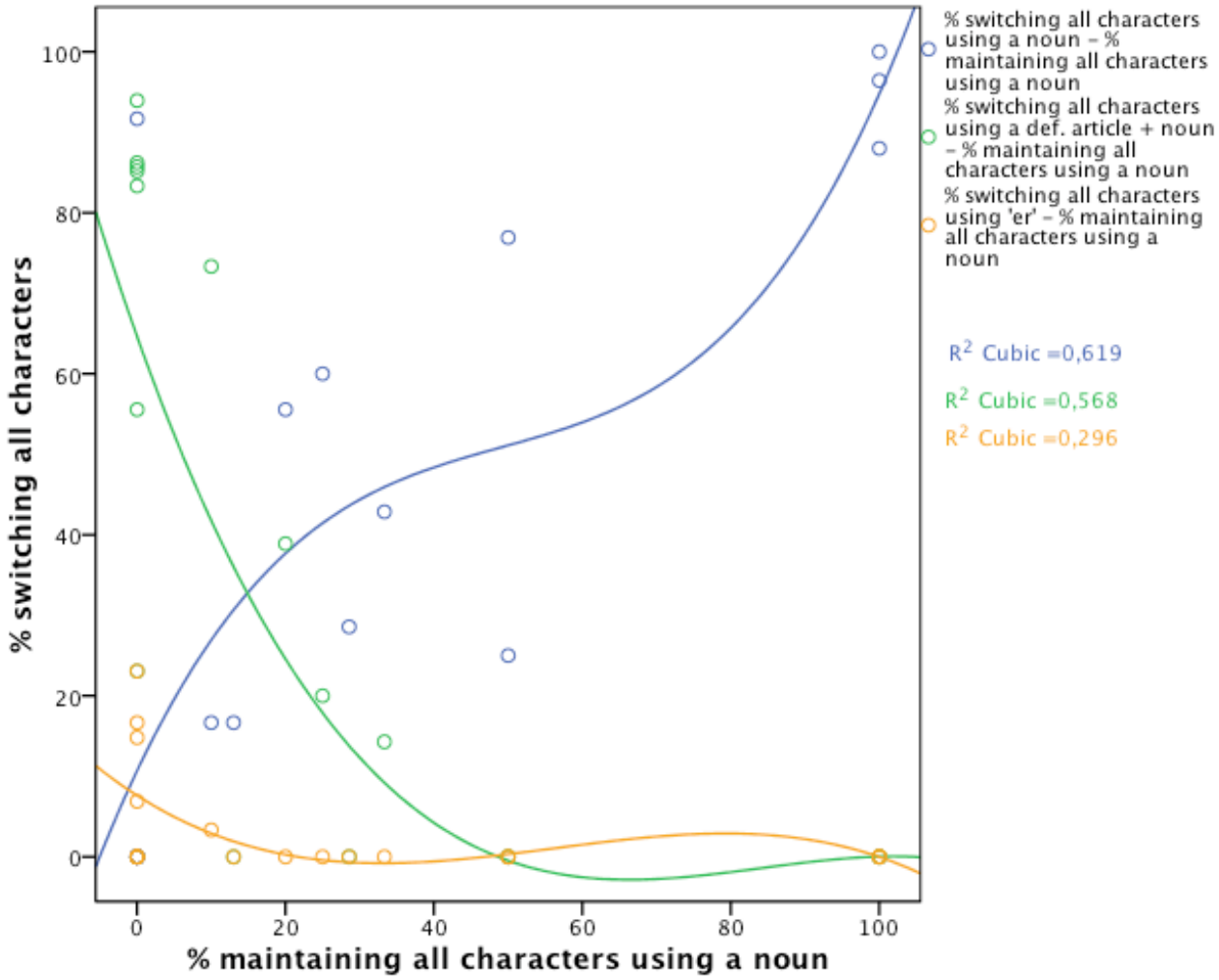


Diagram 86: % of switching all characters using a bare noun, def. article + N, or pronoun `er´ per participant by % of maintaining all characters using a bare noun.

Moreover, there was a significant correlation between (1) maintaining characters using a definite article + noun and switching characters using a definite article + noun, r_s=.79, p=.000, (2) maintaining characters using definite article + noun and switching characters using a bare noun, r_s=-.75, p=.000, and (3) maintaining characters using definite article + noun and switching characters using incorrect zero forms r_s=-.52, p=.022. This shows that participants who maintained characters using a definite article + noun also switched characters using a definite article + noun. They did not tend to switch characters using a bare noun or an incorrect zero form. In other words, participants who switched characters using a definite article + noun, also maintained characters using a definite article + noun. However, participants who switched characters using bare nouns or incorrect zero forms, did not tend to maintain characters using a definite article + noun.

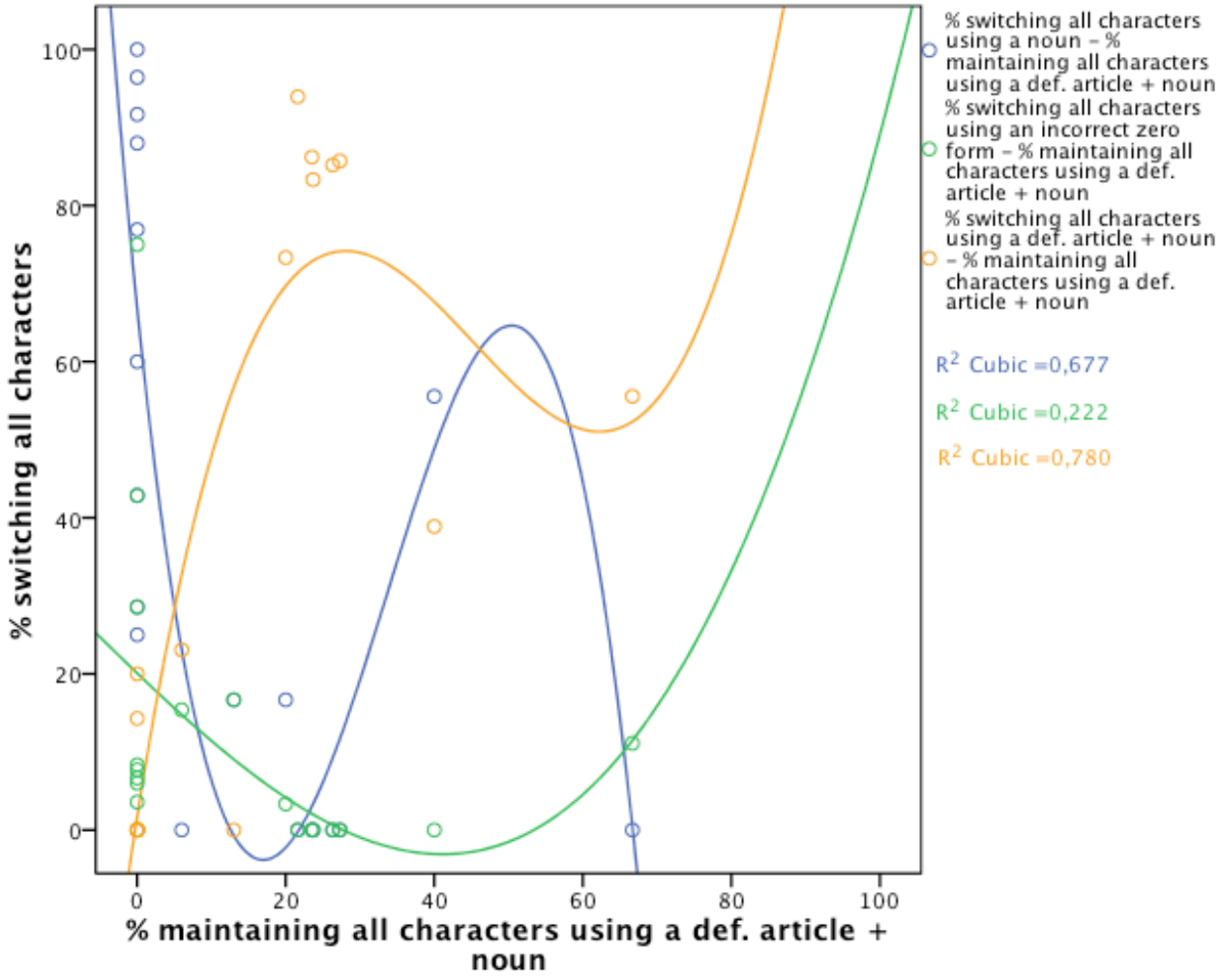


Diagram 87: % of switching all characters using a bare noun, incorrect zero form, or def. article + N per participant by % of maintaining all characters using a def. article + N.

Another significant correlation could be noted between (1) maintaining characters with the pronoun *er* and switching characters using a definite article + noun, r_s=.83, p=.000, (2) maintaining characters with the pronoun *er* and switching characters using the pronoun *er*, r_s=.72, p=.000, (3) maintaining characters with the pronoun *er* and switching characters using a bare noun, r_s=-.72, p=.000, and (4) maintaining characters with the pronoun *er* and switching characters using an incorrect zero forms, r_s=-.56, p=.012. This suggests that participants who maintained characters using the pronoun er, also switched characters using a definite article + noun or the pronoun *er*. They did not tend to switch characters using a bare noun or incorrect zero forms. Looking at this result from another point of view, one can say that participants who switched characters using a definite article + noun, also maintained characters using the pronoun *er*. In contrast, participants who switched characters using bare nouns or incorrect zero forms, did not maintain characters using the pronoun *er*.

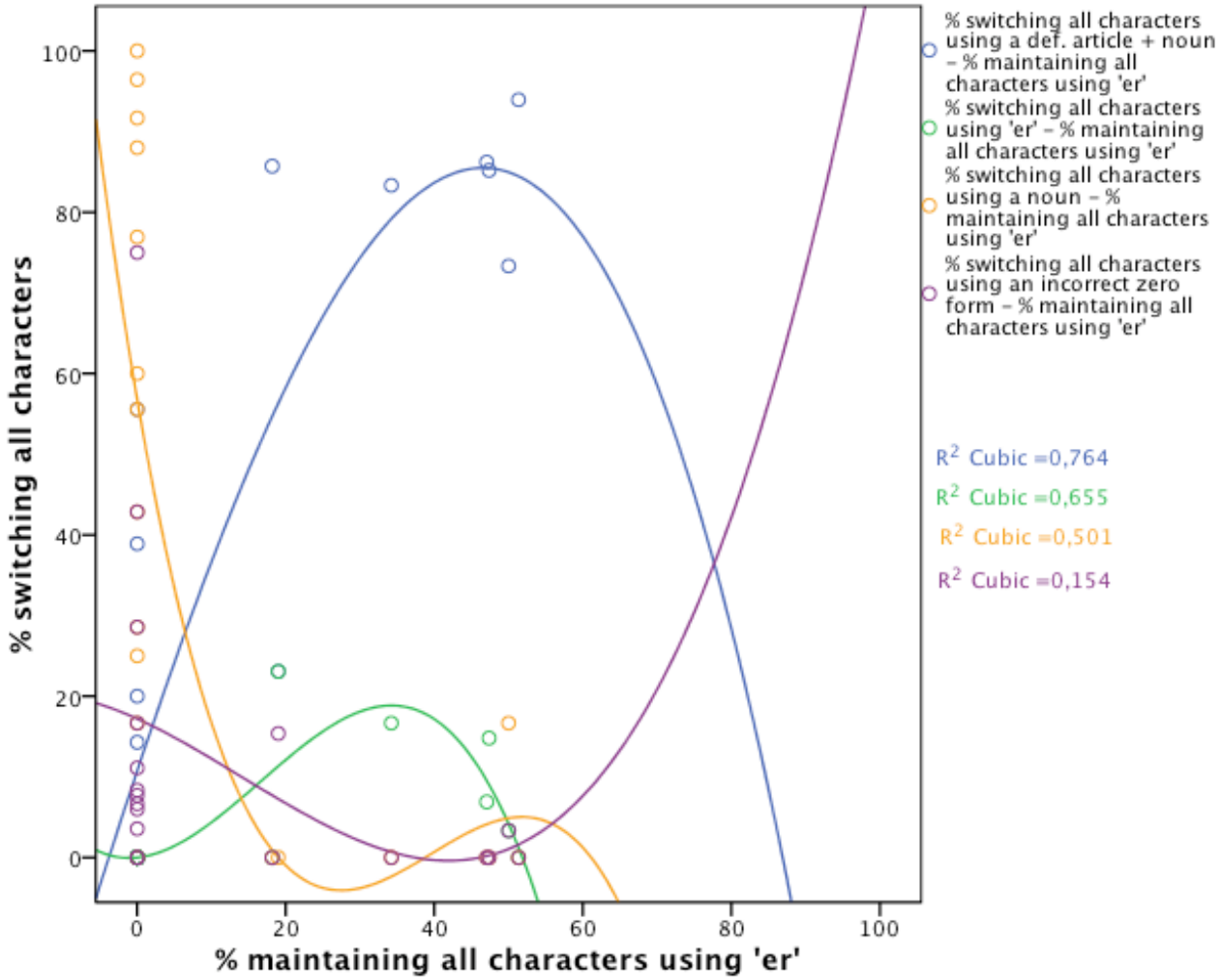


Diagram 88: % of switching all characters using a def. article + N, pronoun `er´, bare noun, or incorrect zero form per participant by % of maintaining all characters using `er´.

Moreover, there was a significant correlation between maintaining characters using the pronoun *der* and switching characters using a bare noun, r_s=-.50, p=.030. This suggests that participants who use the pronoun *der* to maintain reference to characters, do not tend to switch characters using a bare noun, and vice versa.

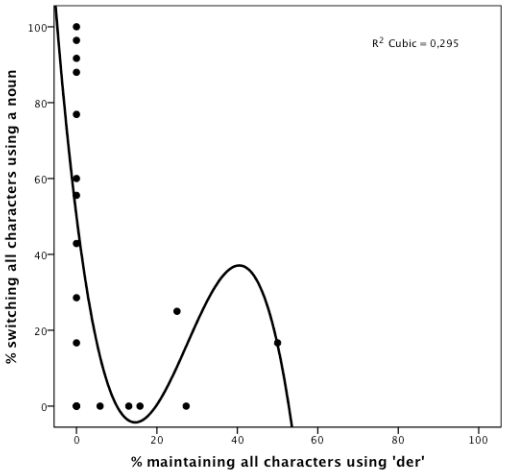


Diagram 89: % of switching all characters using a bare noun per participant by % of maintaining all characters using the pronoun `der´.

Furthermore, there was a significant correlation between maintaining characters using incorrect zero forms and switching characters using incorrect zero forms, r_s=.62, p=.005. This suggests that participants who maintain reference to story characters using incorrect zero forms also do so when switching characters.

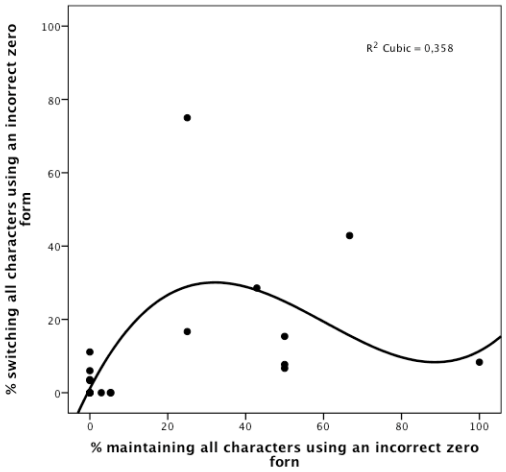


Diagram 90: % of switching all characters using an incorrect zero form per participant by % of maintaining all characters using an incorrect zero form.

Also, there was a significant correlation between maintaining characters using correct zero forms and switching characters using a definite article + noun, r_s=.61, p=.006. This suggests that participants who maintain reference to story characters using correct zero forms also switch characters using a definite article + noun, and vice versa.

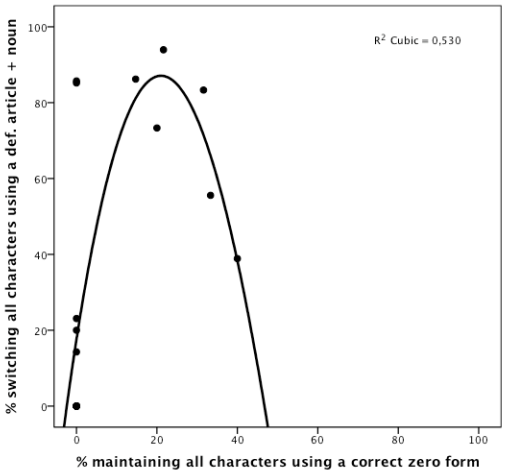


Diagram 91: % of switching all characters using a def. article + N per participant by % of maintaining all characters using a correct zero form.

Finally, there was a significant correlation between (1) maintaining reference using a possessive pronoun and switching all characters using the pronoun *er*, r_s=.79, p=.000, and (2) maintaining reference to characters using a possessive pronoun and switching characters using a bare noun, r_s=-.49, p=.036. This shows that participants who maintain reference to characters using a possessive pronoun also switch characters using the pronoun *er* and they do not tend to use a bare noun. Put differently, participants who switch characters using the pronoun *er*, also maintain reference using a possessive pronoun. But participants, who switch characters using a bare noun do not tend to do so.

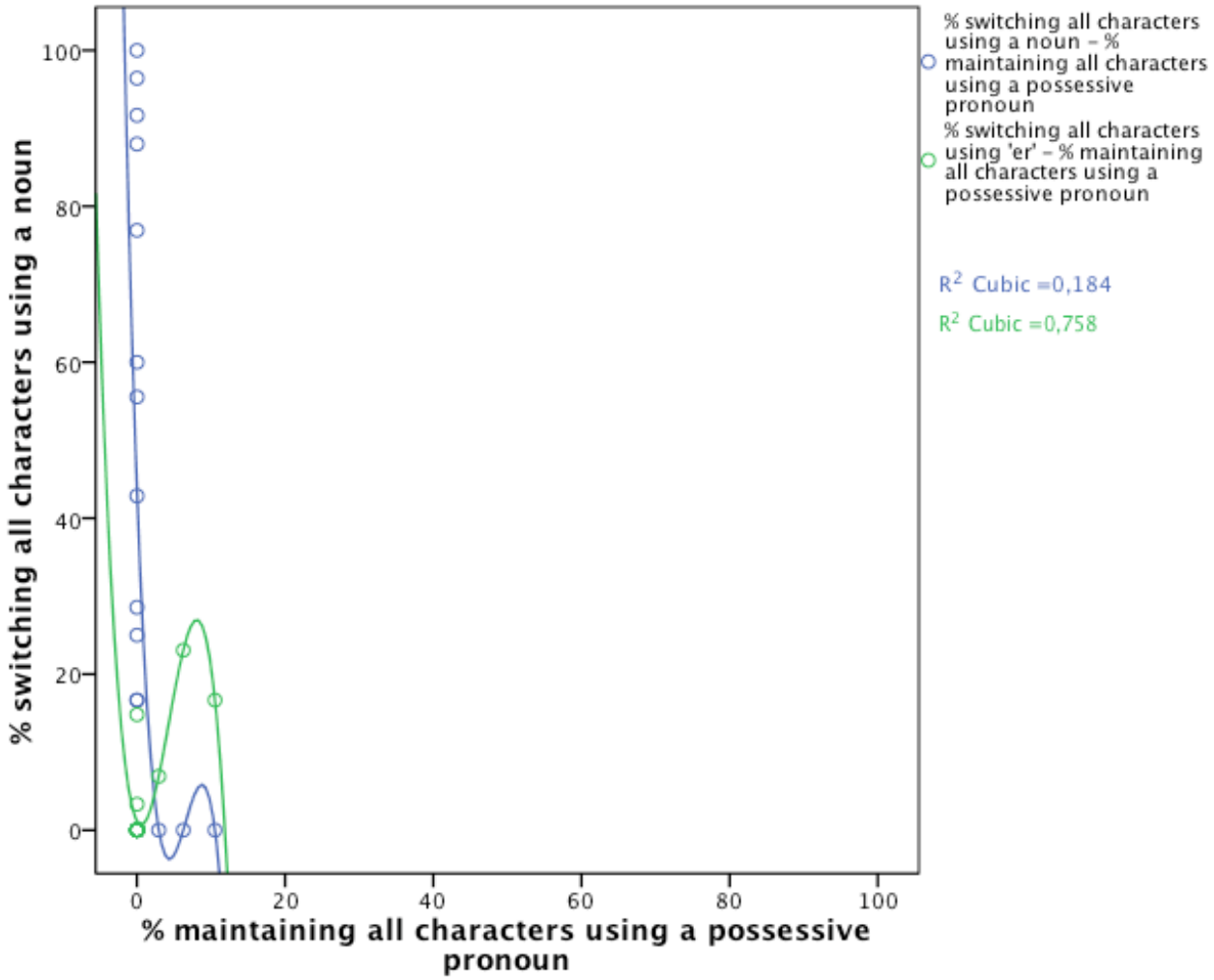


Diagram 92: % of switching all characters using a bare noun per participant by % of maintaining all characters using a possessive pronoun.

Switching characters

Concerning the switching of characters, significant correlations could be noted: There was a significant correlation between (1) switching characters using a bare noun and switching characters using the pronoun *er*, r_s=-.58, p=.009, and (2) switching characters using a bare noun and switching characters using a definite article + noun, r_s=-.80, p=.000. This suggests that participants who switch characters using a bare noun, do not tend to switch characters using the pronoun *er* or a definite article + noun, and vice versa.

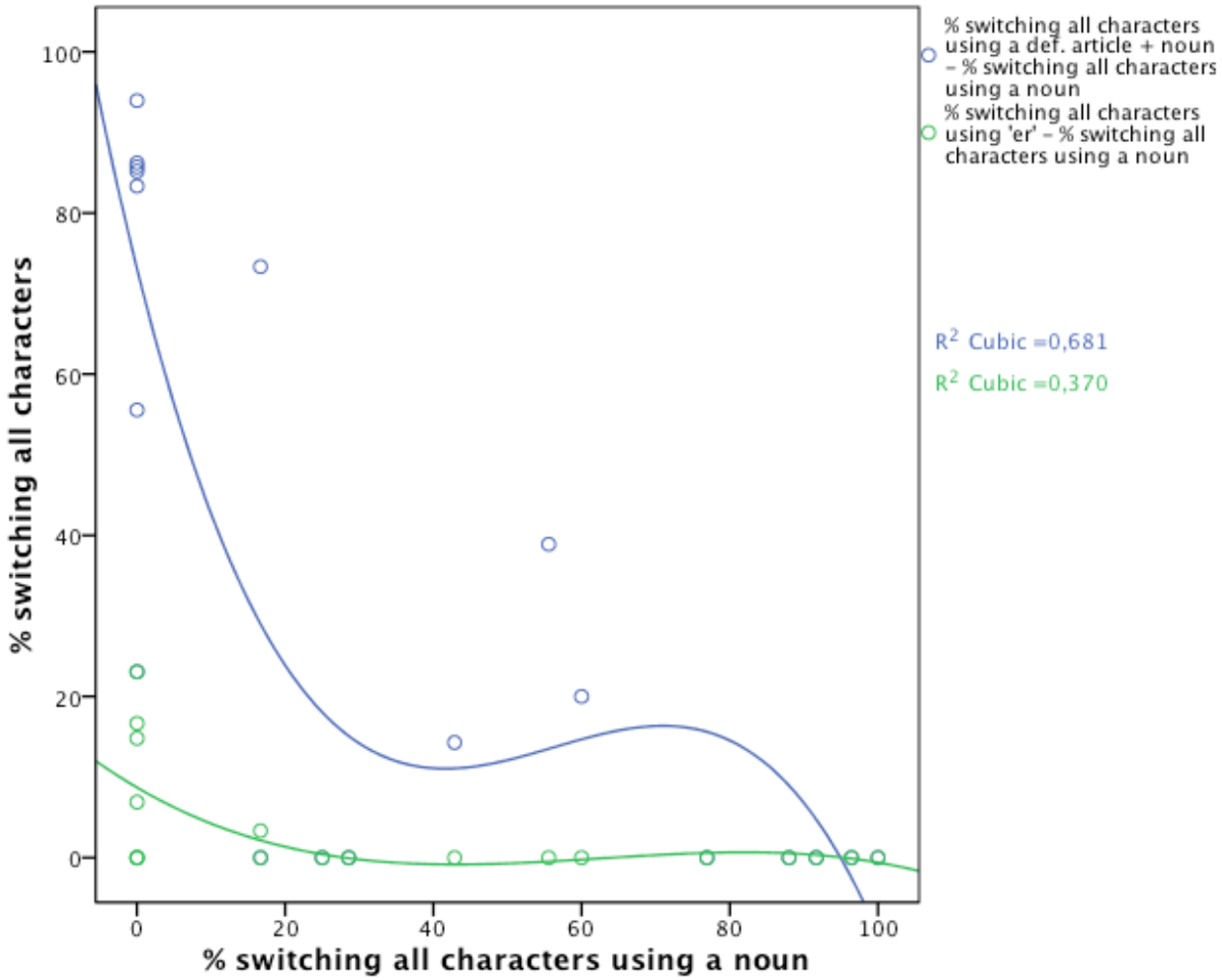


Diagram 93: % of switching all characters using a def. article + N, or pronoun `er´ per participant by % of switching all characters using a bare noun.

Moreover, there was a significant correlation between (1) switching characters using a definite article + noun and switching characters using the pronoun *er*, r_s=.52, p=.024, and (2) switching characters using a definite article + noun and switching characters using an incorrect zero form, r_s=-.62, p=.005. This indicates that participants who switch characters using a definite article + noun, also use the pronoun *er* to switch characters, but do not tend to use incorrect zero forms. In other words, participants who use the pronoun *er* to switch characters also use a definite article + noun to switch characters. But participants who use incorrect zero forms to switch characters, do not tend to use a definite article + noun to switch characters.

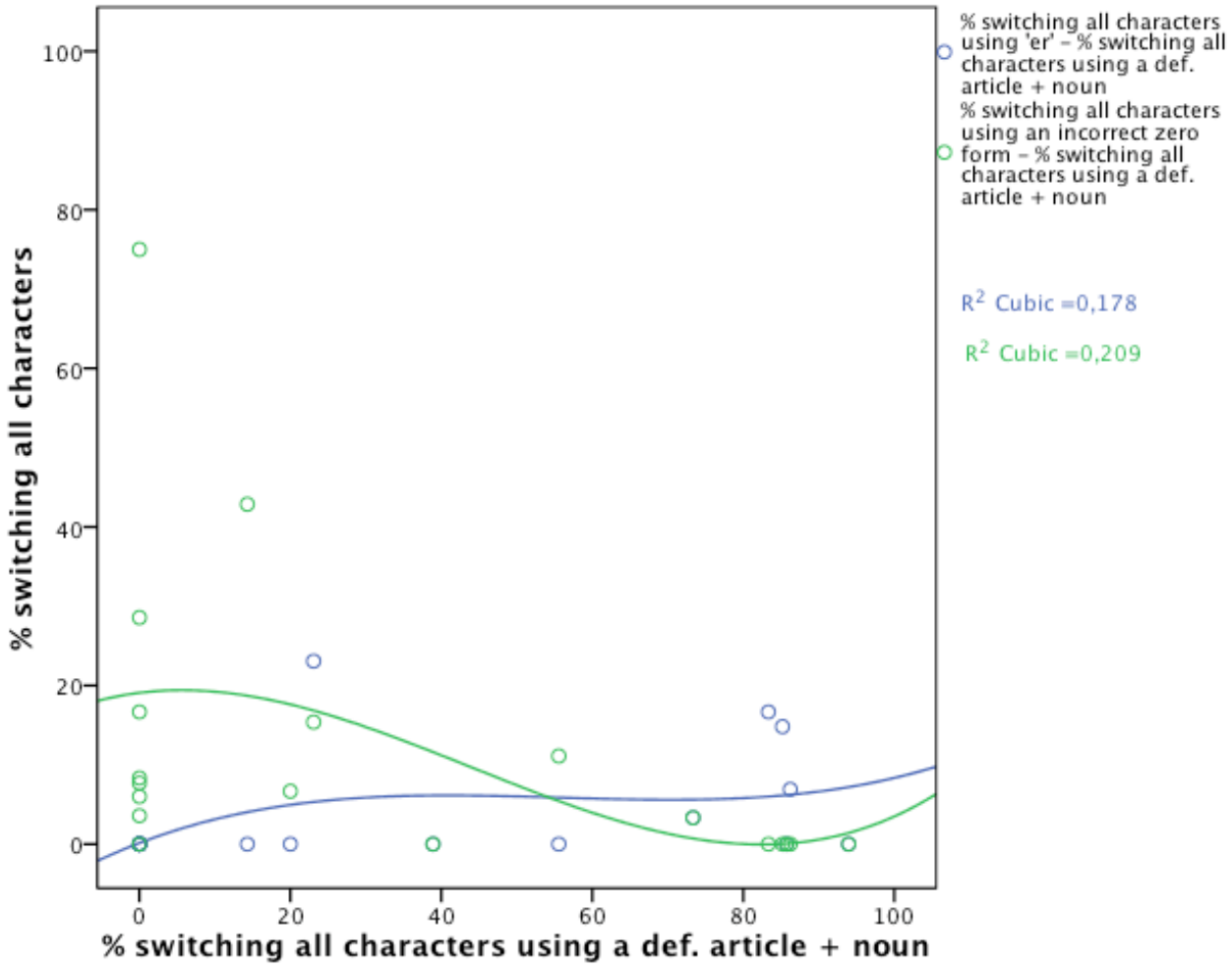


Diagram 94: % of switching all characters using the pronoun `er´ or an incorrect zero form per participant by % of switching all characters using a def. article + N.

6.5.1.2 Correlations between participant characteristics and referring expressions

Introducing correlated with age

As regards the use of referring expressions and age in the picture story, there was a significant correlation between age and the use of incorrect zero forms when introducing story characters, r_s=-.49, p=.033. The correlation suggests that the younger participants are, the more incorrect zero forms they use when talking about story characters for the first time.

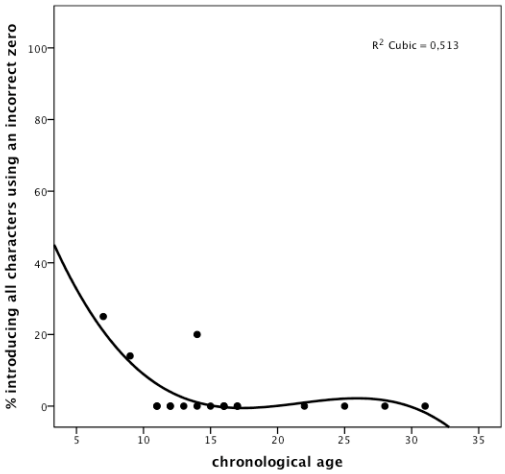


Diagram 95: % of introducing all characters using an incorrect zero form per participant by chronological age.

Maintaining correlated with age

Moreover, a significant correlation was found between age and the use of bare nouns to maintain story characters, r_s=-.56, p=.012. This shows that younger participants use more bare noun constructions when maintaining reference to story characters than older participants, which is ungrammatical in German.

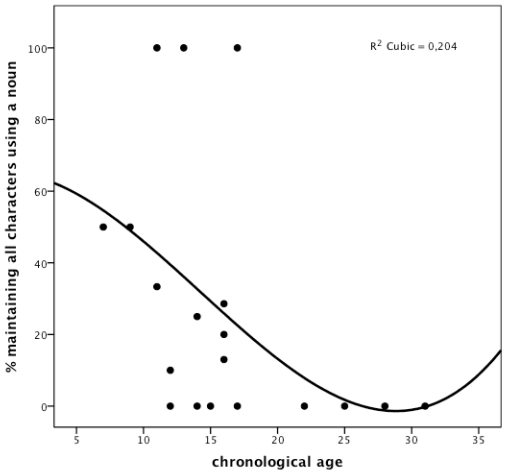


Diagram 96: % of maintaining all characters using a bare noun per participant by chronological age.

A further result showed a significant correlation between age and maintaining story characters with the pronoun *er*, r_s=.58, p=.010. This relation indicates that the older participants are, the more they use the pronoun *er* to refer back to just mentioned story characters.

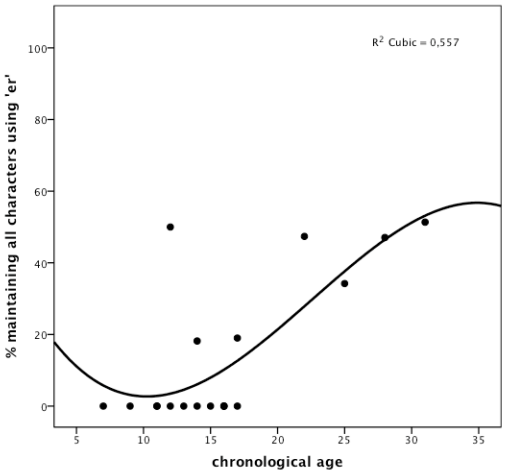


Diagram 97: % of maintaining all characters using the pronoun `er´ per participant by chronological age.

Switching correlated with age

Concerning the switching of story characters, a significant correlation was found between age and switching characters using bare nouns, r_s=-.47, p=.044. As illustrated in the diagram below, this shows that older participants do not use bare nouns to switch story characters.

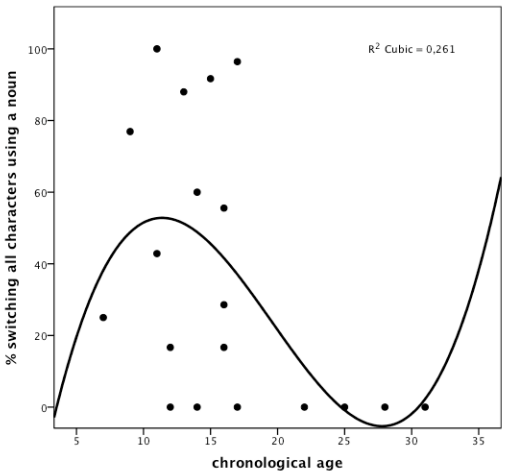


Diagram 98: % of switching all characters using a bare noun per participant by chronological age.

Another significant correlation was found between age and switching characters using incorrect zero forms, r_s=-.47, p=.043. As shown in the diagram below, this suggests that older participants do not use incorrect zero forms to switch between characters.

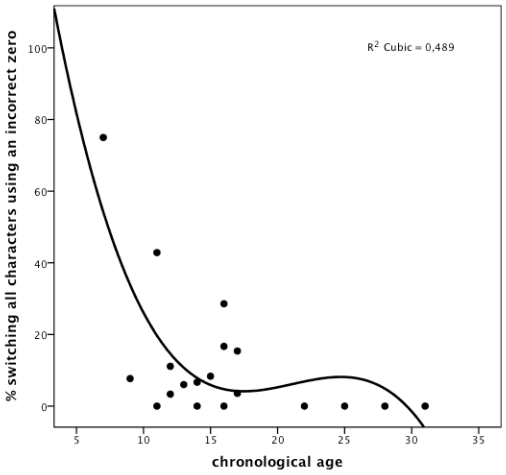


Diagram 99: % of switching all characters using an incorrect zero form per participant by chronological age.

Furthermore, there was a significant correlation between age and switching using a definite article + noun, r_s=.53, p=.020. As illustrated in the diagram below, this result shows that older participants use more definite article + noun constructions to switch between characters than younger ones.

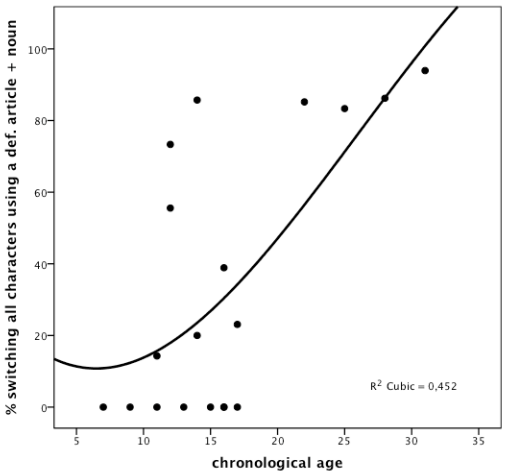


Diagram 100: % of switching all characters using a def. article + N per participant by chronological age.

Finally, there was a significant correlation between age and switching using the pronoun *er*, r_s=.49, p=.032. This shows that older participants sometimes use the pronoun *er* to switch between characters, whereas younger do not (see the diagram below). However, the pronoun *er* is not pragmatically correct.

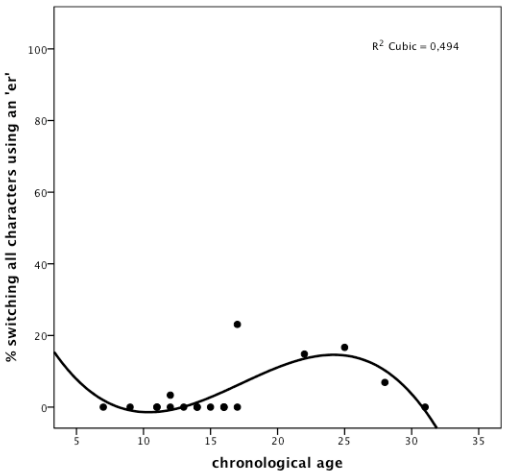


Diagram 101: % of switching all characters using the pronoun `er´ per participant by chronological age.

Introducing correlated with IQ

Regarding the use of referring expressions and IQ, a significant correlation could be noted between language comprehension and introducing story characters by use of a bare noun, r_s=-.54, p=.036. This shows that participants with the highest language comprehension do not introduce characters with a bare noun, which would be grammatically incorrect (see the following diagram).

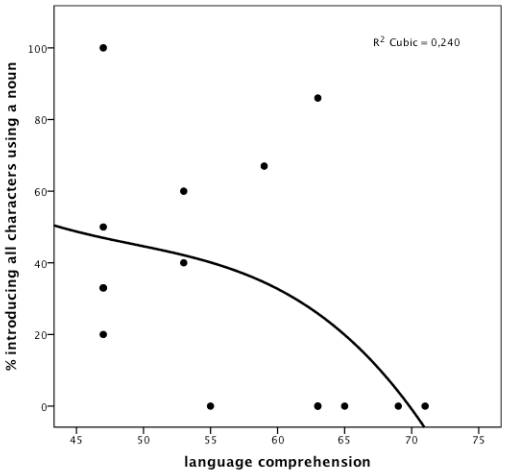


Diagram 102: % of introducing all characters using a bare noun per participant by chronological age.

Moreover, there was a significant correlation between language comprehension and introducing story characters using an indefinite article + noun, r_s=.56, p=.030. This suggests that the higher participants' language comprehension is, the more indefinite article + noun constructions they use to introduce story characters.

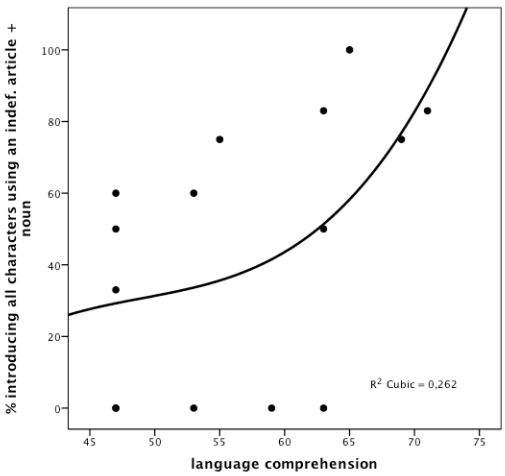


Diagram 103: % of introducing all characters using an indef. article + N per participant by language comprehension.

Maintaining correlated with IQ

Moreover, there was a significant correlation between IQ and maintaining of character reference. For example, there was a significant relationship between general IQ and the use of incorrect zero forms when maintaining reference, r_s=-.60, p=.024 (see the diagram below). More specifically, there was a significant relationship between language comprehension and incorrect zero forms, r_s=-.04, p=.038, and logical thinking and incorrect zero forms, r_s=-.54, p=.038. These results suggest that participants with a higher IQ do not maintain characters using zero forms which are both grammatically and pragmatically incorrect.

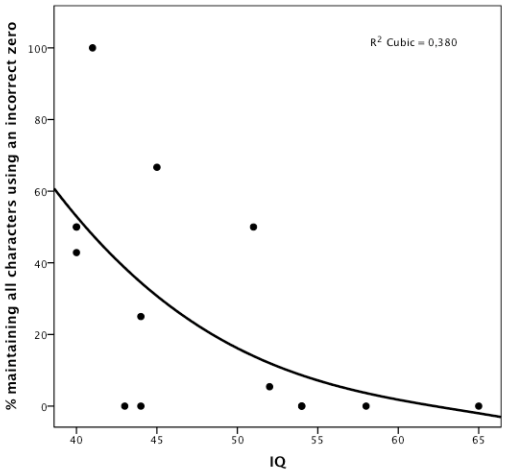


Diagram 104: % of maintaining all characters using an incorrect zero form per participant by IQ.

Moreover, there was a significant correlation between language comprehension and maintaining characters using the pronoun *er*, r_s=.59, p=.020, as well as working memory and maintaining using the pronoun *er*, r_s=.58, p=.019. As illustrated in the diagrams below, these results show that participants with higher language comprehension and higher working memory use the pronoun *er* to maintain reference to a story character, whereas participants with lower language comprehension and working memory do not.

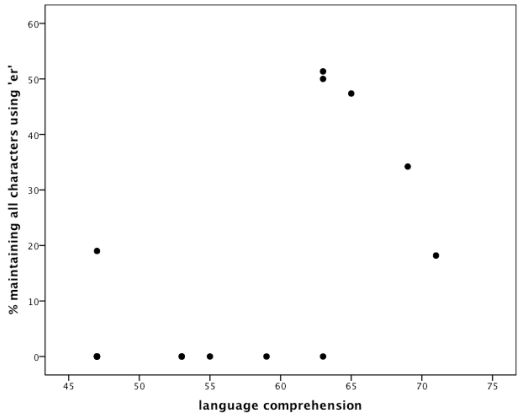


Diagram 105: % maintaining all characters using `er´ per participant by language comprehension.

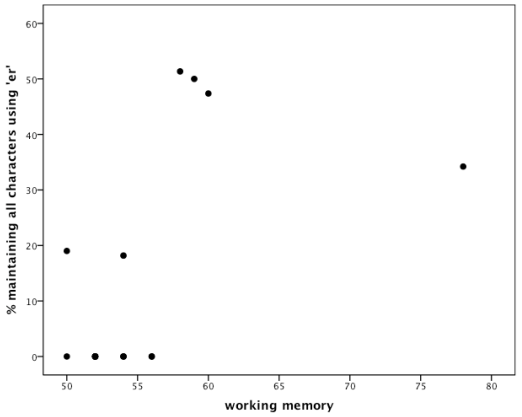


Diagram 106: % maintaining all characters using `er´ per participant by language comprehension.

Switching correlated with IQ

As concerns the switching of story characters, there was a significant correlation between general IQ and the use of indefinite articles, r_s=-.56, p=.037, as well as general IQ and the use of incorrect zero forms, r_s=-.65, p=.012. As shown in the diagram below, these results suggest that participants with a higher IQ do not use an indefinite article + noun for switching story characters, which is grammatically correct, but not pragmatically. Moreover, they do not use incorrect zero forms for switching, which is both grammatically and pragmatically incorrect.

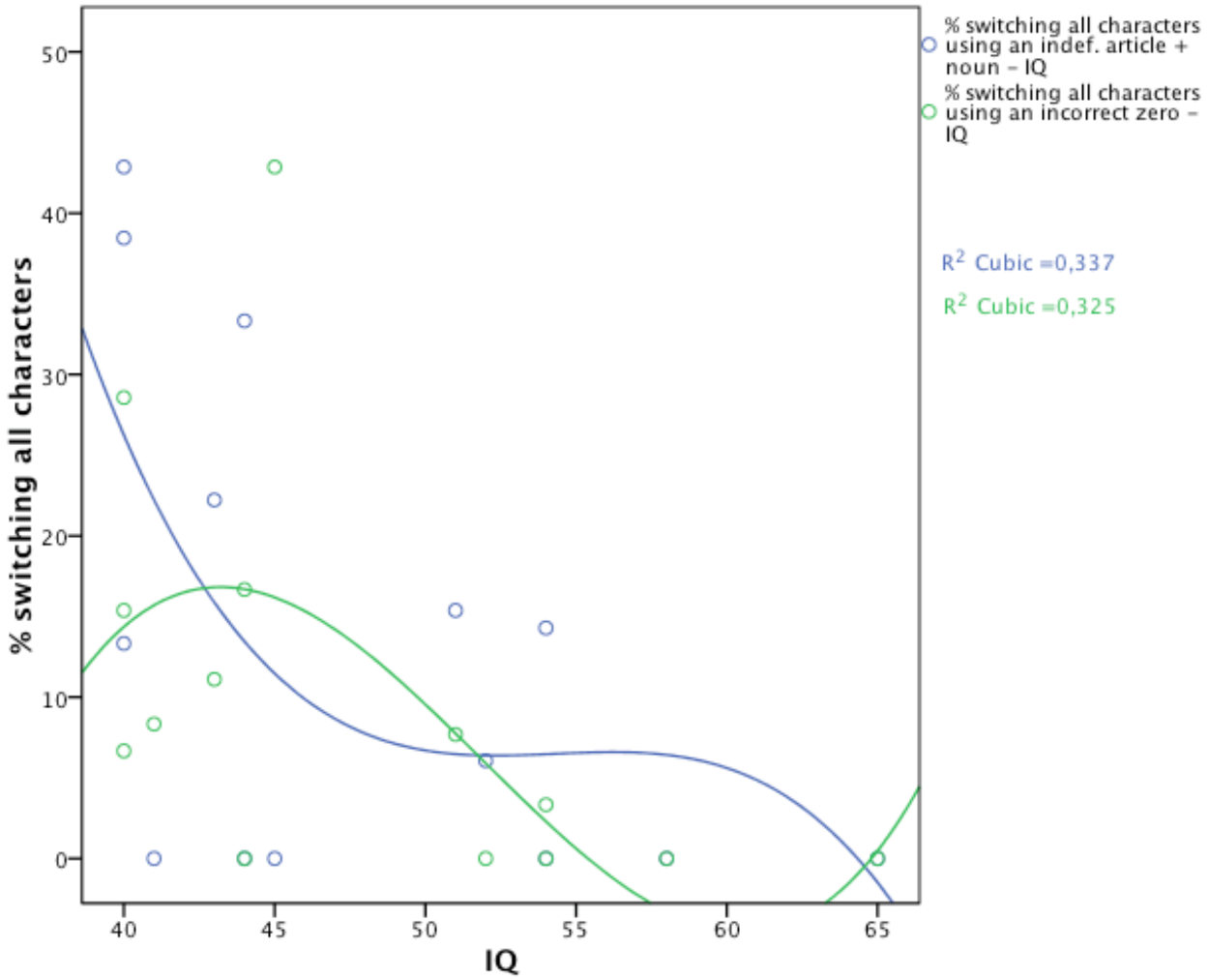


Diagram 107: % of switching all characters using an indef. article + N or an incorrect zero form per participant by IQ.

To be more specific, there was a significant correlation between the use of indefinite articles + nouns to switch to story characters, and logical thinking, r_s=-.49, p=.039, the use of indefinite articles + nouns and working memory, r_s=.-63, p=.010, as well as the use of indefinite articles + nouns and processing speed, r_s=.-60, p=.012 (see the diagram below).

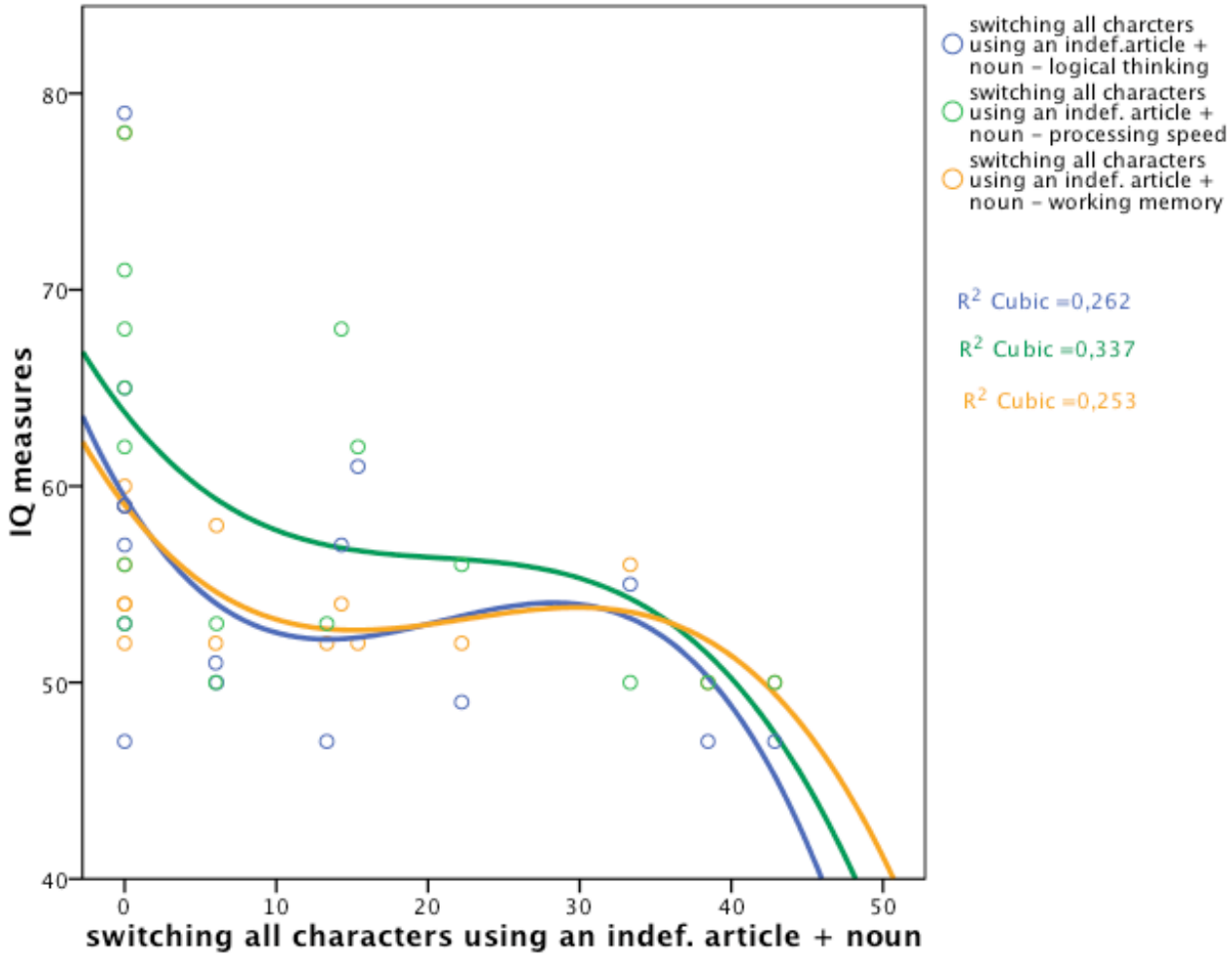


Diagram 108: % of switching all characters using an indef. article + N per participant by logical thinking, processing speed and working memory.

Similarly, there was a significant correlation between (1) the use of incorrect zero forms for switching to characters and logical thinking, r_s=-.56, p=.015, (2) incorrect zero forms and working memory, r_s=-.69, p=.003, (3) incorrect zero forms and processing speed, r_s=-.58, p=.015, as well as (4) incorrect zero forms and language comprehension, r_s=-.58, p=.023. These correlations are illustrated in the diagram below. In general, it can be seen that participants who use none or few incorrect zero forms to switch to characters show higher logical thinking, processing speed, working memory and language comprehension. One participant (ID 5) is an outlier. She is 9 years old and thus the second youngest participant. She shows more incorrect zero forms when switching to story characters than would be expected, based on her processing speed (62) alone.

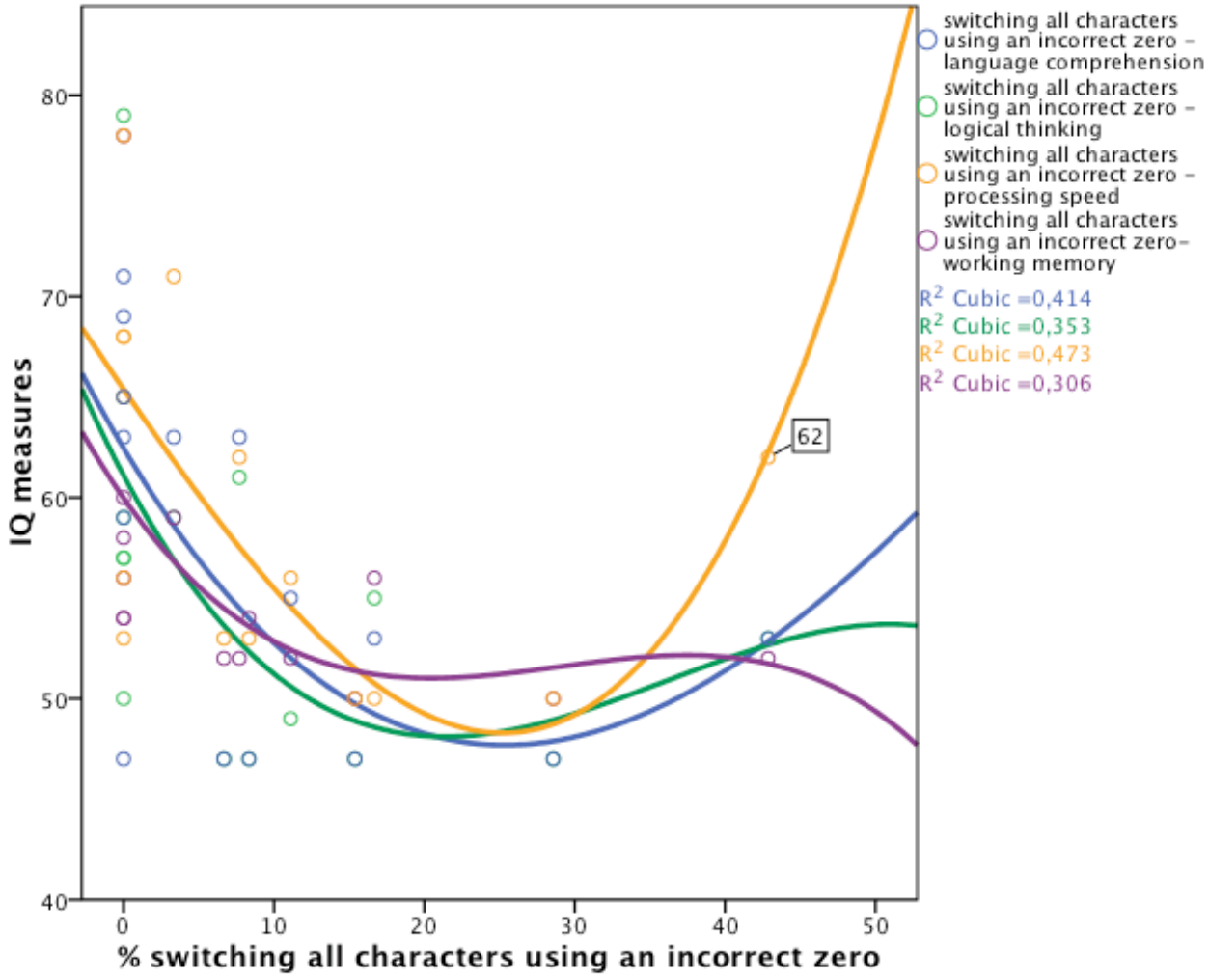


Diagram 109: % of switching all characters using an incorrect zero form per participant by language comprehension, logical thinking, processing speed, and working memory.

Finally, there was a significant correlation between language comprehension and the use of a definite article + noun to switch to characters, r_s=.60, p=.018. This suggests that participants with higher language comprehension switch between characters using a definite article + noun, whereas participants with a lower language comprehension do so less frequently.

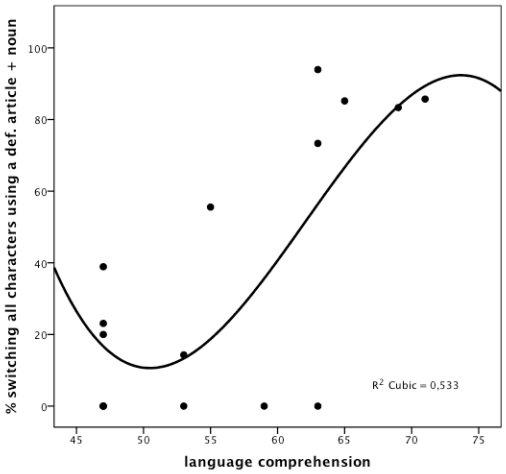


Diagram 110: % of switching all characters using a def. article + N per participant by language comprehension.

Introducing, maintaining and switching correlated with language measures

The type of reference used for introducing, maintaining and switching all characters showed significant correlations with the various language measures. Language measures included the plural test (see Chapter 5.3.2), the past participle test (see Chapter 5.3.3), and a composite total score consisting of the plural test and the past participle test, which was named ‘grammar’. Furthermore, language measures included vocabulary size measures based on the picture story test, namely a type, token and lemma analysis (see 5.3.4). In what follows, the relationship between the type of reference and the language measures will be described for introducing, maintaining and switching respectively.

Introducing

Remember, the indefinite article + noun was the preferred choice for introducing story characters (40%) (see Chapter 11.1). And there was a significant correlation between introducing story characters using this form and the various language measures (see the diagram below). Thus, there was a significant correlation between introducing story characters using an indefinite article + noun and the composite grammar score, r_s=.54, p=.017. Moreover, there was a significant correlation between introducing story characters using an indefinite article + noun and the total score on the plural test, r_s=.54, p=.018. Also, the lexical measures yielded significant correlations. Thus, there was a significant correlation between introducing story characters using an indefinite article + noun and the total number of types used in the picture story, r_s=.54, p=.017. Furthermore, there was a significant correlation between introducing story characters using an indefinite article + noun and the total number of token used for telling the picture story, r_s=.54, p=.014. Finally, there was a significant correlation between introducing story characters using an indefinite article + noun and the total number of lemmata used in the picture story, r_s=.57, p=.011. In sum, these results suggest that participants with higher grammatical skills and a larger lexicon use more indefinite articles + nouns to introduce story characters, whereas participants with lower grammatical skills and a smaller lexicon are less likely to do so.

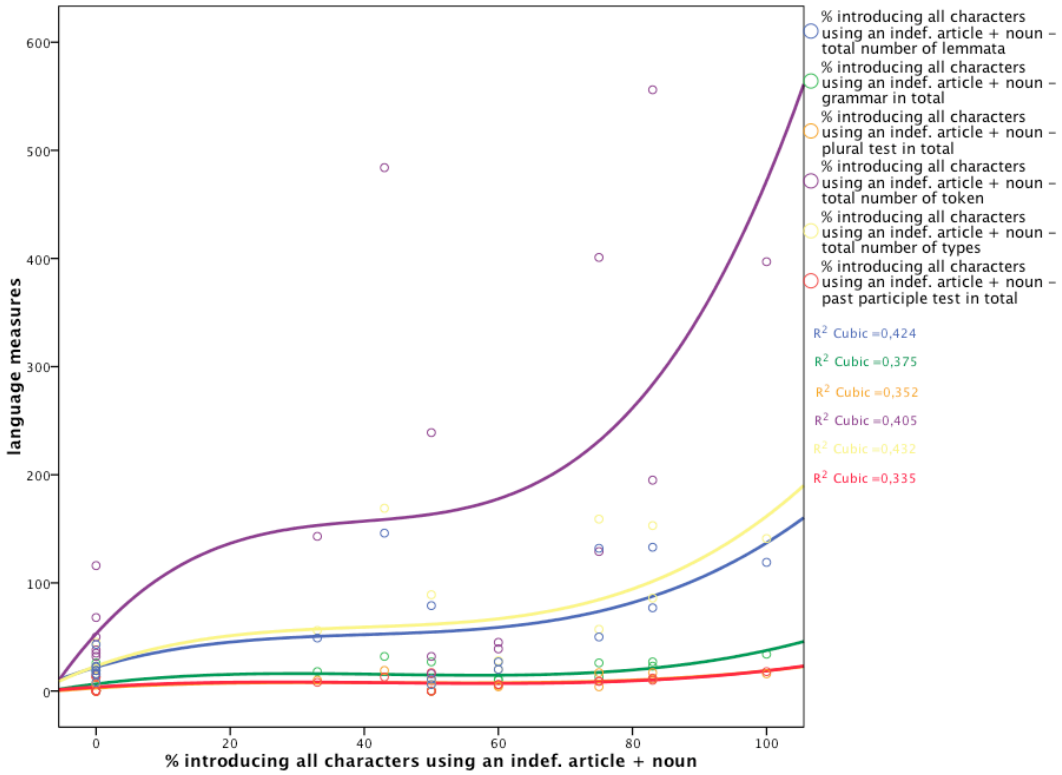


Diagram 111: % of introducing all characters using an indef. article + N per participant by grammatical and lexical measures.

The second most frequent form to introduce story characters was the bare noun construction (37.9%), which is both grammatically and pragmatically incorrect. The percentage of use was also related with the various language measures (see the diagram below). So, there was a significant correlation between introducing all characters using a bare noun and the total score on the plural test, r_s=-.80, p=.000. Furthermore, there was a significant correlation between introducing all characters using a bare noun and the total score on the past participle test, r_s=-.77, p=.000. Therefore, there was also a significant correlation between introducing all characters using a bare noun and the composite score on grammar, r_s=-.83, p=.000. In addition to these grammatical measures, the lexical measures also showed significant correlations. As such, there was a significant correlation between introducing all characters using a bare noun and the total number of types used in the pictures story, r_s=-.79, p=.000. Also, there was a significant correlation between introducing all characters using a bare noun and the total number of token used to tell the picture story, r_s=-.76, p=.000. Finally, there was a significant correlation between introducing all characters using a bare noun and the total number of lemmata in the picture story, r_s=-.80, p=.000. Taken together, these results indicate that participants with higher grammatical skills and a larger vocabulary size, are less likely to introduce story characters using a bare noun, whereas participants with lower grammatical skills and a smaller vocabulary size, are more likely to do so.

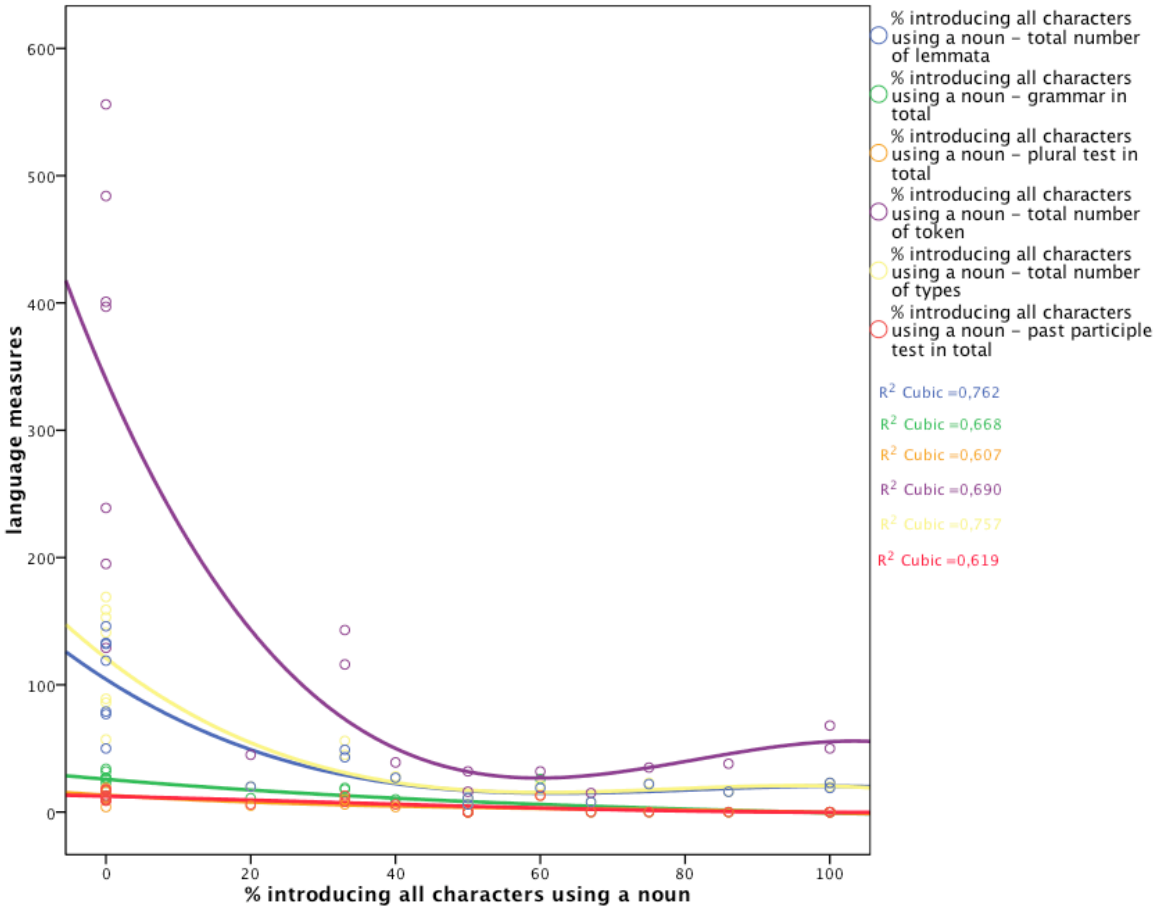


Diagram 112: % of introducing all characters using a bare noun per participant by grammatical and lexical measures.

The definite article + noun was the third most frequent type of reference used (17.9%). It is grammatically correct, but pragmatically ill-formed. Similarly to the other types of reference, there were significant correlations with grammar and vocabulary measures (see the diagram below). Thus, there was a significant correlation between introducing story characters using a definite article + noun and the total score on the plural test, r_s=.68, p=.001. Also, there was a significant correlation between introducing all characters using a definite article + noun and the total score on the past participle test, r_s=.74, p=.000. Consequently, there was also a significant correlation between introducing story characters using a definite article + noun and the composite grammar score, r_s=.69, p=.001. Furthermore, there was a significant correlation between introducing story characters using a definite article + noun and the total number of types used in the picture story, r_s=.62, p=.005. Also, there was a significant correlation between introducing story characters using a definite article + noun and the total number of token used for telling the picture story, r_s=.53, p=.018. Finally, there was a significant correlation between introducing story characters using a definite article + noun and the total number of lemmata used in the picture story, r_s=.58, p=.009. In short, these results suggest that participants with higher grammar and vocabulary skills more frequently use a definite article + noun to introduce story characters, whereas participants with lower grammar and vocabulary skills less frequently do so.

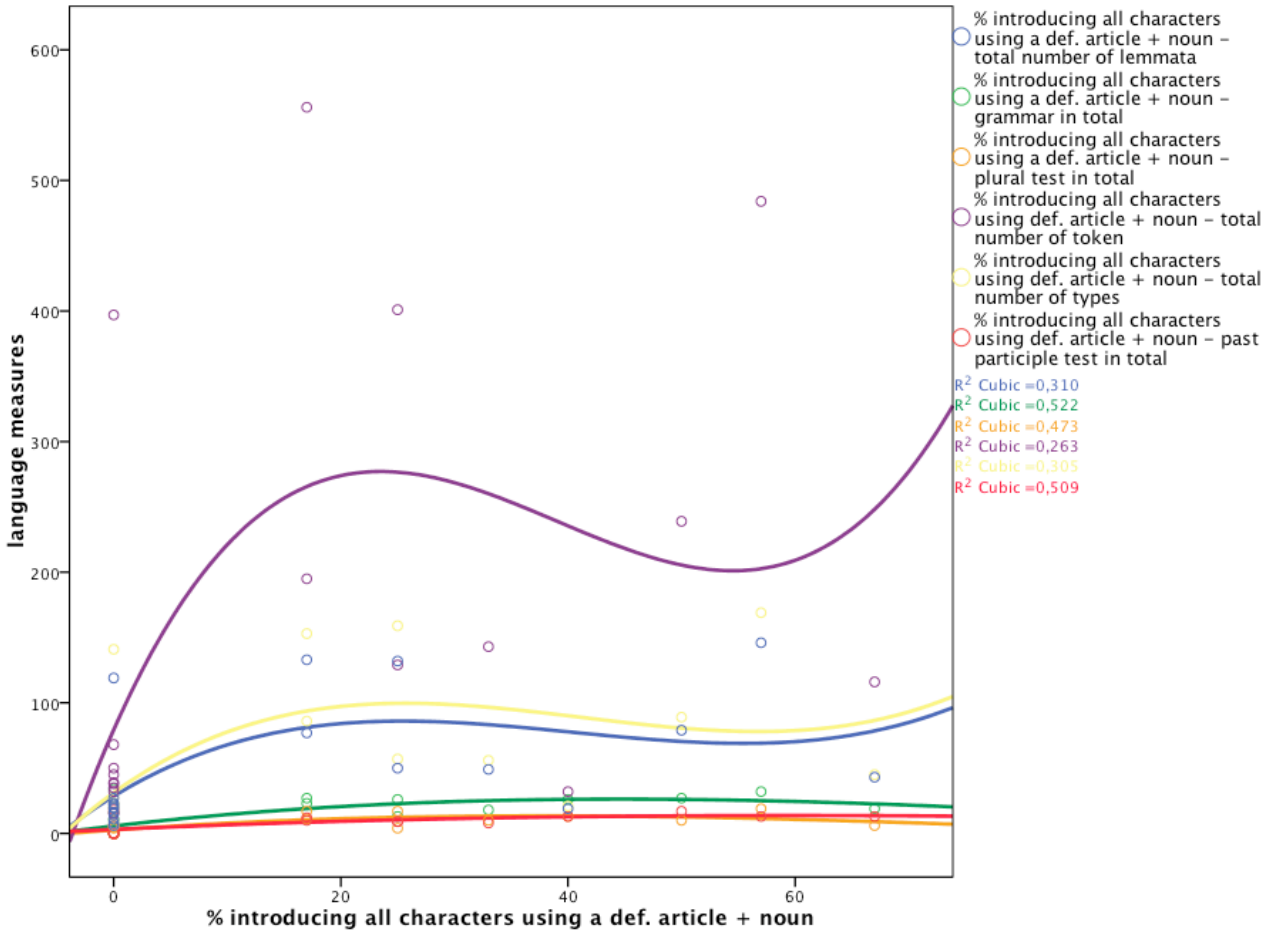


Diagram 113: % of introducing all characters using a def. article + N per participant by grammatical and lexical measures.

Taken together, the above results suggest that participants with higher grammatical and lexical skills either choose an indefinite article + noun or a definite article + noun to introduce story characters. The indefinite article + noun construction is both grammatically and pragmatically correct, whereas the definite article + noun is grammatically legal, but pragmatically ill-formed. Participants with lower grammatical and lexical skills, on the other hand, use a bare noun construction to introduce story characters. It is both grammatically illegal and pragmatically incorrect.

Maintaining

As regards the maintaining of story characters, participants most frequently chose the pronoun *er* (29.5%) (see also Chapter 11.6.2 in the appendix). And there were significant correlations between maintaining characters using the pronoun *er* and all language measures (see the diagrams below). Thus, there was a significant correlation between maintaining story characters using *er* and the total score on the plural test, r_s=.79, p=.000. Moreover, there was a significant correlation between maintaining all characters using *er* and the total score on the past participle test, r_s=.67, p=.002. Therefore, there was also a significant correlation on maintaining all characters using *er* and the composite grammar score, r_s=.82, p=.000. Moreover, there was a significant correlation between maintaining all characters using *er* and the total number of types used in the picture story, r_s=.82, p=.000. Likewise, there was a significant correlation between maintaining all characters using *er* and the total number of token used for telling the picture story, r_s=.85, p=.000. Finally, there was a significant correlation between maintaining story characters and the total number of lemmata used in the picture story, r_s=.82, p=.000. In sum, these results suggest that participants with higher grammatical and lexical skills are more likely to choose the pronoun *er* to maintain reference to story characters, whereas participants with lower grammatical and lexical skills are less likely to do so.

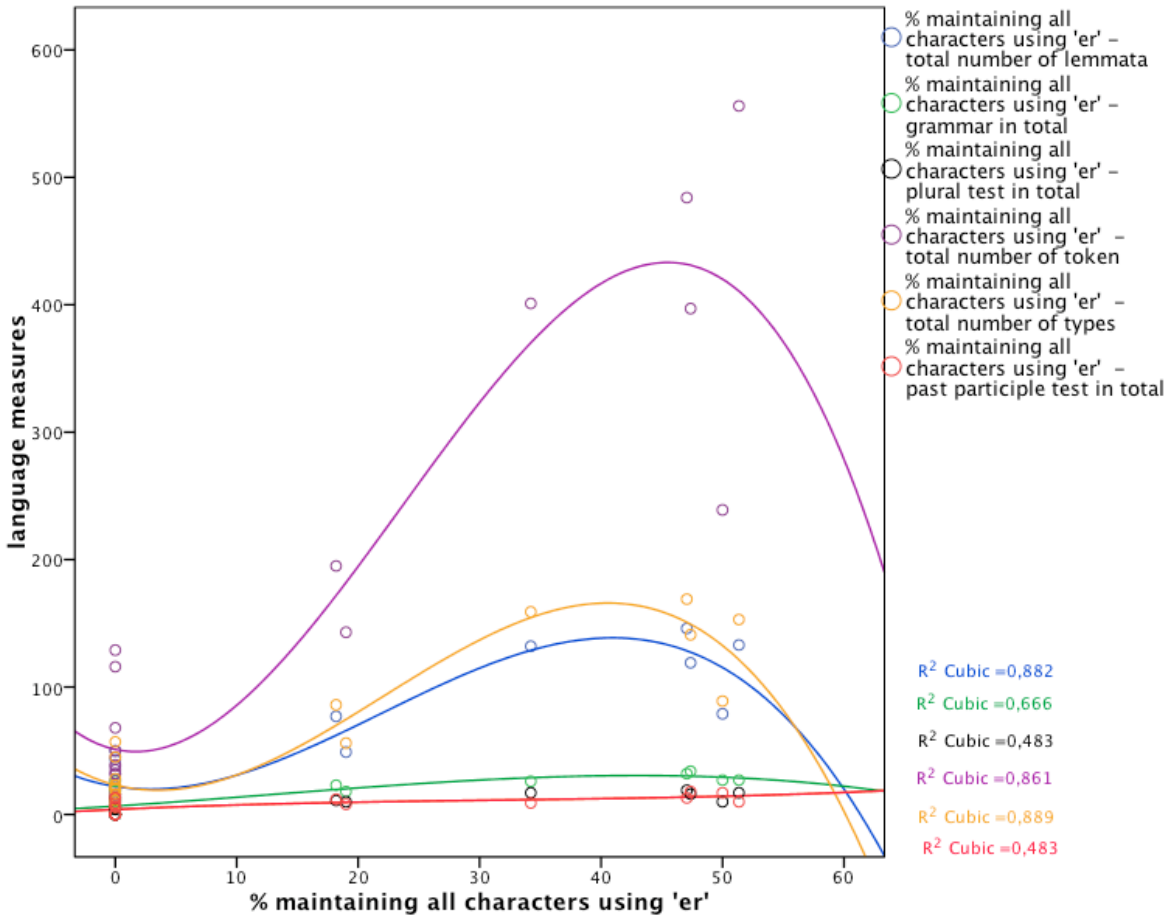


Diagram 114: % of maintaining all characters using the pronoun er per participant by grammatical and lexical measures.

The second most frequent type of reference for maintaining all characters was a definite article + noun (19%). This type of reference is both grammatically and pragmatically correct. There were again significant correlations with grammatical and lexical measures (see the diagram below). Thus, there was a significant correlation between maintaining all story characters using a definite article + noun and the total score on the plural test, r_s=.73, p=.000. Also, there was a significant correlation between maintaining all characters using a definite article + noun and the total score on the past participle test, r_s=.82, p=.000. So, there was also a significant correlation between maintaining all characters using a definite article + noun and the composite grammar score, r_s=.78, p=.000. The vocabulary measures also yielded significant results; there was a significant correlation between maintaining all characters using a definite article + noun and the total number of types used in the picture story, r_s=.77, p=.000. Moreover, there was a significant correlation between maintaining all characters using a definite article + noun and the total number of token used for telling the story, r_s=.71, p=.001. Finally, there was a significant correlation between maintaining all characters using a definite article + noun and the total number of lemmata, r_s=.75, p=.000. All in all, these results indicate that participants with higher grammatical and lexical skills more frequently use a definite article + noun to maintain reference to story characters, whereas participants with lower grammatical and lexical skills less frequently do so.

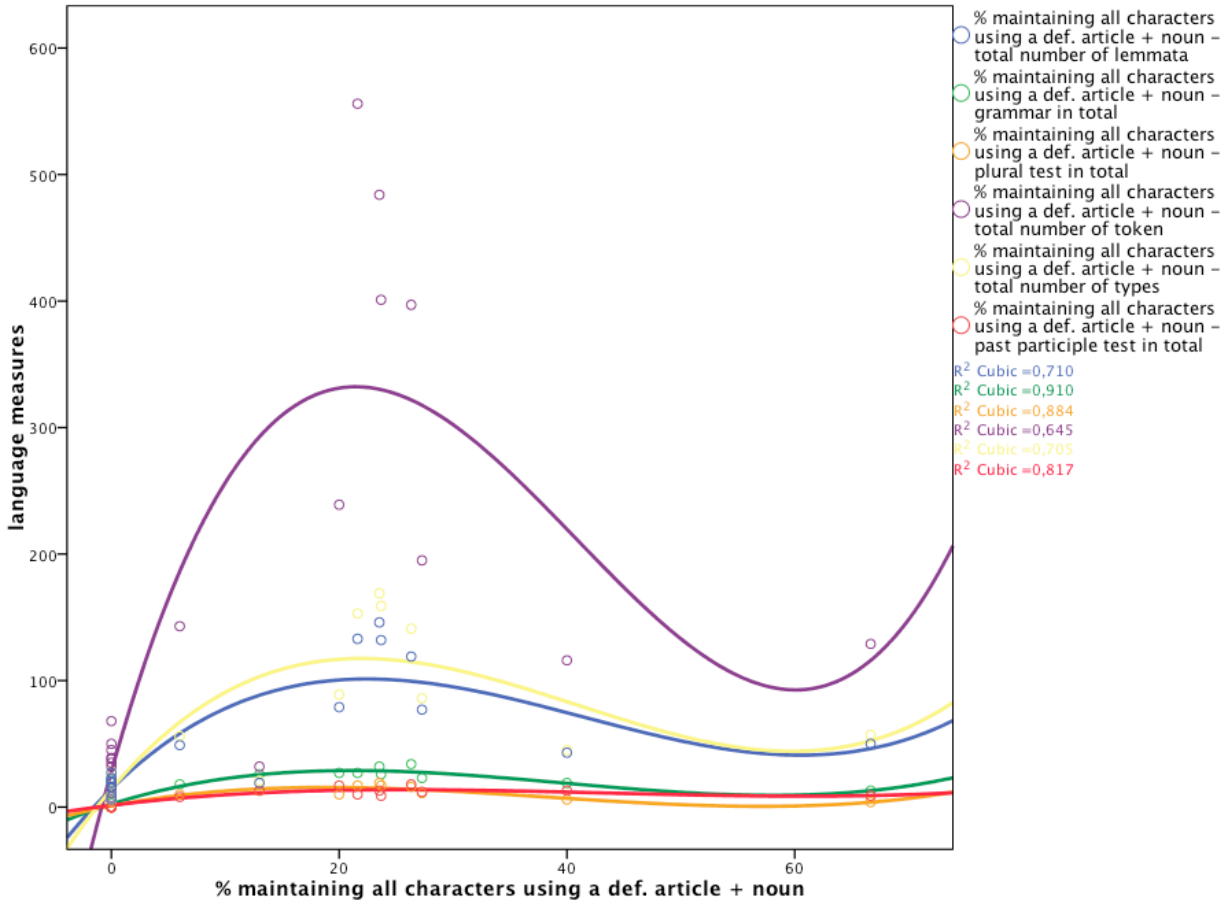


Diagram 115: % of maintaining all characters using a def. article + N per participant by grammatical and lexical measures.

As can be seen in the diagram above, there were two outliers, who go against this trend. The first is a participant (ID 10) aged 16 with an IQ of 44, who used definite articles + nouns to maintain reference to characters in 40% of instances. She thus showed the second highest percentage of definite articles + nouns for maintaining characters. However, she showed a rather low number of token (N=116), types (N=45) and lemmata (N=43). Moreover, she produced a low number of correct plurals (N=8, 29%). Nevertheless, her results on the past participle test (N=13, 65%) were fairly high. Still, the participant produced 40% definite articles + nouns for maintaining reference, 40% correct zero forms and 20% bare nouns. By using definite articles + nouns and correct zero forms she thus shows a high percentage of grammatically and pragmatically correct types of reference despite her low scores on grammatical and lexical measures.

The second outlier is a participant (ID 12) aged 12 with an IQ of 43. She also produced a rather low number of token (N=129), types (N=57) and lemmata (N=50). Moreover, she showed a rather lower performance on the plural test (N=7, 33%) and past participle test (N=9, 45%). Still, she produced 66.67% definite articles + nouns to maintain reference and 33.33% correct zero forms. She thus only uses grammatically and pragmatically correct types of reference for maintaining story characters, despite her low performance on grammatical and lexical measures.

The third most frequent type of reference used for maintaining story characters, were correct zero forms (14%). Again, there were significant correlations with grammatical and lexical measures (see the diagram below). So, there was a significant correlation between maintaining all characters using a correct zero form and the total number of correct responses on the plural test, r_s=.48, p=.036. Moreover, there was a significant correlation between maintaining story characters and the total number of correct responses on the past participle test, r_s=.52, p=.023. Thus, there was also a significant correlation between maintaining all characters using a correct zero form and the composite grammar score, r_s=.51, p=.024. The lexical measures also yielded significant results. So, there was a significant correlation between maintaining all characters using a correct zero form and the total number of types, r_s=.62, p=.005. Furthermore, there was a significant correlation between maintaining story characters using a correct zero form and the total number of token, r_s=.60, p=.007. Finally, there was a significant correlation between maintaining story characters and the total number of lemmata, r_s=.62, p=.005. In sum, these results suggest that participants with higher grammatical and lexical skills, use more correct zero forms than participants with lower language skills.

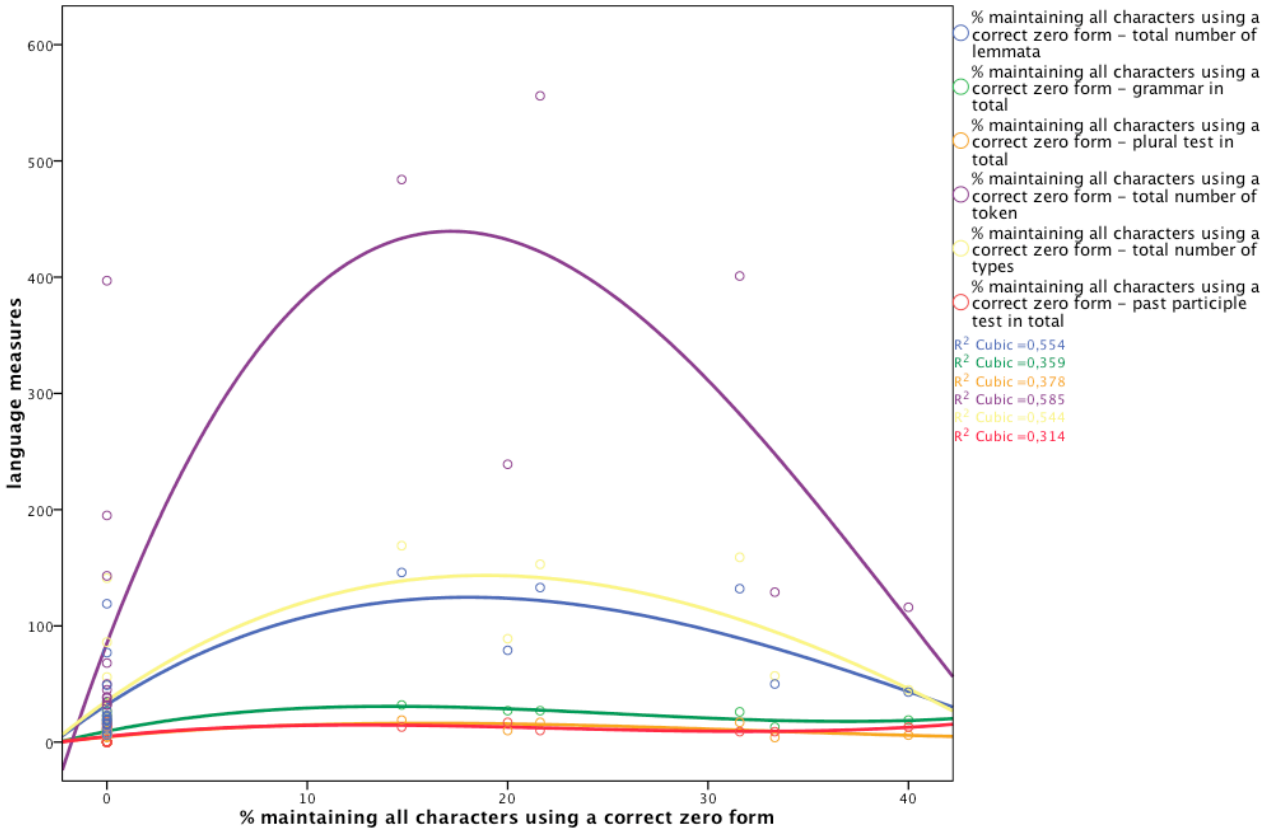


Diagram 116: % of maintaining all characters using a correct zero form per participant by grammatical and lexical measures.

As can be seen in the diagram above, there were two outliers. Again, these are the above mentioned participants (ID 10 and ID 12). Participant ID 12 showed the second highest percentage of correct zero forms for maintaining story characters (33%), despite her low performance on grammatical and lexical measures. Participant ID 10 showed the highest percentage of correct zero forms for maintaining story characters (40%), despite her low lexical measures and her low performance on the plural test.

Story characters were also maintained using a bare noun (11.5%). Significant correlations were observed between maintaining all characters using a bare noun and the total number of correct plural forms on the plural test, r_s=-.74, p=.000. Also, there was a significant correlation between maintaining story characters using a bare noun and the total number of correct past participles on the past participle test, r_s=-.65, p=.003. Therefore, there was also a significant correlation between maintaining all characters using a bare noun and the composite grammar score, r_s=-.72, p=.000. Lexical measures also yielded significant results. Thus, there was a significant correlation between maintaining all characters using a bare noun and the total number of types used in the picture story, r_s=-.83, p=.000. Moreover, there was a significant correlation between maintaining all characters using a bare noun and the total number of token used for telling the story, r_s=-.78, p=.000. Finally, there was a significant correlation between maintaining all characters using a bare noun and the total number of lemmata used in the picture story, r_s=-.83, p=.000. Taken together, these results show that participants with higher grammatical and lexical skills rarely use bare nouns to maintain reference to story characters, whereas participants with lower grammatical and lexical skills do.

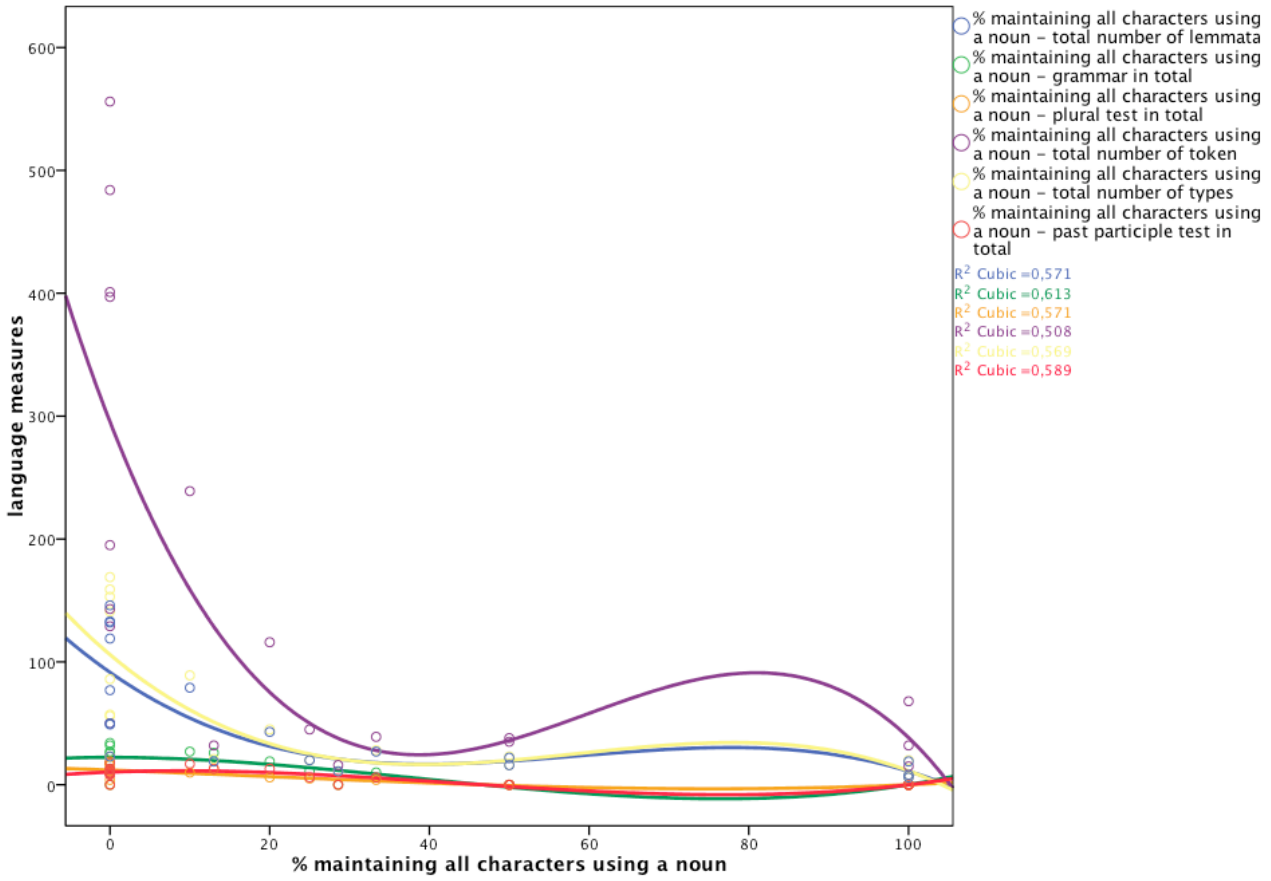


Diagram 117: % of maintaining all characters using a bare noun per participant by grammatical and lexical measures.

Finally, significant correlations between grammatical/lexical measures and maintaining all characters using a possessive pronoun + noun were observed (see the diagram below). Thus, there was a significant correlation between maintaining all characters using a possessive pronoun + noun and the total number of correct responses on the plural test, r_s=.51, p=.026. Also, there was a significant correlation between maintaining all characters using a possessive pronoun + noun and the total number of types used in telling the picture story, r_s=.50, p=.031. Moreover, there was a significant correlation between maintaining all characters using a possessive pronoun + noun and the total number of token used to tell the picture story, r_s=.47, p=.042. Finally, there was a significant correlation between maintaining all characters using a possessive pronoun + noun and the total number of lemmata used in the picture story, r_s=.47, p=.044. In sum, these results suggest that participants with higher scores on the plural test and a higher number of types, token and lemmata also produced more possessive pronouns + nouns to maintain reference to a story character, than participants with lower scores.

In the diagram below, one might believe to see an outlier, who goes against this trend. It was a participant (ID 13), who produced a possessive pronoun + noun to maintain reference in 6.25% of instances, despite showing low results on the language measures. In fact, however, she only used the possessive pronoun + noun once (N=1). Therefore, she cannot be regarded as a true outlier.

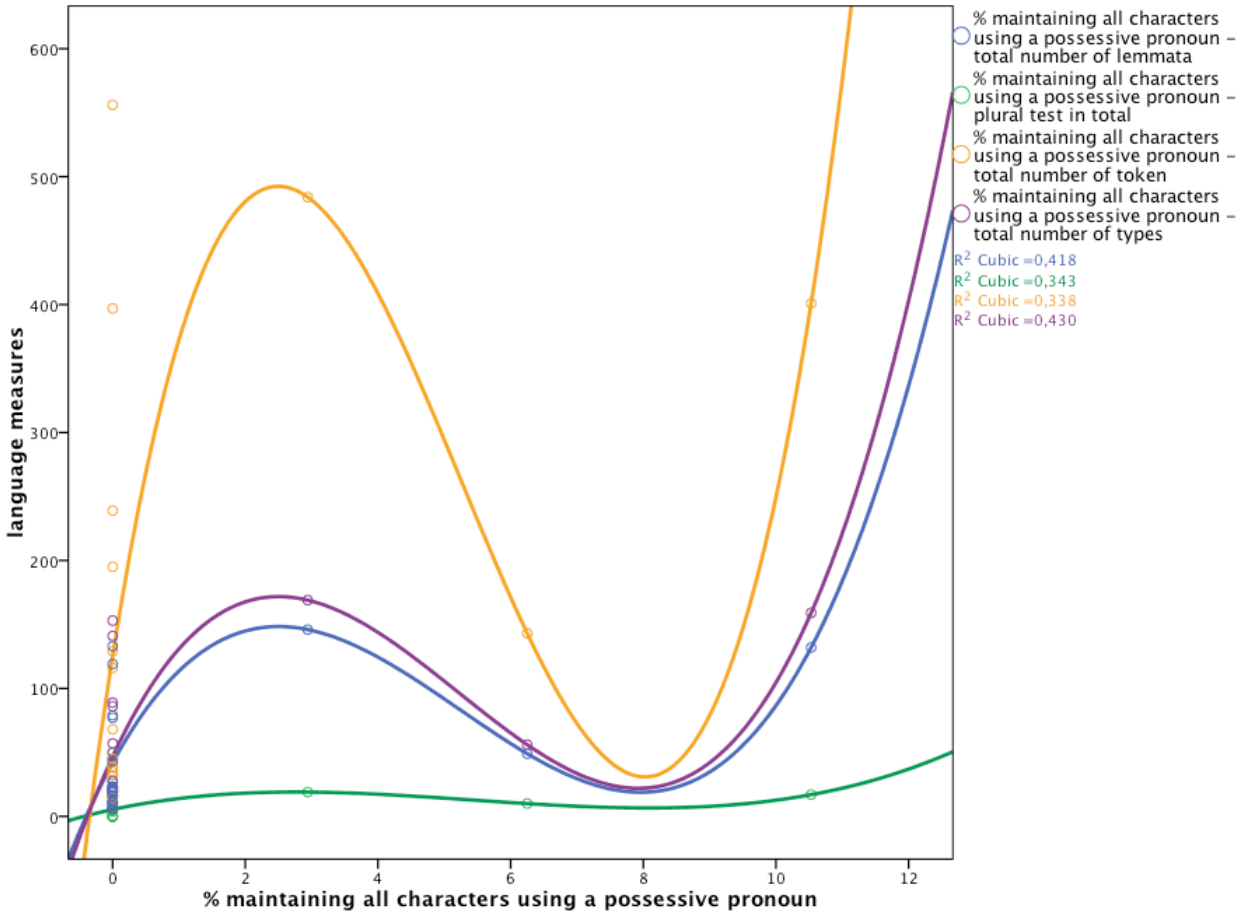


Diagram 118: % of maintaining all characters using a possessive pronoun per participant by grammatical and lexical measures.

Switching

Concerning switching, a number of significant correlations were observed between types of reference and participants' language measures (see the diagrams below). For example, participants most frequently used a definite article + noun (48%) and there was a significant correlation between switching characters using a definite article + noun and correct responses on the plural test, r_s=.85, p=.000. Moreover, there was a significant correlation between switching characters using a definite article + noun and correct responses on the past participle test, r_s=.77, p=.000. Therefore, there was also a significant correlation between switching characters using a definite article + noun and the composite grammar score, r_s=.86, p=.000. Moreover, there were significant correlations with lexical measures. So, there was a significant correlation between between switching all characters using a definite article + noun and the total number of types used in the picture story, r_s=.90, p=.000. Also, there was a significant correlation between switching all characters using a definite article + noun and the total number of token used for telling the picture story, r_s=.91, p=.000. Finally, there was a significant correlation between switching story characters and the total number of lemmata used in the picture story, r_s=.93, p=.000. Taken together, these results show that participants with higher grammatical and lexical skills produce more definite articles + nouns when switching to story characters than participants with lower language skills.

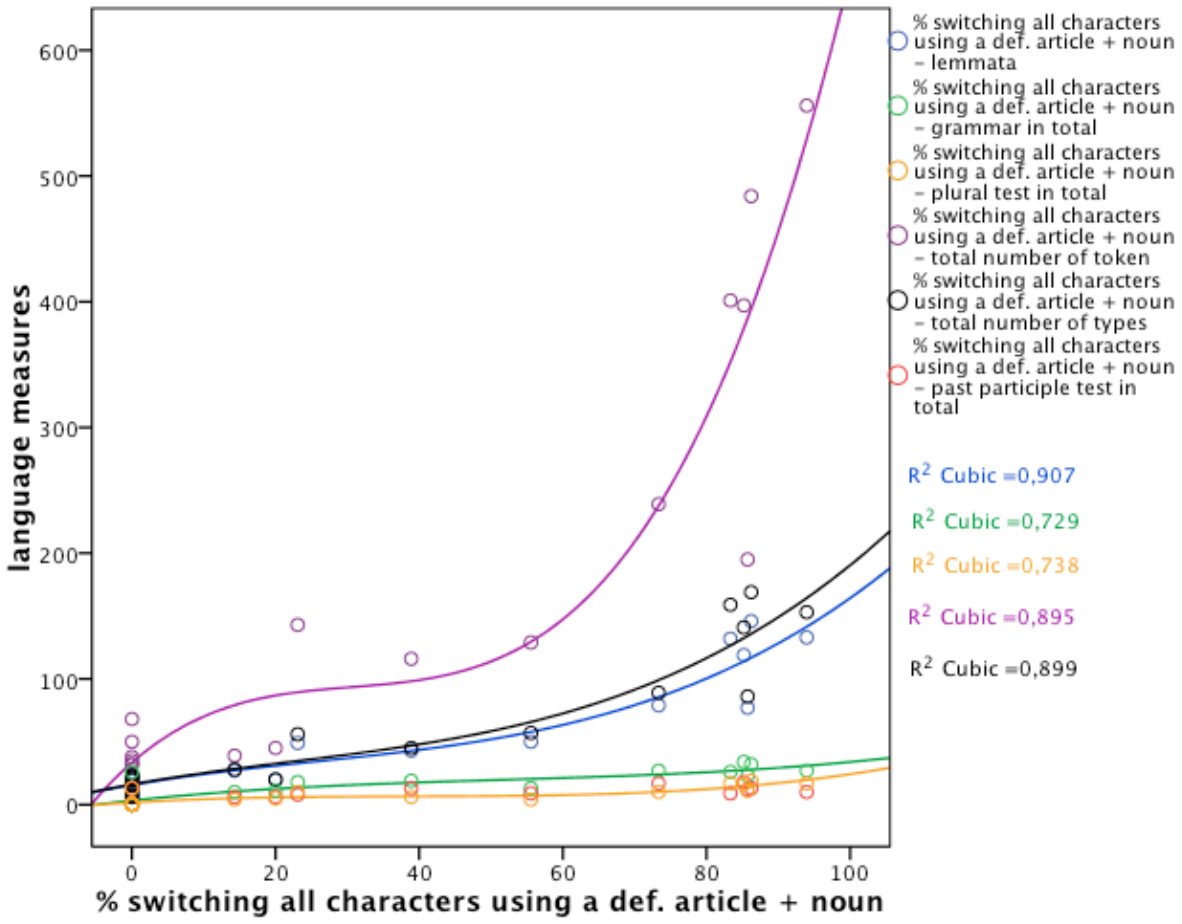


Diagram 119: % of switching all characters using a def. article + N per participant by grammatical and lexical measures.

When switching characters, bare nouns were the second most frequent type of reference (32.4%), although illegal. There was a significant correlation between switching characters using a bare noun and correct responses on the plural test, r_s=-.81, p=.000. Furthermore, there was a significant correlation between switching characters using a bare noun and correct responses on the past participle test, r_s=-.70, p=.001. Thus, there was also a significant correlation between switching characters using a bare noun and correct responses on the composite grammar score, r_s=-.79, p=.000. Additionally, there were significant correlations with the lexical measures. Thus, there was a significant correlation between switching all characters using a bare noun and the total number of types used in the picture story, r_s=-.83, p=.000. Moreover, there was a significant correlation between switching all characters using a bare noun and the total number of token used for telling the picture story, r_s=-.72, p=.001. Finally, there was a significant correlation between switching all characters using a bare noun and the total number of lemmata, r_s=-.81, p=.000. All in all, these results show that participants with higher grammatical and lexical skills used less bare nouns to switch characters, than participants with lower grammatical and lexical skills (see the diagram below).

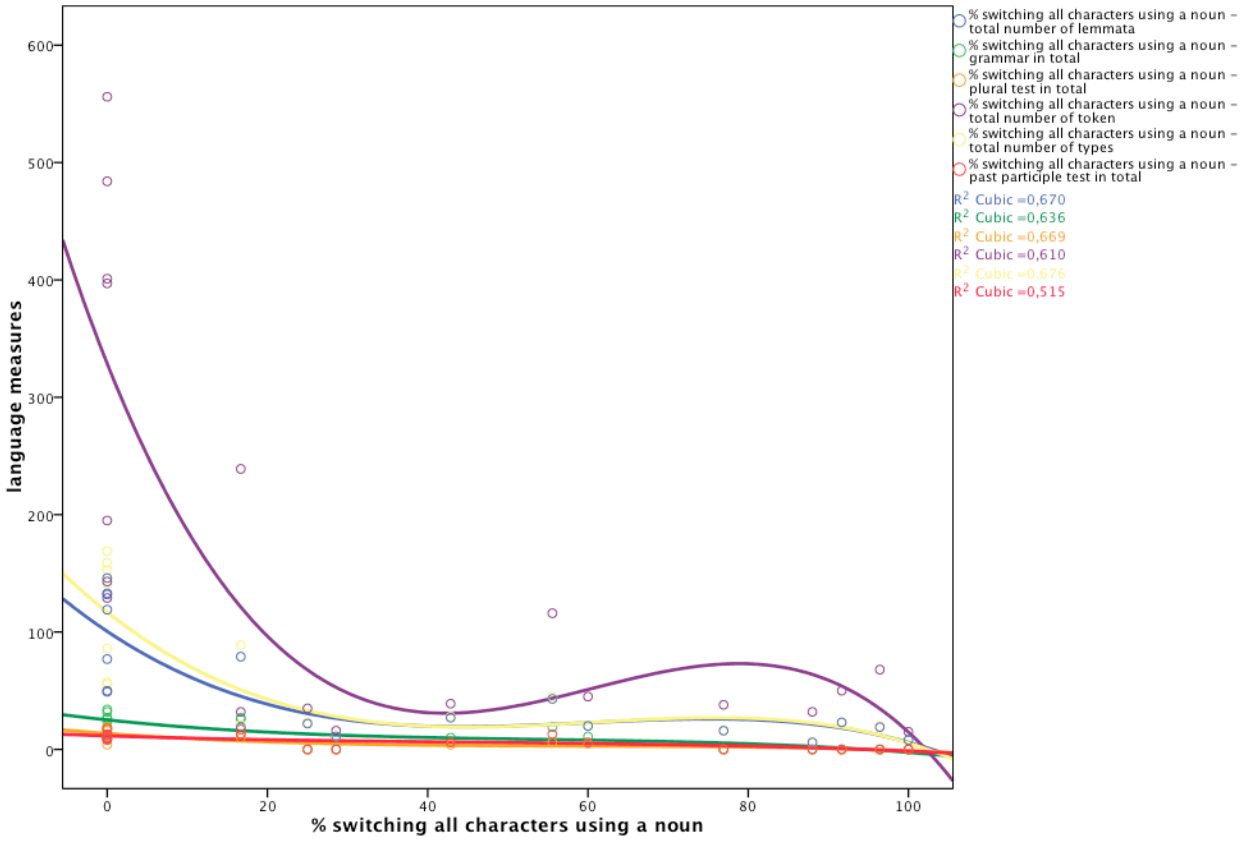


Diagram 120: % of switching all characters using a bare noun per participant by grammatical and lexical measures.

Sometimes, switching characters was also done using an incorrect zero form (6.1%). This was also correlated with language measures (see the diagram below). So, there was a significant correlation between switching all characters using an incorrect zero form and correct responses on the plural test, r_s=-.51, p=.027. Moreover, there was a significant correlation between switching story characters using an incorrect zero form and correct responses on the past participle test, r_s=-.46, p=.048. Thus, there was also a significant correlation between switching all characters using an incorrect zero form and the composite grammar score, r_s=-.52, p=.023. Furthermore, lexical measures yielded significant correlations. Thus, there was a significant correlation between switching all characters using an incorrect zero form and the type-token ratio, r_s=.64, p=.003. Also, there was a significant correlation between switching characters using an incorrect zero form and the total number of token, r_s=-.58, p=.010. Finally, there was a significant correlation between switching all characters using an incorrect zero form and the total number of lemmata used in telling the story, r_s=-.46, p=.046. Taken together, these results indicate that participants with higher grammatical and lexical skills, use less incorrect zero forms than participants with lower language skills.

As can be seen in the diagram below, there were two outliers. The first outlier (ID 8) was an 11 year old girl, who produced 42.8% incorrect zero forms, despite a total of 39 token and 27 lemmata. The second outlier (ID 1) was a 7 year old girl, who produced 75% of incorrect zero forms, although she used a total of 35 token and 22 lemmata.

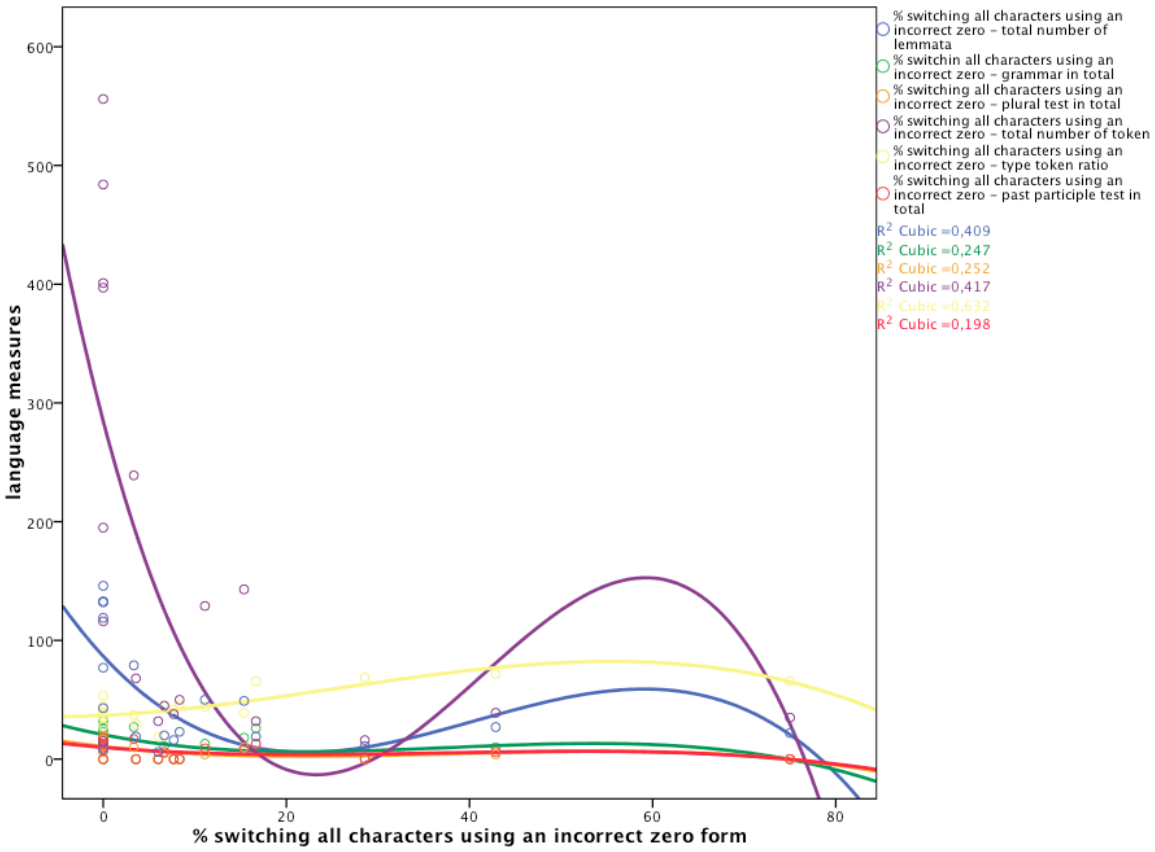


Diagram 121: % of switching all characters using an incorrect zero form per participant by grammatical and lexical measures.

Participants also switched reference to story characters using the pronoun *er*, which is pragmatically ill-formed. This was rare (4.1%) and it was again correlated with participants' language measures (see diagram below). So, there was a significant correlation between switching all characters using *er* and correct responses on the plural test, r_s=.60, p=.006. Furthermore, there was a significant correlation between switching all characters using *er* and correct responses on the past participle test, r_s=.49, p=.032. Thus, there was also a correlation between maintaining all characters using *er* and the composite grammar score, r_s=.61, p=.006. Lexical measures also yielded significant results. For instance, there was a significant correlation between switching all characters using *er* and the total number of types, r_s=.63, p=.004. There was also a significant correlation between switching all characters using *er* and the total number of token used for telling the picture story, r_s=.61, p=.005. Finally, there was a significant correlation between switching story characters using *er* and the total number of lemmata used in the picture story, r_s=.61, p=.006. Summarizing, these results suggest that participants with higher grammatical and lexical skills less frequently use the pragmatically incorrect *er* to switch characters than participants with lower skills.

As can be seen in the diagram below, there was one outlier. It was a female participant (ID 13) aged 17 with an IQ of 40. She switched reference using *er* three times, which amounts to 23.8%, and still had a total of 143 token, 56 types and 49 lemmata.

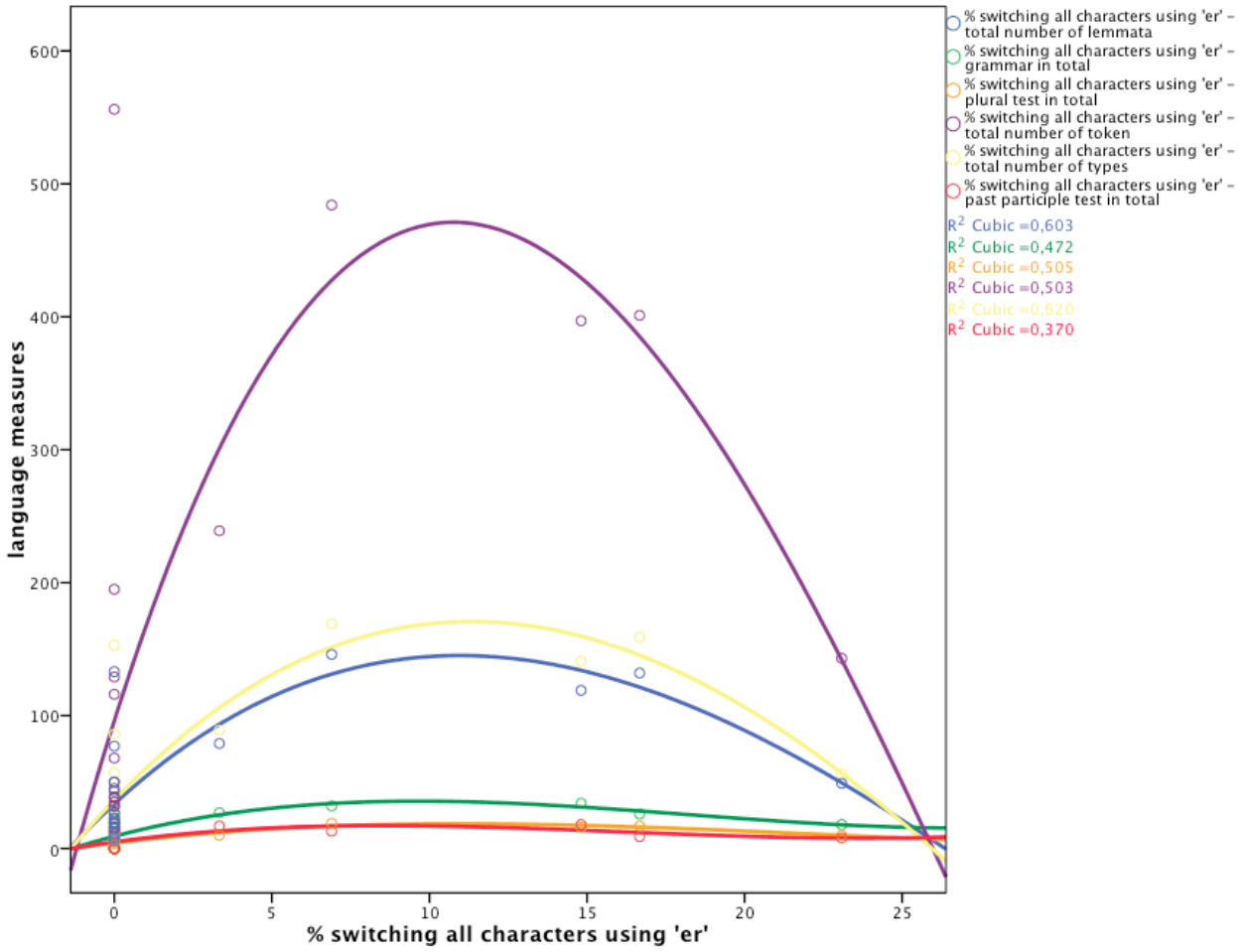


Diagram 122: % of switching all characters using the pronoun `er´ per participant by grammatical and lexical language measures.

Finally, there were few instances of switching characters using the pronoun *der*. This is grammatically legal, but pragmatically incorrect as the listener does not know which character is referred to. Correlations showed that there was a significant relationship between switching characters using der and correct responses on the past participle test, r_s=.62, p=.005. Moreover, there was a significant correlation between switching characters using *der* and the composite grammar score, r_s=.50, p=.028. However, there were no significant correlations with correct responses on the plural test or the lexical measures. So, these results may indicate that participants with higher grammatical skills know the deictic function and meaning of the demonstrative pronoun *der* and use it as a referential device more often than participants with lower grammatical skills. However, they sometimes still lack the pragmatic knowledge.

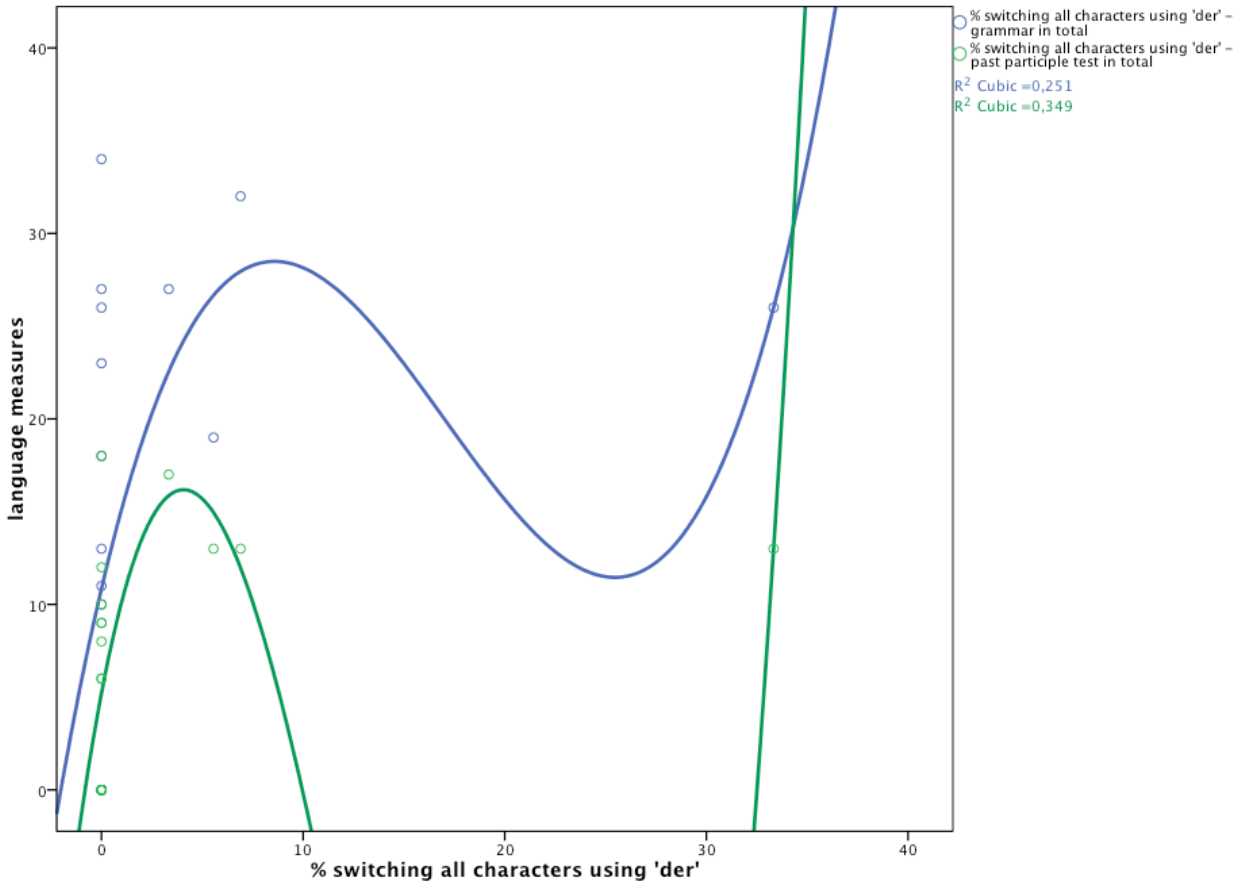


Diagram 123: % of switching all characters using `der´ per participant by the composite grammar score and the past participle test in total.

6.5.1.4 Correlations between number and type of utterances and referring expressions

As regards the number and type of utterances (descriptive vs. non-descriptive) used for telling the pictures story and the use of referring devices, several significant relationships could be noted.

Introducing

Concerning the introduction of story characters, there was a significant correlation between the total number of utterances and the percentage of bare nouns used for introducing story characters, r_s=-.47, p=.043. Also, there was a significant correlation between the percentage of descriptive utterances used and the percentage of bare nouns used, r_s=.83, p=.000. Finally, there was a significant correlation between the percentage of non-descriptive utterances and the percentage of bare nouns used for introducing characters, r_s=-.83, p=.000. These results show that participants who tell longer stories and who narrate rather than describe a story, use significantly less bare nouns for introducing story characters.

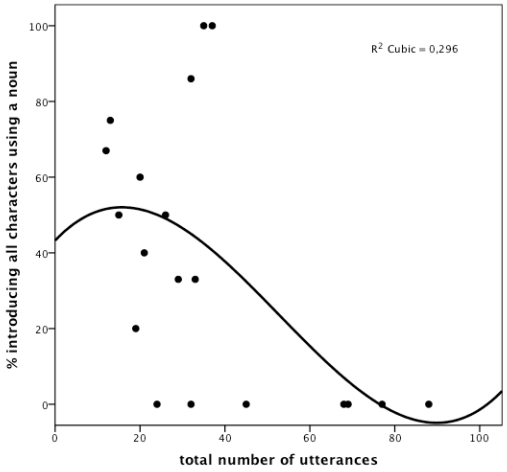


Diagram 124: % of introducing all characters using a bare noun per participant by total number of utterances.

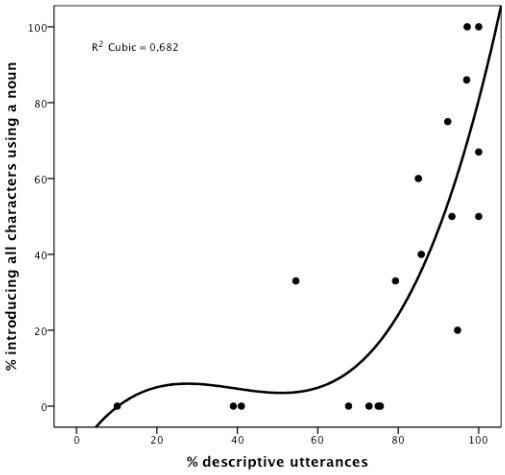


Diagram 125: % introducing all characters using a bare noun per participant by % descriptive utterances.

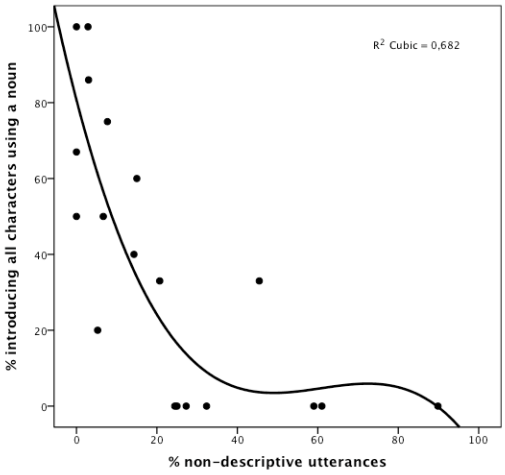


Diagram 126: % introducing all characters using a bare noun per participant by % non-descriptive utterances.

Moreover, there was a significant correlation between the percentage of descriptive utterances used and the percentage of indefinite article + noun constructions used for introducing characters, r_s=-.57, p=.011. And there was also a significant correlation between the percentage of non-descriptive utterances and the percentage of indefinite article + noun constructions, r_s=.57, p=.011. These results indicate that participants who describe rather than narrate a picture story use significantly less indefinite article + noun constructions for introducing story characters, whereas participants who narrated the story used significantly more.

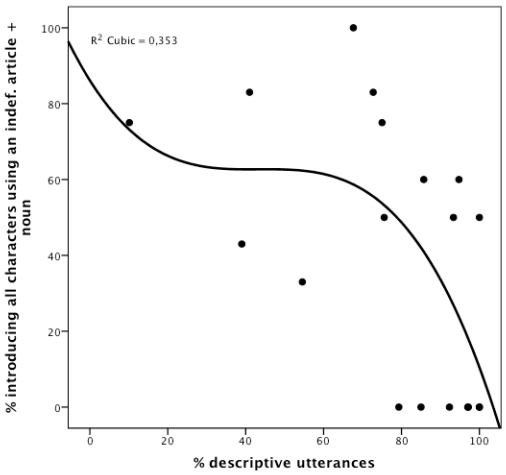


Diagram 127: % of introducing all characters using an indef. article + N per participant by % of descriptive utterances.

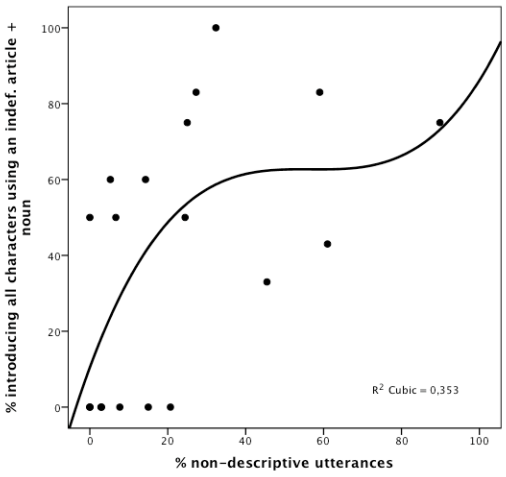


Diagram 128: % of introducing all characters using an indef. article + N per participant by % of non-descriptive utterances.

Similarly, there was a significant correlation between the type of utterances produced (descriptive vs. non-descriptive) and the definite article + noun construction used for introducing story characters. Thus, there was a significant correlation between the percentage of descriptive utterances and the percentage of definite articles + nouns, r_s=-.68, p=.001. Contrary to this, there was a different, significant correlation between the percentage of non-descriptive utterances and the percentage of definite article + noun constructions used, r_s=.68, p=.001. In sum, these results suggest that – as with the indefinite article + noun construction – participants who showed many narrative features, produced significantly more definite article + noun constructions to introduce story characters. On the other hand, participants who described a picture rather than narrated the story, used significantly less definite article + noun constructions.

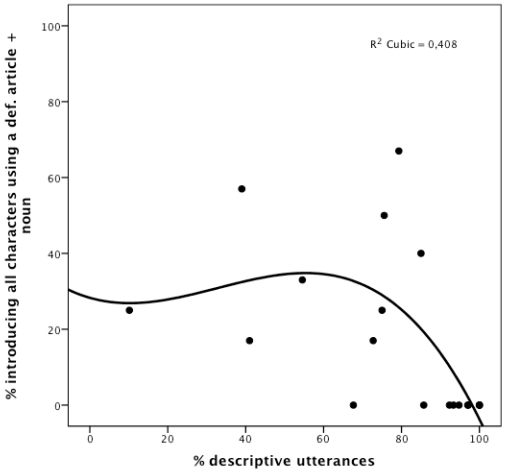


Diagram 129: % of introducing all characters using a def. article + N per participant by % of descriptive utterances.

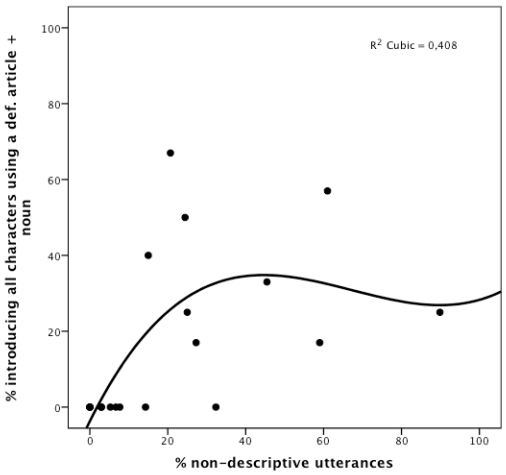


Diagram 130: % of introducing all characters using a def. article + N per participant by % of non-descriptive utterances.

Maintaining

Concerning the maintaining of characters, there was also a significant correlation between the total number and type of utterances (descriptive vs. non-descriptive) used to narrate the story. For example, there was a significant correlation between the percentage of bare nouns used for maintaining reference and the total number of utterances, r_s=-.63, p=.004 (see the diagram below). Also, there was a significant correlation between the percentage of bare nouns used for maintaining and the percentage of descriptive utterances, r_s=.78, p=.000 (see the diagram below). Likewise, there was a significant correlation between the percentage of bare nouns used for maintaining and the percentage of non-descriptive utterances, r_s=-.78, p=.000 (see the diagram below). These results suggest that participants who produced a larger number of utterances to tell the story, and who narrated rather than described the story, used significantly less bare nouns to maintain reference to story characters. On the other hand, participants who produced a lower number of utterances, and who primarily used descriptive utterances to tell the story, also used bare noun only constructions to maintain reference to a story character, which is grammatically and pragmatically incorrect.

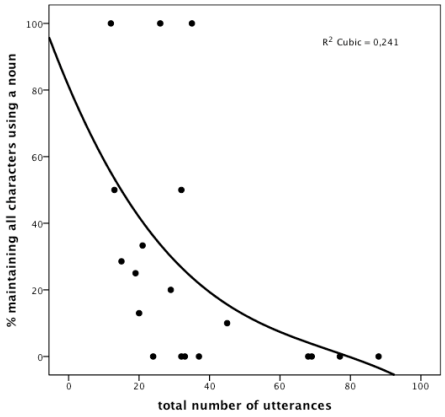


Diagram 131: % of maintaining all characters using a bare noun per participant by total number of utterances.

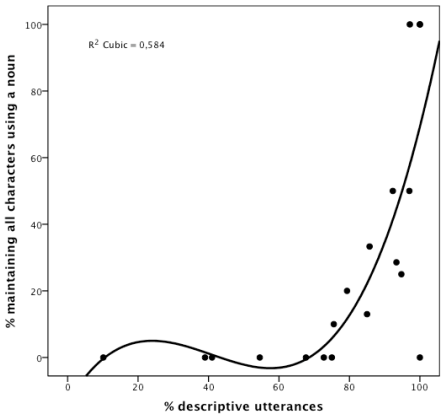


Diagram 132: % maintaining all characters using a bare noun per participant by % descriptive utterances.

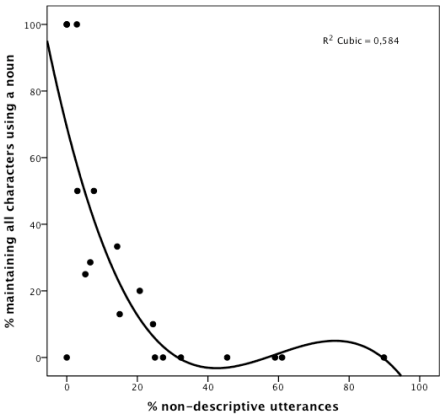


Diagram 133: % maintaining all characters using a bare noun per participant by % non-descriptive utterances.

Also, there was a significant correlation between the total number of utterances and the percentage of definite article + noun constructions used for maintaining reference to story characters, r_s=.46, p=.049. Moreover, there was a significant correlation between the percentage of descriptive utterances and the percentage of definite article + noun constructions, r_s=-.80, p=.000. In contrast, a significant correlation was found between the percentage of non-descriptive utterances and the percentage of definite article + noun constructions, r_s=.80, p=.000. These results show that participants who produced a higher number of utterances, and who narrated the story rather than described it, produced more definite articles + nouns to maintain reference to story characters. On the other hand, participants who produced a lower number of utterances, and who described the pictures rather than narrated them, used significantly less definite article + noun constructions to maintain reference to story characters.

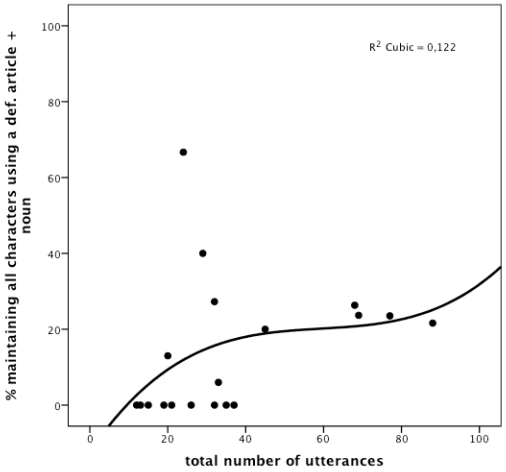


Diagram 134: % of maintaining all characters using a def. article + N per participant by total number of utterances.

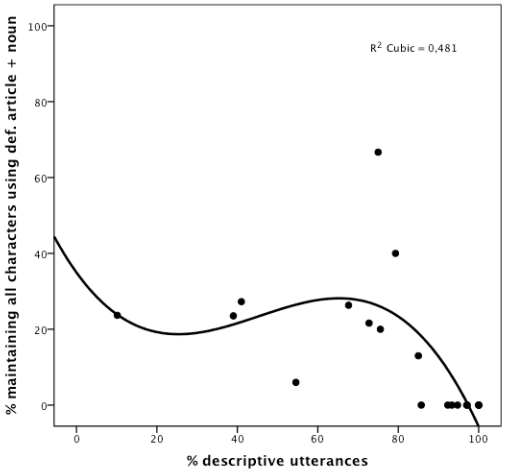


Diagram 135: % maintaining all characters using a def. article + N per participant by % descriptive utterances.

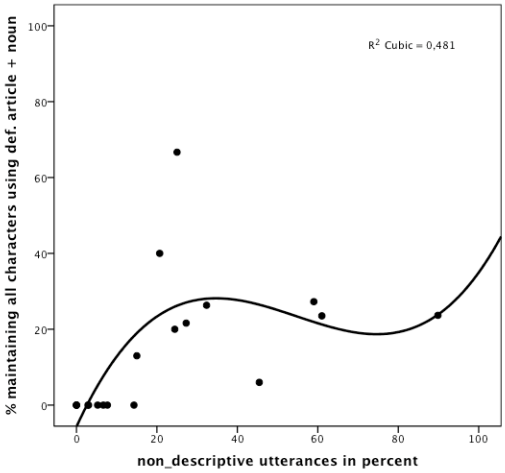


Diagram 136: % maintaining all characters using a def. article + N per participant by % non-descriptive utterances.

Similarly, there was a significant correlation between the total number of utterances produced and the percentage of *er* used to maintain reference, r_s=.78, p=.000. Also, there was a significant correlation between the percentage of descriptive utterances and the percentage of *er*, r_s=-.75, p=.000, and between the percentage of non-descriptive utterances and the percentage of *er*, r_s=.75, p=.000. This indicates that participants who produced a lower number of utterances and who described the pictures rather than narrated the story, used significantly less *er* to maintain reference than participants who produced a higher number of utterances and who narrated the story rather than described its pictures.

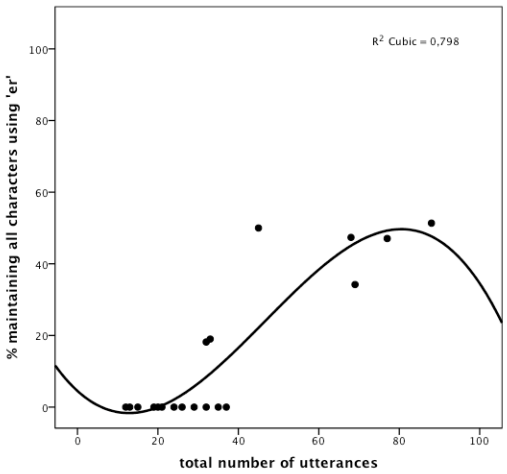


Diagram 137: % of maintaining all characters using `er´ per participant by total number of utterances.

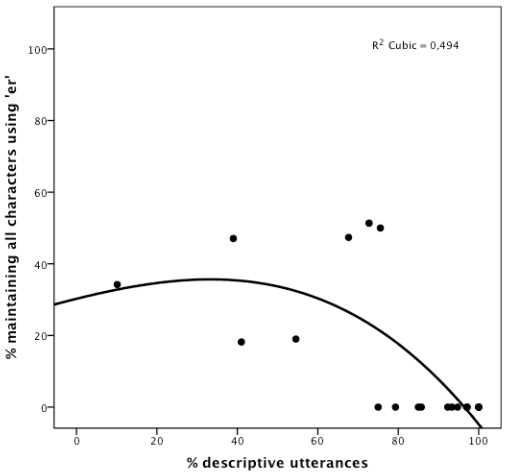


Diagram 138: % maintaining all characters using `er´ per participant by % descriptive utterances.

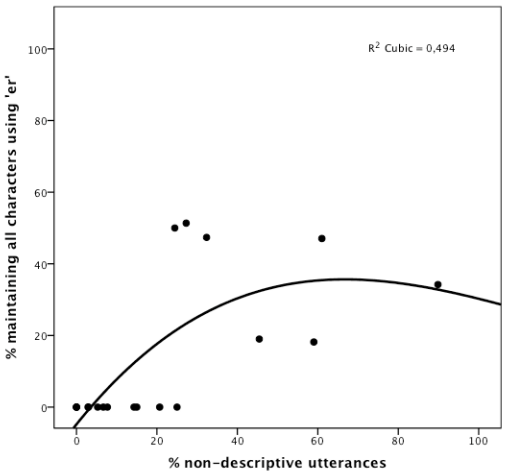


Diagram 139: % maintaining all characters using `er´ per participant by % non-descriptive utterances.

Likewise, there was a significant correlation between the percentage of descriptive utterances and the percentage of correct zero forms used to maintain reference, r_s=-.52, p=.023. Furthermore, there was a significant correlation between the percentage of non-descriptive utterances and the percentage of correct zero forms, r_s=.52, p=.023. Both results show that participants who narrated stories used significantly more correct zero forms, than participants who produced picture descriptions.

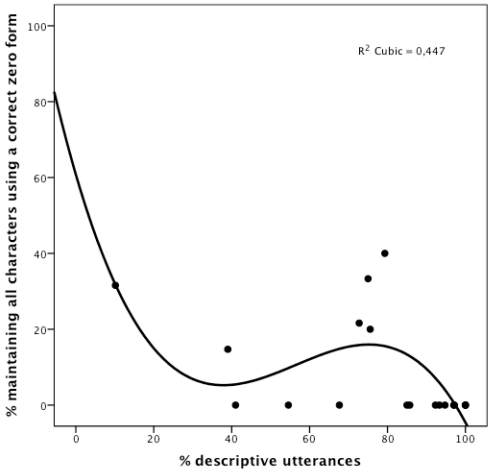


Diagram 140: % maintaining all characters using a correct zero form per participant by % descriptive utterances.

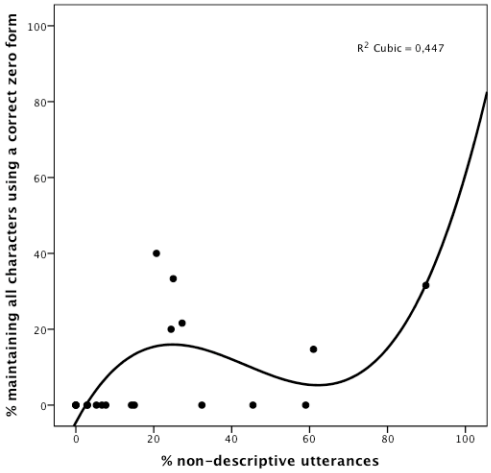


Diagram 141: % maintaining all characters using a correct zero form per participant by % non-descriptive utterances.

Finally, there was a significant correlation between the percentage of descriptive utterances and the percentage of possessive pronouns used to maintain reference, r_s=-.61, p=.006. The converse relationship could be noticed in the relationship between the percentage of non-descriptive utterances and the percentage of possessive pronouns, r_s=.61, p=.006.

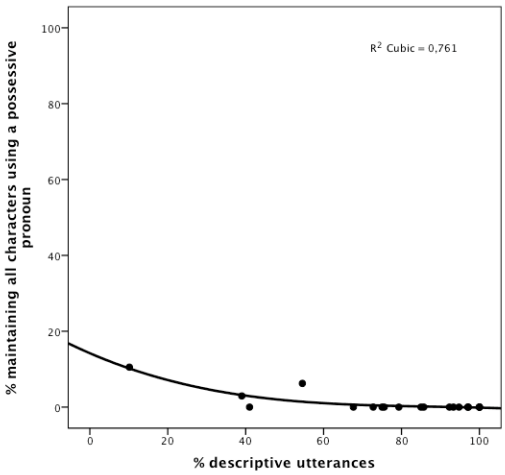


Diagram 142: % maintaining all characters using a possessive pronoun per participant by % descriptive utterances.

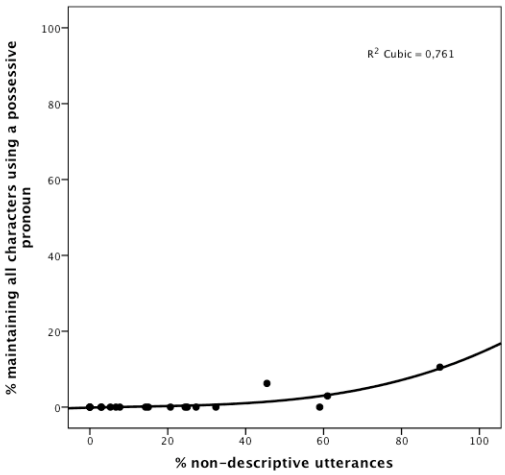


Diagram 143: % maintaining all characters using a possessive pronoun per participant by % non-descriptive utterances.

Switching

Concerning the switching of references, further significant correlations could be noted between the number or type of utterances (descriptive vs. non-descriptive) and switching devices. For example, there was a significant correlation between the number of utterances and the percentage of bare noun constructions used to switch to a character, r_s=-.46, p=.046. Moreover, there was a significant correlation between the percentage of descriptive utterances and the percentage of bare noun constructions, r_s=.94, p=.000. The reverse relation could be noted for the correlation between non-descriptive utterances and bare noun constructions, r_s=-.94, p=.000. In sum, these results show that participants who produced a low number of utterances and who described rather than narrated the picture story, also used significantly more bare nouns to switch reference to story characters. This parallels the production for introducing and maintaining reference.

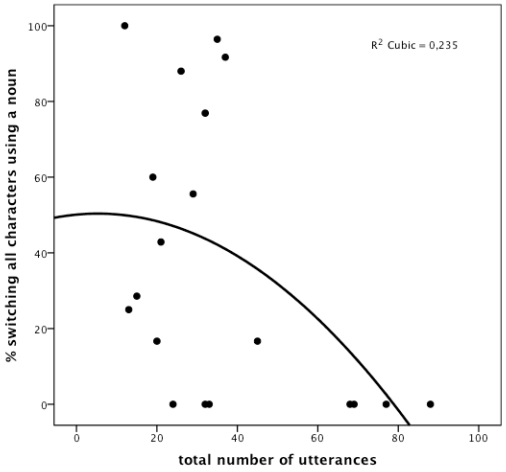


Diagram 144: % of switching all characters using a bare noun per participant by total number of utterances.

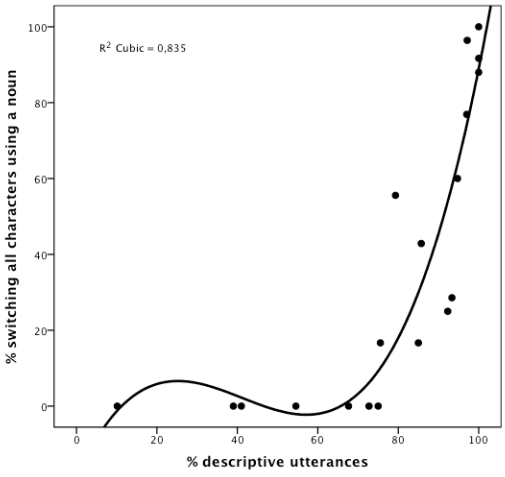


Diagram 145: % switching all characters using a bare noun per participant by % descriptive utterances.

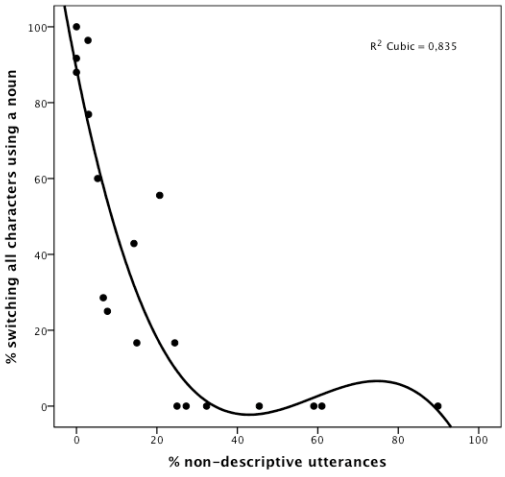


Diagram 146: % switching all characters using a bare noun per participant by % non-descriptive utterances.

Furthermore, there was a significant correlation between the number of utterances and the percentage of incorrect zero forms used to switch to a character, r_s=-.57, p=.012. For the type of utterances, there was no significant relationship, but a trend could be noted; participants with predominantly descriptive utterances were more likely to use incorrect zero forms than participants with non-descriptive utterances.

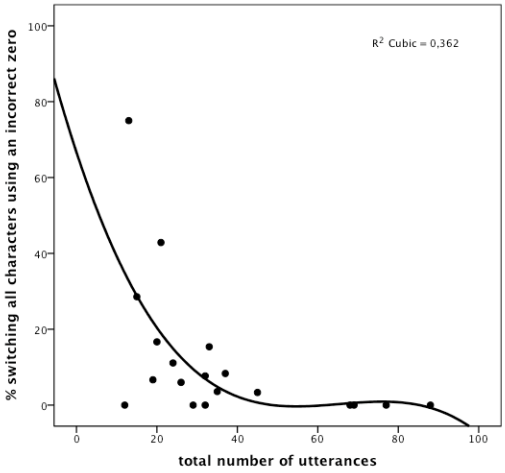


Diagram 147: % of switching all characters using an incorrect zero per participant by total number of utterances.

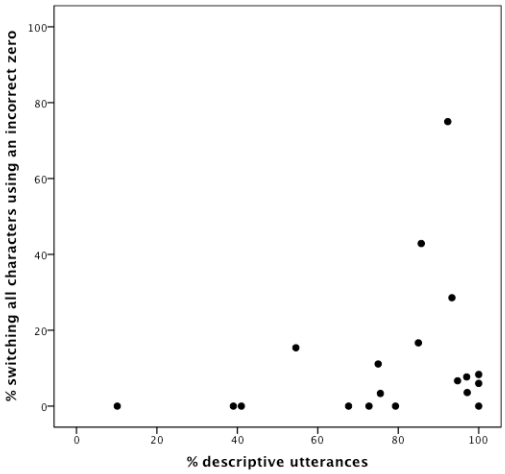


Diagram 148: % switching all characters using an incorrect zero form per participant by % descriptive utterances.

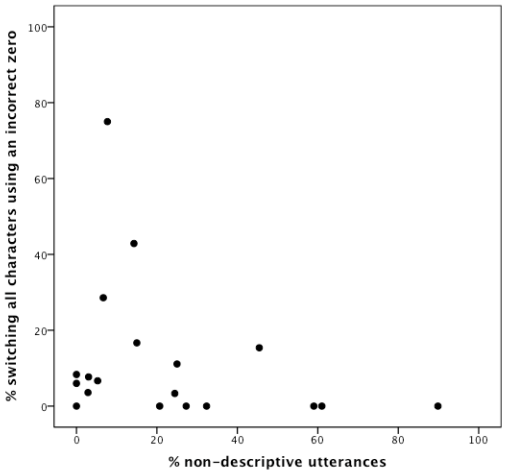


Diagram 149: % switching all characters using an incorrect zero form per participant by % non-descriptive utterances.

The opposite relationship was observed for definite articles + nouns and the pronoun *er*. Thus, there was a significant correlation between the total number of utterances and the percentage of definite articles + nouns used to switch reference, r_s=.66, p=.002. Moreover, there was a significant correlation between the percentage of descriptive utterances and the percentage of definite article + noun constructions, r_s=-.86, p=.000. The converse correlation was noted between the percentage of non-descriptive utterances and the percentage of definite article + noun constructions, r_s=.86, p=.000. In sum, these results show that participants who produce shorter stories and who describe the pictures rather than narrate the story, use significantly less definite article + noun constructions to switch reference. Whereas participants who produced longer stories and who narrated the story content instead of describing pictures, used significantly more definite articles + nouns. This parallels the productions for introducing and maintaining characters.

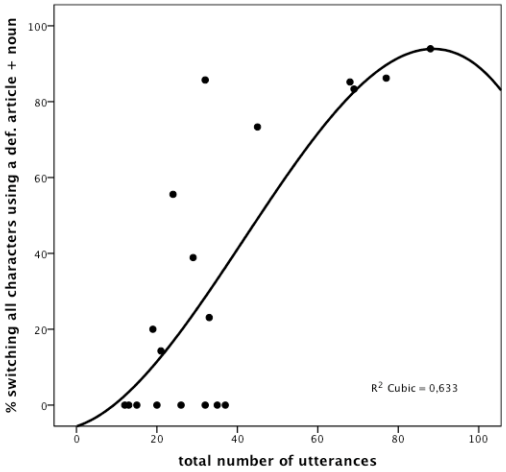


Diagram 150: % of switching all characters using a def. article + N per participant by total number of utterances.

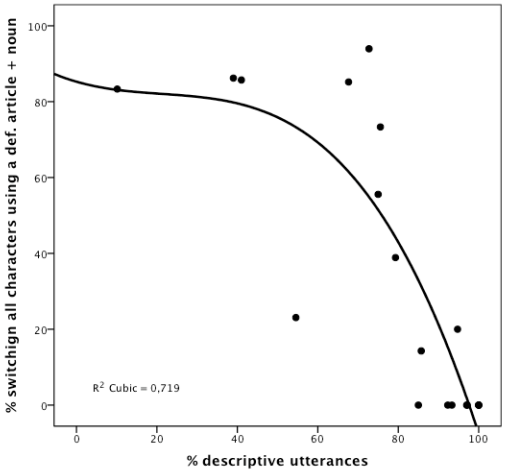


Diagram 151: % switching all characters using a def. article + N per participant by % descriptive utterances.

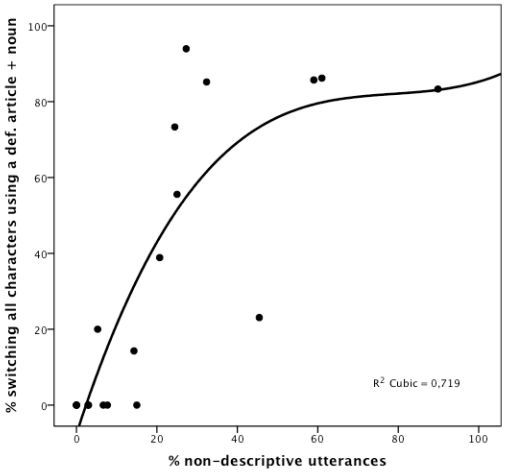


Diagram 152: % switching all characters using a def. article + N per participant by % non-descriptive utterances.

Moreover, a significant correlation could be noted for the total number of utterances and the use of the pronoun *er* when switching characters, r_s=.59, p=.008. This is pragmatically incorrect. Furthermore, there was a significant correlation between the percentage of descriptive utterances and the percentage of the pronoun *er* used for switching, r_s=-.67, p=.002. The converse relation was present for the correlation between the percentage of non-descriptive utterances and the percentage of *er* used, r_s=.67, p=.002.

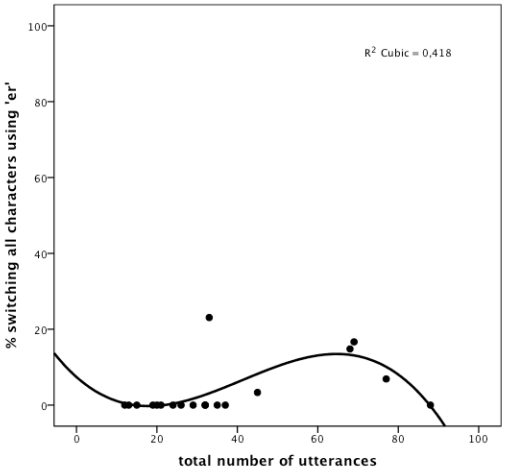


Diagram 153: % of switching all characters using the pronoun `er´ per participant by total number of utterances.

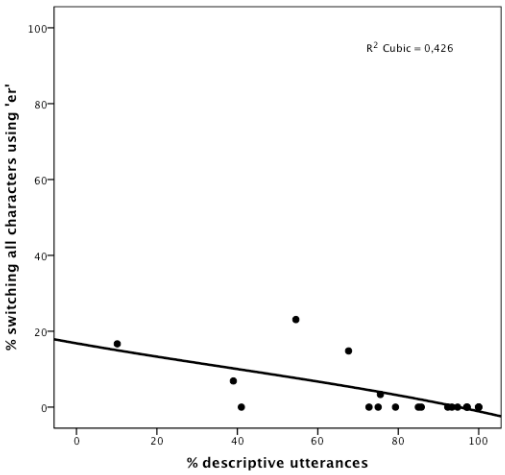


Diagram 154: % switching all characters using `er´ per participant by % descriptive utterances.

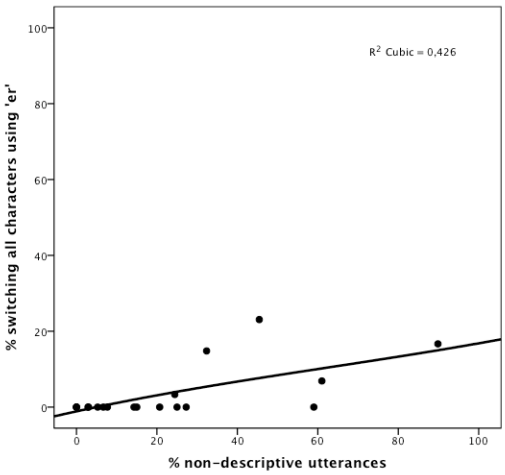


Diagram 155: % switching all characters using `er´ per participant by % non-descriptive utterances.

6.6 Between test results

As the use of referential devices when introducing, maintaining and switching characters correlated with many dependent variables (such as age, grammar, types, token and total number of utterances, types of utterances), it is interesting to look at the correlation between these predictor variables. Such an analysis can show whether the variables are “very closely linearly related” (Field, 2009, p. 790), that is multicollinear, or whether they are not related, and as such individually important predictors for referential skills.

As presented in Chapter 12 and illustrated in diagram below (only significant results were included in the diagram), participants' chronological age, grammar, vocabulary size and length of the picture story correlated significantly. The only variable that did not correlate significantly with the other variables, was IQ. These results indicate that chronological age and language skills are related, whereas IQ is not.

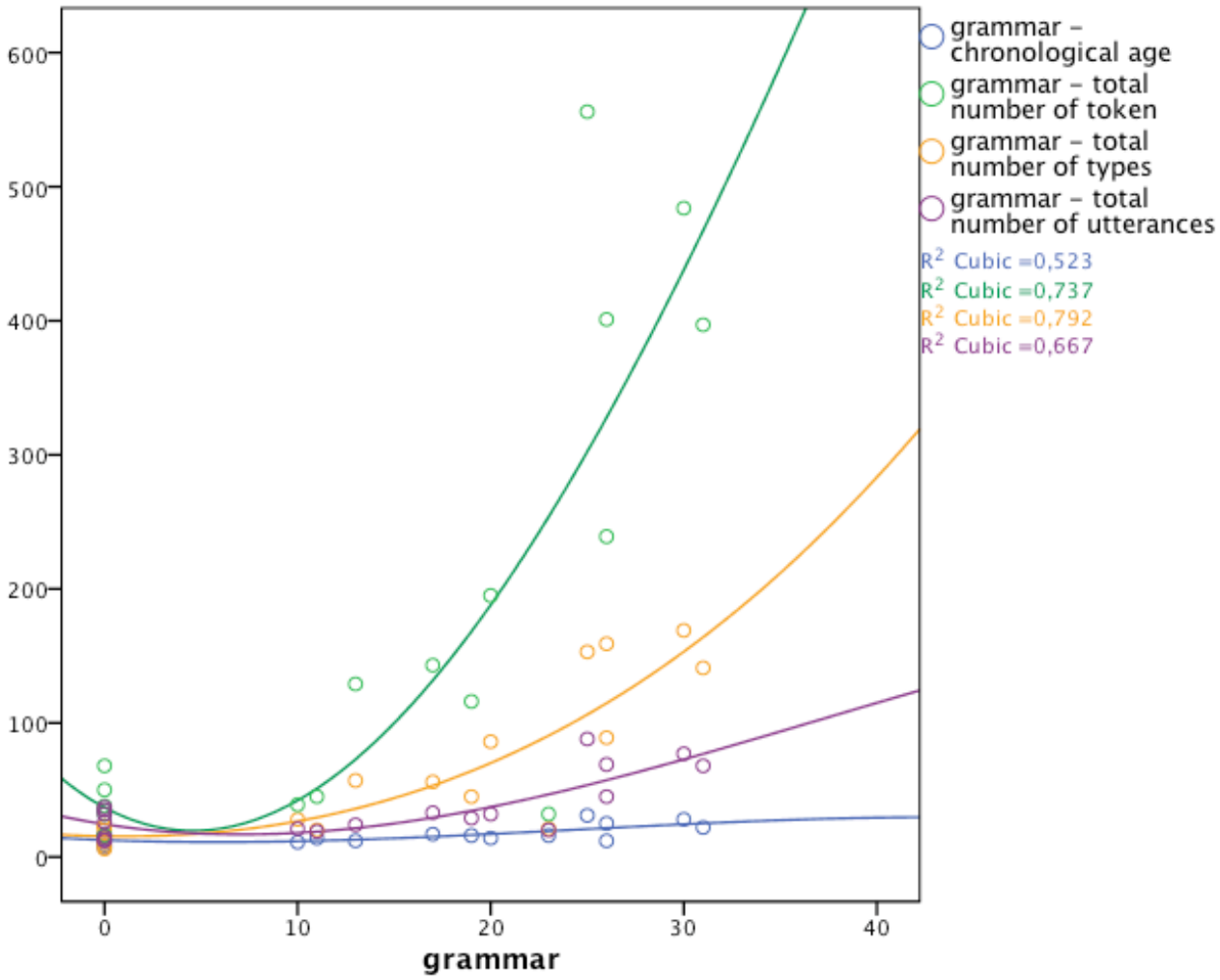


Diagram 156: Chronological age, total number of token, total number of types and total number of utterances per participant by the grammar composite score.

Summary and discussion

The present study investigated possible interrelationships between chronological age (CA), intelligence quotient (IQ), and productive language in Down Syndrome (DS), with a specific focus on DS individuals‘ reference and co-reference abilities when telling a picture-story. The test group included children, adolescents and adults with DS with a CA of 7.8-30.2, and Austrian German as their first language. Individuals with comorbid neurological disorders, such as Alzheimer and autism were excluded.

DS individuals completed a wide test battery. IQ was tested using the HAWIK-IV, language measures tapped into productive morphosyntax (by use of a nominal plural and past participle test), productive lexicon (by an analysis of participants‘ types, token, and lemmata in a picture-story), and reference and co-reference abilities (by an analysis of the same picture story).

In what follows, DS individuals‘ linguistic development will be described, and discussed with regard to CA and IQ. As participants were tested at one specific point in their linguistic development, data are ‘pseudo longitudinal’, and development means, more precisely, apparent (vs. genuine) development (Labov, 1963). In contrast to genuine longitudinal case studies, statistically significant differences must be found in order to establish linguistic development. The context of genuine linguistic development was not equal for all test participants, because of CA differences. A lower accessibility to functional therapies for speech, and schooling disfavoured our older participants. Therefore, the apparent development found in older test participants is the more remarkable.

When discussing linguistic development, reference to CA and IQ will be made. It is therefore, important to note from the onset that CA and IQ were not correlated. Thus, it might be assumed that any relationships found between CA and language measures as well as IQ and language measures are independent from each other. This hypothesis awaits further research with bigger groups of participants, and more elaborate statistical measures.

Productive lexicon, morphosyntax, and CA

A significant positive correlation was found between CA and the development of productive vocabulary (as measured by the use of types, token, and lemmata in a picture narrative) in DS, indicating that productive vocabulary grows as participants‘ life experience grows. Previous research has shown early growth of productive vocabulary in DS between a CA of 1 to 5, including a vocabulary spurt (Berglund, et al., 2001; Miller, 1999). The present data complement these findings, and show vocabulary growth for older children, adolescents and adults with DS between a CA of 7.8 to 30.2. This is in line with previous work (Bargagna, Perelli, Dressler, & Pinsuti, 2004; Dressler, Perelli, Feucht, & Bargagna, 2010). This vocabulary growth seems to halt at higher levels of CA (37 years onwards) (e.g. Rondal & Comblain, 2002). The reason for this stagnation remains open, but might be associated with a plateau of cognitive functioning and a discontinuation of

intervention (Rondal & Comblain, 2002), or lack of adequate stimuli. A decline of expressive vocabulary in older individuals with DS may also be associated with Alzheimer.

Moreover, a significant positive correlation was found between CA and the development of productive morphosyntax (as indicated by a nominal plural and past participle test) in DS. This suggests that correct use of inflectional morphology increases with increasing life experience. Thus, the present data stand in contrast to findings by Rondal and Comblain (1996), who suggest that there is no morphosyntactic development in DS after puberty, because of a critical period for language learning (Lenneberg, 1967). Instead the present data support results by Schaner-Wolles (1992), who found no evidence for stagnation of morphosyntactic abilities in DS after puberty. How long the development of morhphosyntax in DS proceeds, and under what circumstances it declines, is still open to investigation.

Productive lexicon, morphosyntax, and IQ

In the present study no significant correlation was obtained between 1) productive vocabulary (types, token, lemmata) and general IQ, and 2) between productive morphosyntax (nominal plurals and past participle) and IQ in DS. This indicates that productive vocabulary and morphosyntax do not develop parallel to IQ in DS.

A more fine-grained analysis of the relationship between IQ subtests and productive vocabulary as well as productive morphosyntax, however, did show some significant positive correlations. To be more precise, language comprehension as part of IQ showed a significant positive correlation with DS participants‘ productive vocabulary and productive morphosyntax. This is interesting, in the light of previous research, which showed that overall language comprehension is a relative strength in DS, while language production is a weakness (Abbeduto & Chapman, 2005). However, it should be borne in mind, that the answers to the questions of the language comprehension subtest of the HAWIK-IV are (among other abilities) dependent on language production.

In addition, verbal working memory correlated significantly with productive vocabulary (types, token, lemmata) and productive morphosyntax (nominal plural and past participle) in DS. This result expands previous research. As already pointed out by Lanfranchi (2009), Ypsilanti and Grouios (2008) hypothesise in a theoretical paper that in DS, deficits in auditory short-term memory (which is a part of working memory), “may be causing downstream effects on language“ (Ypsilanti & Grouios, 2008, p. 161). This hypothesis finds support in various studies (Chapman & Hesketh, 2001; Chapman, Miller, Sindberg, & Seung, 1996; Lanfranchi, Jerman, et al., 2009; Laws, 1998). For example, Chapman et al. (1996) showed that auditory short-term memory is related to the learning of productive vocabulary in TD and DS. Moreover, Chapman and Hesketh (2001) demonstrated that auditory short-term memory is related to MLU in TD and DS. Also, Laws (1998) found that nonword repetition (an indicator of auditory short-term memory) is related to receptive vocabulary, language comprehension and reading ability. Finally, Lanfranchi (2009) showed that in DS individuals, verbal working memory (especially low-control working

memory) is related to verbal skills as measured by the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 1967), including “language expression, comprehension, listening, and the ability to apply these skills to solving problems“ (Lanfranchi, Jerman, et al., 2009, p. 405). This relation is even stronger in TD. Therefore, the authors suggest that “verbal WM (and in particular low-control WM) is crucial to language development and may be affecting vocabulary and language production in individuals with DS“ (Lanfranchi, Jerman, et al., 2009, p. 411). The present study expands this research as it shows that in DS verbal working memory is related to the use of productive vocabulary in a picture story telling task, as well as productive morphosyntax (nominal plural, past participle) in elicitation tasks. Such a relation, however, does not exclude the possibility that verbal working memory and language are independently impaired in DS individuals (Lanfranchi 2009).

In future studies on the interrelationships between language comprehension, language production and working memory in DS individuals, it would be informative to (1) test language comprehension using non-verbal responses (e.g. gestures), and (2) include a measure of non-verbal (e.g. visual) WM. In studies on English-speaking TD children and clinical groups, language comprehension (vocabulary and grammar) is widely tested using picture selection (e.g. the British Picture Vocabulary Scales (Dunn, Dunn, & Whetton, 1982), the Peabody Picture Vocabulary Test (Dunn & Dunn, 1981), the Test for Reception of Grammar (Bishop, 1982), and the Test of Auditory Comprehension of Language (Carrow-Woolflok, 1985). This would allow a more clear-cut distinction between language comprehension vs. language production in DS. Moreover, working memory could be tested using not only verbal, but also non-verbal measures. This would allow to investigate a possible interrelationship between non-verbal cognition (i.e. nonverbal working memory) and language and thus help contribute to the discussion of language specificity.

Developmental progression of reference and co-reference across participants

The present data included DS individuals across varying ages, and degrees of linguistic abilities. Some were at an early developmental stage, others were at a more advanced level. Reference use for introducing, maintaining and switching was homogeneous within participants and stages, as will be summarised below.

When introducing characters, DS participants at an early developmental stage used incorrect zero forms or incorrect bare nouns. There were very few instances of introductions using incorrect zero forms. Thus, there were no correlations with maintaining or switching. There were more instances of introducing using bare nouns, and significant positive correlations were observed with maintaining and switching alike. That is, individuals who introduced story characters using incorrect bare nouns, used significantly more incorrect zero forms and incorrect bare nouns, and significantly less definite articles + nouns and the pronoun 'er' to maintain and switch reference. Note that all main characters are male or have at least masculine gender. This shows that the use

of referential devices for introducing, maintaining and switching is homogeneous within participants at an early developmental stage.

Participants at a more advanced developmental stage, used definite and indefinite articles + nouns to introduce characters. This is the stage of development that might be compared to TD individuals (from 3 years CA onwards) as tested in narrative studies. Again, development is homogenous within participants at this stage. Individuals using definite articles + nouns for introducing (this is the preferred device of younger TD children), also used significantly more definite articles + nouns, and correct zero forms for maintaining reference, and there was a positive trend for the pronoun 'er'. Participants at this advanced stage of development used significantly less incorrect bare nouns. Furthermore, individuals who used definite articles + noun for introducing, also used significantly more definite articles + nouns and the pronoun 'der' for switching. Note that the pronoun 'der' was used deictically and is, as such, an indicator of early development when compared to TD, but (as will be explicated below) pronouns are an area of weakness in DS. Therefore, the use of pronouns for switching shows advanced abilities in DS. Moreover, individuals with DS who introduced characters using a definite article + noun used significantly less bare nouns to switch characters. Similarly, individuals who used indefinite articles + nouns for introducing, also used significantly more definite articles + nouns and the pronoun 'er', and significantly less bare nouns for maintaining. Finally, they used significantly, more definite articles + nouns, and significantly less bare nouns for switching. Again, this shows that also at an advanced stage, use of referring expressions is homogenous.

Introducing story characters

In their narrative development, individuals with DS start off using incorrect zero forms or bare nouns to introduce characters. Incorrect zero forms are used significantly more often by the youngest participants. However, due to the small number of very young participants (and as such instances of the linguistic form), it cannot be ruled out that other, especially linguistic factors could also be correlated with the use of incorrect zero forms. Bare nouns are used significantly more often by participants with lower language comprehension (HAWIK-IV), lower morphosyntactic skills (nominal plural, past participle), a smaller and morphologically less varied vocabulary (types, token, lemmata), and shorter as well as more descriptive picture stories.

Then, individuals with DS progress and use determiner phrases to introduce characters, namely definite and indefinite articles + nouns. These forms are used significantly more often by participants with a higher language comprehension, higher morphosyntactic skills, a richer vocabulary, and longer as well as less descriptive pictures stories.

These findings expand previous research on reference in individuals with DS, as they suggest that the use of incorrect zero forms and bare nouns for introducing are characteristic of an early development of linguistic abilities and language comprehension. As such, both forms must be included in analyses and coded separately from character introductions with articles + nouns.

In narrative research on TD children, the use of incorrect zero forms or bare nouns to introduce characters has not been reported previously. Instead, the use of definite articles + nouns, and indefinite articles + nouns for introducing all story characters in German (Bamberg, 1994) and the main protagonist in English and French (Karmiloff-Smith, 1985) has been to focus of interest. Definite articles + nouns are used to introduce story characters from 3 years CA in German (Bamberg, 1994). For English and French data were collected from 4 years CA and are thus not comparable. Indefinite articles + nouns are used to introduce story characters at a chronologically later point than definite articles + nouns, in English/French from 5 years CA (Karmiloff-Smith, 1985), and in German from 9 years CA (Bamberg, 1994). There are no reports of instances of incorrect zero forms or incorrect bare nouns, as the youngest participants in studies on narrative development are 3 years CA and above. Around that time, German-speaking children stop using incorrect zero forms (Bittner, 2007) and German- and French-speaking children (Bassano, Korecky-Kröll, Maillochon, & Dressler, 2013; Bittner, 2007) as well as English-speaking children (Abu-Akel & Bailey, 2000) use determiners in obligatory contexts in spontaneous speech at an adult-like level.

In narrative research on English-speaking children and adolescents with DS (Moore, et al., 1998), the use of bare nouns has been implied, but no use of bare nouns has been reported. Moore et al. showed that TD children and DS children and adolescents (not matched) used full reference (which the authors defined as indefinite article + noun, definite article + noun, and bare noun) to introduce story characters while watching a silent film. They found that this was independent of listener position, character movement or number of peripheral characters. However, the authors did not report instances of what they termed reduced reference (pronouns, nominal substitute, zero form) for character introductions.

The reason why the English data on story telling in DS children (5-18 years CA) do not show instances of incorrect zero forms, whereas the present German data do (7.8-14 years CA), may be explained by crosslinguistic differences. Research in TD children has shown that the emergence of determiners in spontaneous speech starts later in German-speaking children than French-speaking children (Bassano, et al., 2013) or Spanish-speaking children (Lleó, 2001). As proposed by Bassano et al. (2013) this is due to prosodic and morphophonological differences between the languages, leading to a more challenging system in German. It could thus be hypothesised that the emergence of obligatory determiners by German-speaking individuals with DS, proceeds later than in English-speaking individuals with DS, because of the more challenging German morphosyntactic system.

On the surface, it thus seems that individuals with DS show the same incorrect zero forms and linguistic devices for introducing referents as TD children. This is possible, because introducing referents in a story is relatively easy compared to maintaining or switching (Whitely & Colozzo, 2013). Thus, the question is, which linguistic devices individuals with DS use for these more complex tasks, and which strategies they employ relative to TD.

Maintaining story characters

Maintaining at an early stage of development was, interestingly, differentially correlated with IQ or language measures. That is, an incorrect zero form was significantly more often used by participants with lower IQ, lower language comprehension, and lower fluid reasoning. Remember, that IQ was not correlated with age or any language measures (nominal plural, past participle, types, token, lemmata). This indicates that maintaining using incorrect zero forms was used by participants of different ages (7.8-30.2 years CA), and different morphosyntactic as well as lexical abilities. It should be noted, however, that a qualitative analysis revealed that maintaining using incorrect zero forms was not performed by participants with the lowest and the highest morphosyntactic, and lexical abilities, but by participants performing in the middle range. This is the usual performance curve found for errors, and explains, why no significant linear relation was found.

The significant correlation found between maintaining characters using incorrect zero forms and IQ, especially fluid reasoning, is interesting. Former research in TD children and adults or clinical groups, has, to my knowledge, not investigated the relation between co-reference and fluid reasoning. To my knowledge the only studies specifically investigating the relation between language and fluid reasoning are concerned with reading ability in TD children and adolescents (Carver, 1990), story summarising, and procedural discourse (which is similar to instructions) in elderly women (North, Ulatowska, Macaluso-Haynes, & Bell, 1986), as well as a theoretical paper on academic language performance and fluid reasoning (Gamaroff, 1997).

More common is psycholinguistic and clinical linguistic research on related cognitive processes, namely inferential reasoning and executive functioning, which includes reasoning and problem solving (for a review on inferential reasoning, executive functioning and pragmatic abilities see Perkins, 2007). An inference in psychological terms can be described as “[t]he process of logical reasoning that combines observed phenomena with accepted truths or axioms in order to formulate generalizable statements“ ("inference," 2007) . Inferential reasoning is a so-called 'higher cognitive function', because there are many cognitive processes involved in inferential reasoning, such as “memory and theory of mind, lexical and syntactic knowledge, and visual and auditory perception“ (Perkins, 2007, p. 73). It may, however, also be independently impaired from language (Perkins, 2007). Important for the present discussion is that inferential reasoning is related to anaphora resolution. More precisely, bridging inference, “which enables us to link previous and current information“ (Perkins, 2007, p. 72) is used in anaphora resolution (Eysenck & Keane, 2005, pp. 377-383). Thus, inferential reasoning is fundamentally important for the comprehension of anaphora and thus coherent discourse representation.

Executive function is an even more complex cognitive process. It includes “a range of higher cognitive processes such as planning, goal setting, monitoring, evaluating, controlling, inhibiting, sustaining, sequencing, organizing, reasoning, synthesiszing, abstracting, problem solving, decision making, multi-tasking and overall cognitive flexibility“ (Perkins, 2007, p. 82). With regard

to the present research, it is important that an impairment in executive function may lead to an inability to monitor the content that has been discussed, or to embed an utterance into the overall goal of a stretch of discourse, as for example shown in an individual with traumatic brain injury (Perkins, Body, & Parker, 1995). Thus, executive function is also important for coherent discourse comprehension.

Taken together, previous research on inferential reasoning and executive function, has shown that these cognitive processes are central for coherent discourse comprehension and production in TD and clinical groups. Following this line of thought, it is not surprising that fluid reasoning, a related cognitive process, is also correlated with coherent discourse production in DS, to be more precise, the use of incorrect zero forms for maintaining character reference. It is therefore suggested that future research further investigate the relation between text coherence and fluid reasoning in TD and clinical groups.

Maintaining characters using an incorrect zero form was also used significantly more often by participants with a higher type-token ratio. Remember that the type-token ratio could not be calculated using the standardised formula. This is because some participants‘ stories were remarkably shorter than others, and no appropriate common 'N' could be chosen. Therefore, this correlation is not informative.

Maintaining at an advanced level of development was correlated with various language measures, and for the pronoun 'er' it was also positively correlated with age and IQ. Thus, maintaining characters using the definite article + noun was positively correlated with morphosyntactic abilities (nominal plural, past participle), lexical abilities (types, token, lemmata), and the number of non-descriptive utterances. Maintaining using correct zero forms was positively correlated with morphosyntactic abilities (nominal plural, past participle) and lexical abilities (types, token, lemmata). Maintaining using the pronoun 'er' was positively correlated with CA, morphosyntactic abilities (nominal plural, past participle), lexical abilities (types, token, lemmata), language comprehension (HAWIK-IV), working memory (HAWIK-IV), and the number of non-descriptive utterances. Maintaining using possessive pronouns was positively correlated with morphosyntactic abilities (nominal plural), and lexical abilities (types, token, lemmata).

Switching story characters

Individuals with DS start off switching characters using incorrect zero forms, bare nouns or indefinite articles + nouns. Participants switching characters using incorrect zero forms are significantly younger, and have a significantly lower IQ (including significantly lower language comprehension, logical thinking, working memory and processing speed). They also have significantly lower morphosyntactic abilities (nominal plural, past participle), and significantly smaller vocabulary (token, lemmata). Finally, they produce shorter picture stories. Participants switching characters using bare nouns are also significantly younger. They have less developed morphosyntactic and lexical skills. Moreover, they produce shorter picture stories. However, IQ is

not correlated with the use of bare nouns. A somewhat different picture arises for participants switching characters using indefinite articles + nouns. Use of indefinite articles + nouns is not correlated with any language measure, but negatively significantly correlated with IQ (including logical thinking, working memory, and processing speed).

Later in development, individuals with DS use definite articles + nouns and the pronoun 'er' to switch between characters. Both referential devices are used significantly for switching by individuals who are older, who have higher morphosyntactic skills (nominal plural, past participle), a broader and richer morphologically richer vocabulary (types, token, lemmata), longer and less descriptive narratives. IQ is not correlated with the use of definite articles + nouns or 'er' to switch characters. The lack of a correlation between IQ and switching using definite articles + nouns can be regarded as a reliable result, as there were enough instances of definite articles + noun in the narrative sample. However, the lack of correlation between IQ (especially working memory) and the pronoun 'er' may be refuted in future research, as very few instances of 'er' were noted.

All in all, it is important to note that switching characters, is a cognitively more demanding activity than introducing or maintaining story characters. Therefore, it is more strongly related to IQ. This seems to be similar in TD and DS (see Whitely & Colozzo, 2013 for findings on TD).

Thematic subject strategy and anaphoric strategy

So far, participants‘ productions have been described as more or less advanced. More advanced individuals use articles + nouns, and the pronoun 'er', whereas less advanced individuals use syntactically underspecified and textually inappropriate forms (incorrect zero forms, bare nouns). It is important to distinguish between these two groups of DS participants. This is because the former do have the linguistic repertoire to potentially use the same form-meaning mappings in reference and co-reference as TD children and adults. The question is, whether they have the grammar skills, or the discourse skills, or both skills to use the thematic subject strategy and/or the anaphoric strategy. The latter do not have the linguistic repertoire to signal specific meanings using specific referential forms.

Remember that the thematic subject strategy is employed by 3-5 year old TD children in German (e.g. Bamberg, 1987, 1994) and has been reported for 6-7 year old TD children in English and French (Karmiloff-Smith, 1985). It basically implies that TD children are able to choose a main character, and mark the status of the main character linguistically by putting it in subject position and maintain as well as switch reference to it by using pronouns. The anaphoric strategy is employed from 9 years CA onwards and has been reported in German (Bamberg, 1987, 1994). It states that pronouns are used for maintaining reference, and determiners + nouns or proper names are used to switch reference.

Based on these strategies, developmental stages can be formulated. Bamberg found experimental evidence for these stages, which I will term Stage 1, Stage 2 and Stage 3 for a better understanding of the subsequent discussion. The stages can be summarised as follows:

Stage 1:

pronominals are used for maintaining and switching (Karmiloff-Smith‘s Level 1, no differentiation between main and peripheral character)

Stage 2:

pronominals are used for maintaining, pronominals and nominals are used for switching (depending on main vs. peripheral characters)

Stage 3:

pronominals are used for maintaining, nominals are used for switching

Now, what has been found in previous research in DS, is that children and teenagers (5-18 years CA) with DS, do not use the thematic subject strategy (i.e. Stage 2) (Moore, et al., 1998) (and although not mentioned by Moore et al., it should be pointed out that at the same time no evidence for an anaphoric strategy was found in their study). That is, for maintaining reference, DS participants did not show a preference of reduced reference (i.e. pronouns, nominal substitute, zero form) over full reference (articles + nouns, nouns), as would be expected based on TD data. Moreover, for switching reference, DS participants were not found to mark the status of the main character (i.e. the thematic subject) linguistically when a main and two peripheral characters were present. That is, DS participants did not show a preference of reduced reference over full reference for switching to the main character, and a preference of full reference over reduced reference for switching to the peripheral characters. In fact, they did not show any preference. When a main and only one peripheral character was present, DS participants did mark the status of the main character linguistically, but it was the opposite of what could be expected, i.e. DS participants preferred full reference over reduced reference to switch to the main character.

Moore et al. (1998) hypothesise that

> “children with Down syndrome can form mental representations of discourse but have difficulty in using them efficiently. Referential forms can be used strategically where fewer items of information have to be integrated, indicating that although it may be possible to store and access each item of information individually, when more complicated discourse occurs which requires information to be maintained over a longer period children with Down syndrome experience difficulty.“ (p. 69)

Put in other words, Moore et al. suggest that to some degree individuals with DS can mentally/ conceptually distinguish between main vs. peripheral characters. This becomes evident, when a main and one peripheral character are being talked about. But due to processing restrictions, individuals with DS find it difficult to integrate conceptual with linguistic information, in order to mark thematic status.

The present research agrees with the finding that individuals with DS do not use the thematic subject strategy, and extends these findings. First, it demonstrates that young DS participants with a low language comprehension, poor morphosyntactic skills and and reduced lexicon do not have the linguistic repertoire to use articles + nouns and pronouns. These participants predominantly use incorrect zero forms and incorrect bare nouns for maintaining and switching characters. Thus, they do not use referential devices characteristic of Stages 3, 2 or 1. Linguistically/cognitively advanced individuals with DS who produce articles + nouns and pronouns skip Stages 1 + 2, and jump right into the anaphoric strategy (Stage 3). This suggests that development is atypical and it suggests that final attainment is atypical, too. Second, the present research uncovers the DS specific processing restrictions for explaining why individuals with DS have difficulties using pronouns, and consequently show no linguistic realisation of Stages 1 and 2.

First, in a qualitative analysis the present research has shown that there was no single evidence for Stage 1 where TD children predominantly use pronouns to maintain as well as switch reference. Neither was there evidence for Stage 2 where TD children use pronouns for maintaining characters as well as switching the main character (i.e. the boy), but not peripheral characters.

Rather, individuals with DS who used TD-like introducing (i.e. articles + nouns) (=6 participants), only used pronouns to maintain, but not switch reference. Preferentially they used pronouns for the boy (=5 out of 6 participants), and one participant showed no preference between articles + nouns vs. pronouns for the boy. There were no clear preferences for the dog, frog or other animals. This is compatible with the animacy hierarchy (Comrie, 1981), where humans are assigned a higher degree of animacy than animals. Applied to the frog story, this yields a story specific animacy hierarchy based on characters‘ degree of activation, activity and individualisation, with: boy>dog>frog>other animals. Thus, based on the degree of animacy, the boy as single human character is seen as the protagonist, and linguistically marked by a pronoun in TD (e.g. Bamberg, 1986) and linguistically/cognitively advanced DS. Reference is predominantly switched using definite articles + nouns in cognitively/linguistically advanced DS. This is reminiscent of Stage 3. Thus, it seems as if individuals with DS skip Stages 1 + 2 and jump right into Stage 3. Therefore, it can be concluded that development is atypical. Moreover, it can be assumed that final attainment is atypical too. The reason for this will be explicated below.

Second, the research by both Moore et al. (1998) and Lorusso et al. (2007), as well as the present study, show that individuals with DS have particular difficulties using pronouns. Pronouns are also relatively challenging to acquire for TD children (e.g. Bittner, 2007; Gülzow & Gagarina, 2007). It can be hypothesised that this is because pronouns as opposed to articles + nouns, have no (or nearly) no inherent meaning, and are indexical, which requires controlling the context. This leads to incorrect pronoun reversal in some TD children, where they mistake the first person pronoun 'I' to mean 'you' or the other way around (Dale & Crain-Thoreson, 1993). Moreover, the acquisition of first, second and third personal pronouns may be related to early abilities in the development of a theory of mind (Ricard, Girouard, & Decarie, 1999), which renders the acquisition process even more demanding.

The present research builds on previous research by showing that in DS, the impaired use of the pronoun 'er' is associated with DS individuals‘ language comprehension and working memory. Pronouns are in general rarely used by individuals with DS. Most instances, especially of 'er', can be found for maintaining reference. This is because maintaining (as compared to introducing and switching) is least demanding for working memory (Whitely & Colozzo, 2013), as it requires least effort in context control, i.e. only of adjacent cotextual co-reference. Therefore, significant results could be obtained here. The use of 'er' showed a positive significant correlation with CA, morphosyntactical performance (nominal plural, past participle), lexical performance (type, token, lemmata), narrative performance (non-descriptive utterances), language comprehension and working memory. In contrast, the use of definite articles + nouns or correct zero forms for maintaining reference, only correlated with linguistic measures (nominal plural, past participle, type, token, lemmata, non-descriptive performance). This shows that the use of the pronoun 'er' is more challenging for individuals with DS in comparison to nominal or zero anaphora, because it draws on working memory. And working memory is impaired in DS, especially verbal working memory, and the central executive (Baddeley & Jarrold, 2007; Jarrold & Baddeley, 1997; Lanfranchi, et al., 2012; Lanfranchi, Carretti, Spano, & Cornoldi, 2009; Lanfranchi, et al., 2004; Vicari, et al., 1995).

In short, it is therefore unlikely that advanced individuals with DS use an anaphoric strategy in the sense found in older TD children or adults. It seems that linguistically and cognitively advanced individuals with DS have the same linguistic repertoire as TD individuals (i.e. indefinite article + noun, definite article + noun, pronoun) to maintain and switch character reference, but are restricted in their use of pronouns because of an impaired working memory. Thus, individuals with DS cannot choose between nominal vs. pronominal reference in the same way as TD when telling stories.

Pronouns as clinical marker for DS

As pronouns have been identified as a specific weakness in DS, they could be potential clinical markers for individuals with cognitive impairment, or even DS. A first comparison with other clinical groups with a cognitive impairment, namely Alzheimer‘s Disease (AD) and high functioning autism (HFA), indicates that the use of pronouns in stories as told by individuals with DS is specific to the syndrome. However, major methodological differences exist between studies. Most notably, the present study differentiated between character introducing, maintaining and switching. Moreover, strategic, functional use of language (thematic subject strategy, anaphoric strategy) was investigate. Nevertheless, first interesting comparisons can be drawn. For example, individuals with AD also have an impaired working memory (Waters & Caplan, 1997). The working memory impairment in AD, however, is differently related to the use of pronouns than in DS. Individuals with AD use more pronouns (personal and reflexive) in spontaneous speech than CA matched healthy individuals so that it becomes difficult to follow them (Almor, Kempler, MacDonald, Andersen, & Tyler, 1999). This overuse is related to working memory in that pronouns are used more frequently

by AD individuals with a lower working memory capacity. Discourse comprehension in individuals with AD is not improved by pronouns as compared to anaphoric articles + nouns, as pronouns have “low informational content, which renders them less effective than full NPs as means of reactivating memory representation“ (Almor, et al., 1999, p. 218), while articles + nouns “are better suited to reactivate information in working memory“ (Almor, et al., 1999, p. 218). Almor et al. 1999 explain AD individuals impaired use of pronouns in the following way: “Because AD patients have a working memory impairment, their representation of referents in working memory is degraded, leading to the loss of some distinguishing semantic features ... Therefore, when, because of a working memory impairment, semantic detail is lost in a referent‘s representation, a more general and less costly expression, such as a pronoun, is likely to be produced“ (Almor, et al., 1999, pp. 222-223). The impairment in working memory in DS is not related to pronoun use in the same way as in AD patients. First, individuals with DS do not overuse pronouns, right to the contrary individuals with DS have difficulties in using pronouns. Second, pronoun use in DS is not negatively correlated with DS individuals‘ working memory, instead pronouns are used by individuals with a higher working memory. Third, the fact that in linguistically/cognitively advanced individuals with DS the use of the pronoun 'er' to maintain reference is positively significantly correlated with the use of definite articles + nouns for maintaining reference, indicates that DS individuals‘ semantic representation of the antecedent is not lost as in AD, but active to a large degree. This is in line with Moore et al. (1998), who also suggest that individuals with DS can build a mental representation of a story.

High functioning autism as the second group of cognitively impaired individuals, has also been identified with a difficulty in pronoun use. Arnold, Bennetto and Diehl (2009) showed an impaired use of pronouns in story telling in children with HFA (9.8-12.9 years CA). Older and younger children with HFA as well as age-matched TD peers most frequently use pronouns for maintaining a character that was just mentioned in the previous clause, especially in subject position, and is thus highly active. But young children with HFA use significantly less personal pronouns in subject position when cognitive demands are high, as in disfluent utterances, or utterances with a high number of words (7 or more words). The reasons for this production deficit is as yet unclear, but the authors speculate that a part of the explanation may be that younger children with HFA have difficulties in keeping a referent active in working memory. A second, but by the authors less favoured explanation is based on an impaired theory of mind. Although pronoun performance of younger children with HFA is more compatible to individuals with DS, differences can be noted between clinical groups: (1) although no statistical analysis is possible, a much higher rate of pronoun use for maintaining a character can be noted for individuals with HFA, (2) authors suggest that only quantitative difference to TD, because also use pronouns especially for referents that are highly active, because just mentioned, and especially for subject position. But future research needs to test the assumption, if DS and individuals with autism differ, with further analyses investigating narrative strategies, such as the thematic subject strategy and the anaphoric strategy.

Strengths, limitations and suggestions for future research

One of the strengths of the present study is that it includes a relatively large number of participants with DS (N=30) with a wide range of ages and mild to moderate IQs. This allows to sketch linguistic development pseudo longitudinally. However, future research should include more participants within certain age and IQ groups, so that stronger statistical test can be carried out.

Another strength is that different tests were carried out, including various language tests and a verbal IQ test. This is important, because it has repeatedly been shown that CA is a less reliable indicator of cognitive development than mental age. However, future studies should include a non-verbal IQ test too. This is because language in DS is impaired, and a verbal IQ test might not show an individuals‘ full potential. By using a non-verbal IQ test, the differences between verbal and non-verbal cognition may be investigated.

Concerning the various language tests, it was important that many different linguistic skills were examined; morphosyntactic, lexical, and textual. These tests too could be expanded. Grammar, for example, was measured via tapping into contextual inflection (past participle test), and inflectional morphology (nominal plural test). However, other measures of grammar were not carried out. Moreover, the present study investigated a narrative text type (picture story). Future studies might also look into argumentative texts. Here logical thinking might become an even more important factor.

Appendix

7 Instructions

7.1 Instructions: plural test

The test administrator presented the participant with a card showing a car, and said: “Das ist ein Auto.” (*This is a car.*). Then she presented the participant with a second card showing three cars, and asked: “Und was sind das? Drei?” (*And what are these? Three?*). The participant was expected to answer: “Autos” (*cars*). There were three practice items. They were repeated, when the participant produced three incorrect plurals in a row during the test proper.

7.2 Instructions: picture story

The picture story *Frog, where are you?* by Mercer Mayer (1969) was in a folder. Before showing the participant the pictures of the picture story, the test administrator told the child: “Das ist die Geschichte von einem Buben, einem Hund, und einem Frosch. Schau dir die Geschichte zuerst an. Wenn du fertig bist, erzähl bitte die Geschichte.” (*This is the story of a boy, a dog, and a frog. First look through the story. When you are ready, please tell the story.*). Then the test administrator showed the participant the story and said: “Die Geschichte fängt hier oben links an (fingerpoint to the first picture) und geht so weiter (fingerpoint to the second, third and fourth picture).“ (*The story begins here at the top left* (fingerpoint to the first picture) *and continues this way* (fingerpoint to the second, third and fourth picture)). Both, the test participant and the administrator were looking at the pictures, while the participant was telling the story.

7.3 Instructions: past participle test

The test administrator was holding the test sentences in her hands, so that the participant could not read them, and told the participant: “Ich erzähle dir jetzt von einem kleinen Buben, der Hans heißt. Und zwar erzähle ich dir, was Hans oft und gerne macht. Und dann sage ich dir, dass er das auch gestern gemacht hat. Dabei sollst du mir helfen Sätze fertig zu machen. Ich beginne also einen Satz und du sollst ihn fertig machen.” (*Now, I‘m going to tell you about a little boy called Hans. And I‘m going to tell you what Hans likes doing frequently. And then I‘m going to tell you that he did that yesterday too. And you should help me complete sentences. So, I start with a sentence, and you should complete it.*). Then the test administrator gave two examples, where she herself used the past participle. These practice sentences were repeated, if necessary. Afterwards, the test sentences were presented orally by the test administrator. For example, she said: “Hans ruft gerne seine Mutter. Auch gestern hat er seine Mutter ge-?“(*Hans likes calling his mother. Yesterday, he has also -ed his mother.*). The child was expected to say “gelesen” (*called*).

8 Plural test: results

8.1 Subject analysis

8.1.1 Responses and participant characteristics

Spearman's Rho		PLURAL TEST: RESPONSES			
		correct	error	omission	other error
PARTICIPANT CHARACTERISTICS					
AGE	Correlation Coefficient	**.673****	.321	-.329	**-.565***
	Sig. (2-tailed)	**.002**	.180	.169	**.012**
	N	19	19	19	19
IQ	Correlation Coefficient	.311	.119	-.427	.029
	Sig. (2-tailed)	.280	.685	.128	.923
	N	14	14	14	14
language comprehension	Correlation Coefficient	.453	.286	-.489	-.002
	Sig. (2-tailed)	.090	.301	.065	.994
	N	15	15	15	15
logical thinking	Correlation Coefficient	.130	-.045	-.125	-.019
	Sig. (2-tailed)	.606	.861	.620	.940
	N	18	18	18	18
working memory	Correlation Coefficient	**.624****	.251	**-.599***	-.370
	Sig. (2-tailed)	**.010**	.347	**.014**	.158
	N	16	16	16	16
processing speed	Correlation Coefficient	.222	.189	-.324	-.082
	Sig. (2-tailed)	.391	.467	.205	.756
	N	17	17	17	17

8.1.2 Responses per participant

	PLURAL TEST: RESPONSES				
	other error	omission	error	correct	total
ID					
1	N=18, 100%	N=0, 0%	N=0, 0%	N=0, 0%	N=18, 100%
2	N=5, 27.8%	N=13, 72.2%	N=0, 0%	N=0, 0%	N=18, 100%
3	N=4, 22.2%	N=14, 77.8%	N=0, 0%	N=0, 0%	N=18, 100%
4	N=2, 11.1%	N=16, 88.9%	N=0, 0%	N=0, 0%	N=18, 100%
5	N=1, 5.6%	N=17, 94.4%	N=0, 0%	N=0, 0%	N=18, 100%
6	N=0, 0%	N=18, 100%	N=0, 0%	N=0, 0%	N=18, 100%
7	N=0, 0%	N=18, 100%	N=0, 0%	N=0, 0%	N=18, 100%
8	N=0, 0%	N=14, 50%	N=0, 0%	N=4, 50%	N=18, 100%
9	N=0, 0%	N=13, 72.2%	N=1, 5.6%	N=4, 22.2%	N=18, 100%
10	N=1, 5.6%	N=9, 50%	N=3, 16.7%	N=5, 27.8%	N=18, 100%
11	N=0, 0%	N=12, 66.7%	N=0, 0%	N=6, 33.3%	N=18, 100%
12	N=1, 5.6%	N=4, 22.2%	N=5, 27.8%	N=8, 44.4%	N=18, 100%
13	N=0, 0%	N=3, 16.7%	N=6, 33.3%	N=9, 50%	N=18, 100%
14	N=0, 0%	N=1, 5.6%	N=8, 44.4%	N=9, 50%	N=18, 100%
15	N=0, 0%	N=7, 38.9%	N=1, 5.6%	N=10, 55.6%	N=18, 100%
16	N=0, 0%	N=3, 16.7%	N=2, 11.1%	N=13, 72.2%	N=18, 100%
17	N=0, 0%	N=1, 5.6%	N=2, 11.1%	N=15, 83.3%	N=18, 100%
18	N=0, 0%	N=0, 0%	N=1, 5.6%	N=17, 94.4%	N=18, 100%
19	N=0, 0%	N=0, 0%	N=1, 5.6%	N=17, 94.4%	N=18, 100%

8.1.3 Responses and age

	PLURAL TEST: RESPONSES					
	other error	omission	error	correct	number of responses	number of participants
AGE						
7	N=18 100%	N=0 0%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
9	N=1 5.6%	N=17 94.4%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
11	N=5 13.9%	N=26 72.2%	N=1 2.8%	N=4 11.1%	N=36 100%	N=2 100%
12	N=0 0%	N=15 27.8%	N=8 22.2%	N=13 50%	N=36 100%	N=2 100%
13	N=2 11.1%	N=16 88.9%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
14	N=2 5.6%	N=13 36.1%	N=8 22.2%	N=13 36.1%	N=36 100%	N=2 100%
15	N=0 0%	N=18 100%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
16	N=4 7.4%	N=33 61.1%	N=1 1.9%	N=16 29.6%	N=54 100%	N=3 100%
17	N=0 0%	N=21 58.3%	N=6 16.7%	N=9 25%	N=36 100%	N=2 100%
22	N=0 0%	N=3 16.7%	N=2 11.1%	N=13 72.2%	N=18 100%	N=1 100%
25	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%
28	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%
31	N=0 0%	N=1 5.6%	N=2 11.1%	N=15 83.3%	N=18 100%	N=1 100%

8.1.4 Responses and IQ

	PLURAL TEST: RESPONSES					
	other error	omission	error	correct	number of responses	number of participants
IQ						
40	N=5 9.3%	N=26 48.1%	N=9 16.7%	N=14 25.9%	N=54 100%	N=3 100%
41	N=0 0%	N=18 100%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
43	N=0 0%	N=14 77.8%	N=0 0%	N=4 22.2%	N=18 100%	N=1 100%
44	N=0 0%	N=19 52.8%	N=1 2.8%	N=16 44.4%	N=36 100%	N=2 100%
45	N=0 0%	N=13 72.2%	N=1 5.6%	N=4 22.2%	N=18 100%	N=1 100%
51	N=1 5.6%	N=17 94.4%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
52	N=0 0%	N=1 5.6%	N=2 11.1%	N=15 83.3%	N=18 100%	N=1 100%
54	N=1 2.8%	N=5 13.9%	N=13 36.1%	N=17 47.2%	N=36 100%	N=2 100%
58	N=5 27.8%	N=13 72.2%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
65	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%

8.1.5 Responses and language comprehension

	PLURAL TEST: RESPONSES					
	other error	omission	error	correct	number of responses	number of participants
language comprehen-sion						
47	N=5 5.6%	N=56 62.2%	N=9 10%	N=20 22.2%	N=90 100%	N=5 100%
53	N=0 0%	N=20 55.6%	N=2 5.6%	N=14 38.9%	N=36 100%	N=2 100%
55	N=0 0%	N=14 50%	N=0 0%	N=4 50%	N=18 100%	N=1 100%
59	N=5 27.8%	N=13 72.2%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
63	N=1 1.9%	N=19 35.2%	N=10 18.5%	N=24 44.4%	N=54 100%	N=3 100%
65	N=0 0%	N=3 16.7%	N=2 11.1%	N=13 72.2%	N=18 100%	N=1 100%
69	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%
71	N=1 5.6%	N=4 22.2%	N=5 27.8%	N=8 44.4%	N=18 100%	N=1 100%

8.1.6 Responses and logical thinking

	PLURAL TEST: RESPONSES					
	other error	omission	error	correct	number of responses	number of participants
logical thinking						
47	N=5 6.9%	N=44 61.1%	N=9 12.5%	N=14 19.4%	N=72 100%	N=4 100%
49	N=0 0%	N=14 50%	N=0 0%	N=4 50%	N=18 100%	N=1 100%
50	N=0 0%	N=1 5.6%	N=2 11.1%	N=15 83.3%	N=18 100%	N=1 100%
51	N=2 11.1%	N=16 88.9%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
53	N=0 0%	N=13 72.2%	N=1 5.6%	N=4 22.2%	N=18 100%	N=1 100%
55	N=0 0%	N=7 38.9%	N=1 5.6%	N=10 55.6%	N=18 100%	N=1 100%
57	N=1 2.8%	N=16 44.4%	N=5 13.9%	N=14 38.9%	N=36 100%	N=2 100%
59	N=0 0%	N=22 40.7%	N=10 18.5%	N=22 40.7%	N=54 100%	N=3 100%
61	N=1 5.6%	N=17 94.4%	N=0 0%	N=0 0%	N=18 100%	N=1 100%
65	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%
79	N=5 27.8%	N=13 72.2%	N=0 0%	N=0 0%	N=18 100%	N=1 100%

8.1.7 Responses and working memory

	PLURAL TEST: RESPONSES					
	other error	omission	error	correct	number of responses	number of participants
working memory						
50	N=4 11.1%	N=17 47.2%	N=6 16.7%	N=9 25%	N=36 100%	N=2 100%
52	N=4 4.4%	N=69 71.1	N=4 4.4%	N=13 20%	N=90 100%	N=5 100%
54	N=1 1.9%	N=34 63%	N=5 9.3%	N=14 25.9%	N=54 100%	N=3 100%
56	N=5 13.9%	N=20 55.6%	N=1 2.8%	N=10 27.8%	N=36 100%	N=2 100%
58	N=0 0%	N=1 5.6%	N=2 11.1%	N=15 83.3%	N=18 100%	N=1 100%
59	N=0 0%	N=1 5.6%	N=8 44.4%	N=9 50%	N=18 100%	N=1 100%
60	N=0 0%	N=3 16.7%	N=2 11.1%	N=13 72.2%	N=18 100%	N=1 100%
78	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%

8.1.8 Responses and processing speed

	PLURAL TEST: RESPONSES					
	other error	omission	error	correct	number of responses	number of participants
processing speed						
50	N=6 8.3%	N=40 55.6%	N=7 9.7%	N=19 26.4%	N=72 100%	N=4 100%
53	N=1 1.9%	N=28 51.9%	N=5 9.3%	N=20 37%	N=54 100%	N=3 100%
56	N=0 0%	N=44 72.2%	N=0 0%	N=10 27.8%	N=54 100%	N=3 100%
62	N=1 2.8%	N=30 83.3%	N=1 2.8%	N=4 11.1%	N=36 100%	N=2 100%
65	N=0 0%	N=3 16.7%	N=2 11.1%	N=13 72.2%	N=18 100%	N=1 100%
68	N=6 16.7%	N=17 47.2%	N=5 13.9%	N=8 22.2%	N=36 100%	N=2 100%
71	N=0 0%	N=1 5.6%	N=8 44.4%	N=9 50%	N=18 100%	N=1 100%
78	N=0 0%	N=0 0%	N=1 5.6%	N=17 94.4%	N=18 100%	N=1 100%

8.2 Item analysis

8.2.1 Responses and item characteristics

Spearman‘s Rho		PLURAL TEST: RESPONSES			
		correct	omission	error	other error
ITEM CHARACTERISTICS					
PLURAL MARKER	Correlation Coefficient	.207	-.077	-.156	-.074
	Sig. (2-tailed)	.410	.761	.537	.770
	N	18	18	18	18
GENDER	Correlation Coefficient	.123	-.009	-.004	-.232
	Sig. (2-tailed)	.626	.970	.989	.354
	N	18	18	18	18
PRODUCTIVITY	Correlation Coefficient	.016	-.015	.102	-.005
	Sig. (2-tailed)	.951	.952	.688	.985
	N	18	18	18	18
INPUT FREQUENCY	Correlation Coefficient	.161	.208	-.189	-.183
	Sig. (2-tailed)	.523	.406	.452	.467
	N	18	18	18	18
CELEX FREQUENCY	Correlation Coefficient	.182	.153	-.333	-.070
	Sig. (2-tailed)	.470	.543	.178	.783
	N	18	18	18	18
CELEX singular Mannheim	Correlation Coefficient	.056	.351	-.328	-.071
	Sig. (2-tailed)	.824	.154	.184	.780
	N	18	18	18	18
CELEX plural Mannheim	Correlation Coefficient	.097	.387	-.387	-.057
	Sig. (2-tailed)	.701	.113	.112	.823
	N	18	18	18	18

8.2.2 Responses and plural marker

	PLURAL TEST: RESPONSES				
	other error	omission	error	correct	total
PLURAL MARKER					
U+e	N=5 8.8%	N=20 35.1%	N=4 7.0%	N=28 49.1%	N=57 100%
U+er	N=4 7.0%	N=27 47.4%	N=1 1.8%	N=25 43.9%	N=57 100%
-e	N=5 8.8%	N=25 43.9%	N=6 10.5%	N=21 36.8%	N=57 100%
-s	N=5 8.8%	N=30 52.6%	N=2 3.5%	N=20 35.1%	N=57 100%
-en	N=6 10.5%	N=26 45.6%	N=10 17.5%	N=15 26.3%	N=57 100%
U	N=7 12.3%	N=30 52.6%	N=7 12.3%	N=13 22.8%	N=57 100%

9 Past participle test: results

9.1 Subject analysis

9.1.1 Responses and participant characteristics

Spearman's Rho		PAST PARTICIPLE: RESPONSES			
		omission	error 2	error 1	correct
PARTICIPANT CHARACTERISTICS					
AGE	Correlation Coefficient	**-.466***	.356	.351	.428
	Sig. (2-tailed)	**.044**	.134	.141	.068
	N	19	19	19	19
IQ	Correlation Coefficient	-.275	-.024	.171	.235
	Sig. (2-tailed)	.342	.936	.558	.418
	N	14	14	14	14
language comprehension	Correlation Coefficient	-.407	.037	.416	.374
	Sig. (2-tailed)	.132	.896	.123	.170
	N	15	15	15	15
logical thinking	Correlation Coefficient	-.241	-.171	.147	.238
	Sig. (2-tailed)	.368	.527	.588	.374
	N	16	16	16	16
working memory	Correlation Coefficient	**-.611***	.106	.156	**.557***
	Sig. (2-tailed)	**.012**	.695	.564	**.025**
	N	16	16	16	16
processing speed	Correlation Coefficient	-.270	.123	.267	.269
	Sig. (2-tailed)	.312	.650	.318	.313
	N	16	16	16	16

9.1.2 Responses per participant

	PAST PARTICIPLE TEST: RESPONSES				
	omission	error 2	error 1	correct	number of responses
ID					
1	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
2	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
3	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
4	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
5	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
6	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
7	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%
8	N=7 35%	N=7 35%	N=0 0%	N=6 30%	N=20 100%
9	N=3 15%	N=11 55%	N=0 0%	N=6 30%	N=20 100%
10	N=1 5%	N=6 30%	N=0 0%	N=13 65%	N=20 100%
11	N=1 5%	N=5 25%	N=2 10%	N=12 60%	N=20 100%
12	N=2 10%	N=9 45%	N=0 0%	N=9 45%	N=20 100%
13	N=5 25%	N=5 25%	N=2 10%	N=8 40%	N=20 100%
14	N=0 0%	N=3 15%	N=0 0%	N=17 85%	N=20 100%
15	N=0 0%	N=4 20%	N=0 0%	N=16 80%	N=20 100%
16	N=0 0%	N=1 5%	N=1 5%	N=18 90%	N=20 100%
17	N=1 5%	N=9 45%	N=0 0%	N=10 50%	N=20 100%
18	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%
19	N=0 0%	N=7 35%	N=0 0%	N=13 65%	N=20 100%

9.1.3 Responses and age

	PAST PARTICIPLE TEST: RESPONSES					
	omission	error 2	error 1	correct	number of responses	number of participants
AGE						
7	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
9	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
11	N=27 67.5%	N=7 17.5%	N=0 0%	N=6 15%	N=40 100%	N=2 100%
12	N=2 5%	N=12 30%	N=0 0%	N=26 65%	N=40 100%	N=2 100%
13	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
14	N=4 10%	N=16 40%	N=2 5%	N=18 45%	N=40 100%	N=2 100%
15	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
16	N=21 35%	N=10 16.7%	N=0 0%	N=29 48.3%	N=60 100%	N=3 100%
17	N=25 62.5%	N=5 12.5%	N=2 5%	N=8 20%	N=40 100%	N=4 100%
22	N=0 0%	N=1 5%	N=1 5%	N=18 90%	N=20 100%	N=1 100%
25	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%	N=1 100%
28	N=0 0%	N=7 35%	N=0 0%	N=13 65%	N=20 100%	N=1 100%
31	N=1 5%	N=9 45%	N=0 0%	N=10 50%	N=20 100%	N=1 100%

9.1.4 Responses and IQ

	PAST PARTICIPLE TEST: RESPONSES					
	omission	error 2	error 1	correct	number of responses	number of participants
IQ						
40	N=28 46.7%	N=16 26.7%	N=2 3.3%	N=14 23.3%	N=60 100%	N=3 100%
41	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
43	N=2 10%	N=9 45%	N=0 0%	N=9 45%	N=20 100%	N=1 100%
44	N=1 2.5%	N=10 25%	N=0 0%	N=29 72.5%	N=40 100%	N=2 100%
45	N=7 35%	N=7 35%	N=0 0%	N=6 30%	N=20 100%	N=1 100%
51	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
52	N=1 5%	N=9 45%	N=0 0%	N=10 50%	N=20 100%	N=1 100%
54	N=1 2.5%	N=8 20%	N=2 5%	N=29 72.5%	N=40 100%	N=2 100%
58	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
65	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%	N=1 100%

9.1.5 Responses and language comprehension

	PAST PARTICIPLE TEST: RESPONSES					
	omission	error2	error 1	correct	number of responses	number of participants
language comprehension						
47	N=49 49%	N=22 22%	N=2 2%	N=27 27%	N=100 100%	N=5 100%
53	N=7 17.5%	N=11 27.5%	N=0 0%	N=22 55%	N=40 100%	N=2 100%
55	N=2 10%	N=9 45%	N=0 0%	N=9 45%	N=20 100%	N=1 100%
59	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
63	N=21 35%	N=12 20%	N=0 0%	N=27 45%	N=60 100%	N=3 100%
65	N=0 0%	N=1 5%	N=1 5%	N=18 90%	N=20 100%	N=1 100%
69	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%	N=1 100%
71	N=1 5%	N=5 25%	N=2 10%	N=12 60%	N=20 100%	N=1 100%

9.1.6 Responses and logical thinking

	PAST PARTICIPLE TEST: RESPONSES					
	other error	error2	error1	correct	number of responses	number of participants
logical thinking						
47	N=48 60%	N=16 20%	N=2 2.5%	N=14 17.5%	N=80 100%	N=4 100%
49	N=2 10%	N=9 45%	N=0 0%	N=9 45%	N=20 100%	N=1 100%
50	N=1 5%	N=9 45%	N=0 0%	N=10 50%	N=20 100%	N=1 100%
51	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
53	N=7 35%	N=7 35%	N=0 0%	N=6 30%	N=20 100%	N=1 100%
55	N=0 0%	N=4 20%	N=0 0%	N=16 80%	N=20 100%	N=1 100%
57	N=2 5%	N=11 27.5%	N=2 5%	N=25 62.5%	N=40 100%	N=2 100%
59	N=20 33.3%	N=4 6.7%	N=1 1.7%	N=35 58.3%	N=60 100%	N=3 100%
61	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%
65	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%	N=1 100%
79	N=20 100%	N=0 0%	N=0 0%	N=0 0%	N=20 100%	N=1 100%

9.1.7 Responses and working memory

	PAST PARTICIPLE TEST: RESPONSES					
	omission	error 2	error 1	correct	number of responses	number of participants
working memory						
50	N=25 62.5%	N=5 12.5%	N=2 5%	N=8 20%	N=40 100%	N=2 100%
52	N=52 52%	N=27 27%	N=0 0%	N=21 21%	N=100 100%	N=5 100%
54	N=22 36.7%	N=11 18.3%	N=2 3.3%	N=25 41.7%	N=60 100%	N=3 100%
56	N=20 50%	N=4 10%	N=0 0%	N=16 40%	N=40 100%	N=2 100%
58	N=1 5%	N=9 45%	N=0 0%	N=10 50%	N=20 100%	N=1 100%
59	N=0 0%	N=3 15%	N=0 0%	N=17 85%	N=20 100%	N=1 100%
60	N=0 0%	N=1 5%	N=1 5%	N=18 90%	N=20 100%	N=1 100%
78	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%	N=1 100%

9.1.8 Responses and processing speed

	PAST PARTICIPLE TEST: RESPONSES					
	omission	error 2	error 1	correct	number of responses	number of participants
processing speed						
50	N=45 56.3%	N=9 11.3%	N=2 2.5%	N=24 30%	N=80 100%	N=4 100%
53	N=24 40%	N=20 33.3%	N=0 0%	N=16 26.7%	N=60 100%	N=3 100%
56	N=23 38.3%	N=15 25%	N=0 0%	N=22 36.7%	N=60 100%	N=3 100%
62	N=27 67.5%	N=7 17.5%	N=0 0%	N=6 15%	N=40 100%	N=2 100%
65	N=0 0%	N=1 5%	N=1 5%	N=18 90%	N=20 100%	N=1 100%
68	N=21 52.5%	N=5 12.5%	N=2 5%	N=12 30%	N=40 100%	N=2 100%
71	N=0 0%	N=3 15%	N=0 0%	N=17 85%	N=20 100%	N=1 100%
78	N=2 10%	N=9 45%	N=1 5%	N=8 40%	N=20 100%	N=1 100%

9.2 Item Analysis

9.2.1 Responses and item characteristics

Spearman's Rho		PAST PARTICIPLE: RESPONSES			
		omission	error 2	error 1	correct
ITEM CHARACTERISTICS					
VERB CLASS	Correlation Coefficient	.299	.287	-.027	-.392
	Sig. (2-tailed)	.201	.219	.910	.087
	N	20	20	20	20
FREQUENCY CELEX STEM	Correlation Coefficient	-.068	.101	-.186	.012
	Sig. (2-tailed)	.796	.699	.474	.962
	N	17	17	17	17
FREQUENCY CELEX past participle	Correlation Coefficient	-.015	-.025	-.311	.119
	Sig. (2-tailed)	.950	.918	.194	.627
	N	19	19	19	19
FREQUENCY CELEX past participle SPOKEN	Correlation Coefficient	-.021	-.074	-.426	.151
	Sig. (2-tailed)	.931	.765	.069	.538
	N	19	19	19	19
FREQUENCY CELEX past participle WRITTEN	Correlation Coefficient	-.114	-.037	-.340	.160
	Sig. (2-tailed)	.641	.881	.154	.512
	N	19	19	19	19

10 Lexicon

10.1 Subject analysis

10.1.1 ACDI 1 and ACDI 2

ID	ACDI 1	ACDI 2
1	193	.
2	.	.
3	490	450
4	.	391
5	.	659
6	.	.
7	411	.
8	680	684
9	687	.
10	.	655
11	.	691
12	.	.
13	667	671
14	.	622
15	.	.
16	.	698
17	.	684
18	.	661
19	.	.

10.1.2 Types, token, type-token ratio

ID	TYPE	TOKEN	TYPE-TOKEN RATIO
1	23	35	65.71
2	8	15	53.33
3	11	16	68.75
4	6	32	18.75
5	16	38	42.11
6	23	50	46.00
7	20	68	29.41
8	28	39	71.79
9	20	45	44.44
10	45	116	38.79
11	86	195	44.10
12	57	129	44.19
13	56	143	39.16
14	89	239	37.24
15	21	32	65.63
16	141	397	35.52
17	153	556	27.52
18	159	401	39.65
19	169	484	34.92

10.1.3 Lexicon and participant characteristics

Spearman's Rho		LEXICON MEASURES				
		type-token ratio	types	token	**lemmata**	**utterances**
PARTICIPANT CHARACTERISTICS						
chronological age	Correlation Coefficient	**-.527***	**.534***	**.628****	**.536***	**.677****
	Sig. (2-tailed)	**.020**	**.019**	**.004**	**.018**	**.001**
	N	19	19	19	19	19
IQ	Correlation Coefficient	-.290	.387	.303	.350	.333
	Sig. (2-tailed)	.315	.171	.292	.221	.244
	N	14	14	14	14	14
language comprehension	Correlation Coefficient	-.420	**.574***	**.523***	**.550***	.503
	Sig. (2-tailed)	.119	**.025**	**.046**	**.034**	**.056**
	N	15	15	15	15	15
logical thinking	Correlation Coefficient	-.232	.106	.104	.054	.198
	Sig. (2-tailed)	.354	.676	.682	.831	.430
	N	18	18	18	18	18
working memory	Correlation Coefficient	-.333	**.586***	**.521***	**.558***	**.537***
	Sig. (2-tailed)	.208	**.017**	**.038**	**.025**	**.032**
	N	16	16	16	16	16
processing speed	Correlation Coefficient	-.056	.441	.392	.426	.310
	Sig. (2-tailed)	.831	.077	.119	.088	.225
	N	17	17	17	17	17

10.2 Lexicon: between test results

Spearman's Rho		type-token ratio	token	types	lemmata	ACDI 1	ACDI 2	utterances
type-token ratio	Correlation Coefficient	1	**-.596****	-.345	-.368	.200	.132	**-.722****
	Sig. (2-tailed)	.	**.007**	.148	.121	.704	.699	**.000**
	N	19	19	19	19	6	11	19
token	Correlation Coefficient		1	**.929****	**.948****	.257	.597	**.872****
	Sig. (2-tailed)		.	**.000**	**.000**	.623	.053	**.000**
	N		19	19	19	6	11	19
types	Correlation Coefficient			1	**.994****	.145	.583	**.735****
	Sig. (2-tailed)			.	**.000**	.784	.060	**.000**
	N			19	19	6	11	19
lemmata	Correlation Coefficient				1	.257	**.606***	**.746****
	Sig. (2-tailed)				.	.623	**.048**	**.000**
	N				19	6	11	19
ACDI 1	Correlation Coefficient					1	**1****	.200
	Sig. (2-tailed)					.	.	.704
	N					6	3	6
ACDI 2	Correlation Coefficient						1	.200
	Sig. (2-tailed)						.	.704
	N						11	6
utterances	Correlation Coefficient							1
	Sig. (2-tailed)							.
	N							19

11 Picture story telling task

11.1 Introducing

	INTRODUCING				
	BOY	DOG	FROG	OTHER	TOTAL
TYPE OF REFERENCE					
bare noun	N=2 11.1%	N=5 31.3%	N=9 47.4%	N=20 47.6%	N=36 37.9%
indef. art. + N	N=6 33.3%	N=8 50%	N=8 42.1%	N=16 38.1%	N=38 40%
def. art. + N	N=7 38.9%	N=3 18.7%	N=2 10.5%	N=5 11.9%	N=17 17.9%
zero form	N=2 11.1%	N=0 0%	N=0 0%	N=1 2.4%	N=3 3.1%
pronoun	N=1 5.6%	N=0 0%	N=0 0%	N=0 0%	N=1 1.1%
TOTAL	N=18 100%	N=16 100%	N=19 100%	N=42 100%	N=95 100%

11.2 Maintaining

	MAINTAINING				
	BOY	DOG	FROG	OTHER	TOTAL
TYPE OF REFERENCE					
bare noun	N=8 5.4%	N=8 19.5%	N=8 42%	N=2 11.8%	N=26 11.5%
indef. art. + N	N=7 4.6%	N=2 4.9%	N=0 0%	N=0 0%	N=9 4%
def. art. + N	N=27 18%	N=7 17.1%	N=4 21.1%	N=5 29.4%	N=43 19%
er	N=45 30%	N=15 36.6%	N=4 21.1%	N=3 17.6%	N=67 29.5%
der	N=12 8%	N=0 0%	N=1 5.3%	N=2 11.8%	N=15 6.6%
zero incorrect	N=25 16.7%	N=1 2.4%	N=2 10.5%	N=1 5.9%	N=29 12.8%
zero correct	N=20 13.3%	N=8 19.5%	N=0 0%	N=4 23.5%	N=32 14%
possessive	N=6 4%	N=0 0%	N=0 0%	N=0 0%	N=6 2.6%
TOTAL	N=150 100%	N=41 100%	N=19 100%	N=17 100%	N=227 100%

11.3 Switching

	SWITCHING				
	BOY	DOG	FROG	OTHER	TOTAL
TYPE OF REFERENCE					
bare noun	N=35 27.6%	N=42 36.8%	N=13 40.6%	N=6 26.1%	N=96 32.4%
indef. art. + N	N=4 3.2%	N=11 9.7%	N=5 15.6%	N=1 4.3%	N=21 7.1%
def. art. + N	N=60 47.2%	N=57 50%	N=11 34.5%	N=14 61%	N=142 48%
er	N=11 8.7%	N=0 0%	N=1 3.13%	N=0 0%	N=12 4.1%
der	N=5 3.9%	N=0 0%	N=0 0%	N=1 4.3%	N=6 2%
zero incorrect	N=12 9.4%	N=4 3.5%	N=1 3.13%	N=1 4.3%	N=18 6.1%
possessive	N=0 0%	N=0 0%	N=1 3.13%	N=0 0%	N=1 0.3%
TOTAL	N=127 100%	N=114 100%	N=32 100%	N=23 100%	N=296 100%

11.4 Correlations between referring expressions

11.4.1 Introducing

Spearman's Rho		INTRODUCING				
		noun	indef. article + noun	def. article + noun	zero incorrect	pronoun
INTRODUCING						
noun	Correlation Coefficient	1	**-.813****	**-.549***	.294	.221
	Sig. (2-tailed)	.	**.000**	**.015**	.223	.363
	N	19	19	19	19	19
indefinite article + noun	Correlation Coefficient		1	.027	-.229	-.266
	Sig. (2-tailed)		.	.911	.345	.272
	N		19	19	19	19
definite article + noun	Correlation Coefficient			1	-.383	-.210
	Sig. (2-tailed)			.	.105	.389
	N			19	19	19
zero incorrect	Correlation Coefficient				1	-.102
	Sig. (2-tailed)				.	.679
	N				19	19
pronoun	Correlation Coefficient					1
	Sig. (2-tailed)					.
	N					19

		MAINTAINING							
INTRODUCING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**zero correct**	**possessive**
noun	Correlation Coefficient	**.688****	-.329	**-.783****	**-.745****	-.127	.363	**-.603****	-.337
	Sig. (2-tailed)	**.001**	.170	**.000**	**.000**	.605	.127	**.006**	.159
	N	19	19	19	19	19	19	19	19
indef. article + noun	Correlation Coefficient	**-.526***	.386	**.487***	**.565***	.019	-.158	.245	.086
	Sig. (2-tailed)	**.021**	.102	**.035**	**.012**	.940	.517	.312	.726
	N	19	19	19	19	19	19	19	19
def. article + noun	Correlation Coefficient	**-.540***	-.040	**.730****	.450	.228	-.359	**.707****	.455
	Sig. (2-tailed)	**.017**	.870	**.000**	.053	.348	.131	**.001**	.050
	N	19	19	19	19	19	19	19	19
zero incorrect	Correlation Coefficient	.355	.032	-.416	-.318	.065	.386	-.286	-.186
	Sig. (2-tailed)	.136	.897	.076	.184	.791	.102	.235	.446
	N	19	19	19	19	19	19	19	19
pronoun	Correlation Coefficient	.359	-.156	-.227	-.174	-.156	-.246	-.156	-.102
	Sig. (2-tailed)	.132	.522	.349	.476	.522	.309	.522	.679
	N	19	19	19	19	19	19	19	19

		SWITCHING						
INTRODUCING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
noun	Correlation Coefficient	**.812****	-.028	**-.929****	**-.515***	-.173	**.501***	-.265
	Sig. (2-tailed)	**.000**	.910	**.000**	**.024**	.479	**.029**	.273
	N	19	19	19	19	19	19	19
indef. article + noun	Correlation Coefficient	**-.645****	.126	**.719****	.278	-.309	-.304	.244
	Sig. (2-tailed)	**.003**	.608	**.001**	.250	.198	.205	.315
	N	19	19	19	19	19	19	19
def. article + noun	Correlation Coefficient	**-.570***	.059	**.562***	.421	**.753****	-.305	.163
	Sig. (2-tailed)	**.011**	.810	**.012**	.072	**.000**	.205	.505
	N	19	19	19	19	19	19	19
zero incorrect	Correlation Coefficient	.228	.071	-.003	.254	-.221	.343	-.102
	Sig. (2-tailed)	.348	.773	.212	.294	.364	.151	.679
	N	19	19	19	19	19	19	19
pronoun	Correlation Coefficient	.397	-.209	-.246	-.139	-.121	-.265	-.056
	Sig. (2-tailed)	.092	.390	.310	.571	.623	.273	.821
	N	19	19	19	19	19	19	19

		MAINTAINING							
MAINTAINING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**zero correct**	**possessive**
noun	Correlation Coefficient	1	-.302	**-.721****	**-.663****	-.305	-.040	-.442	-.451
	Sig. (2-tailed)	.	.208	**.000**	**.002**	.205	.871	.058	.053
	N	19	19	19	19	19	19	19	19
indef. article + noun	Correlation Coefficient		1	.097	.221	.369	.209	-.314	.199
	Sig. (2-tailed)		.	.694	.363	.120	.390	.190	.414
	N		19	19	19	19	19	19	19
def. article + noun	Correlation Coefficient			1	**.535***	.272	**-.510***	**.710****	.253
	Sig. (2-tailed)			.	**.018**	.260	**.026**	**.001**	.297
	N			19	19	19	19	19	19
er	Correlation Coefficient				1	.228	-.206	.384	.452
	Sig. (2-tailed)				.	.347	.397	.104	.052
	N				19	19	19	19	19
der	Correlation Coefficient					1	.079	-.314	.167
	Sig. (2-tailed)					.	.749	.190	.493
	N					19	19	19	19

		MAINTAINING							
MAINTAINING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**zero correct**	**possessive**
zero incorrect	Correlation Coefficient						1	**-.495***	-.027
	Sig. (2-tailed)						.	**.031**	.914
	N						19	19	19
zero correct	Correlation Coefficient							1	.264
	Sig. (2-tailed)							.	.274
	N							19	19
possessive	Correlation Coefficient								1
	Sig. (2-tailed)								.
	N								19

		SWITCHING						
MAINTAINING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
noun	Correlation Coefficient	**.801****	-.113	**-.758****	**-.536***	-.138	.289	-.246
	Sig. (2-tailed)	**.000**	.645	**.000**	**.018**	.572	.229	.309
	N	19	19	19	19	19	19	19
indef. article + noun	Correlation Coefficient	-.345	.429	.274	.265	-.131	-.037	-.156
	Sig. (2-tailed)	.148	.067	.256	.273	.592	.880	.522
	N	19	19	19	19	19	19	19
def. article + noun	Correlation Coefficient	**-.751****	.010	**.794****	.379	.361	**-.523***	.409
	Sig. (2-tailed)	**.000**	.968	**.000**	.109	.128	**.022**	.082
	N	19	19	19	19	19	19	19
er	Correlation Coefficient	**-.722****	-.151	**.828****	**.722****	.153	**-.562***	-.174
	Sig. (2-tailed)	**.000**	.537	**.000**	**.000**	.531	**.012**	.476
	N	19	19	19	19	19	19	19
der	Correlation Coefficient	**-.497***	.172	.163	.259	.262	.087	-.156
	Sig. (2-tailed)	**.030**	.480	.504	.284	.278	.723	.522
	N	19	19	19	19	19	19	19

		SWITCHING						
MAINTAINING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
zero incorrect	Correlation Coefficient	.115	.026	-.299	-.091	-.195	**.620****	-.246
	Sig. (2-tailed)	.638	.283	.213	.712	.424	**.005**	.309
	N	19	19	19	19	19	19	19
zero correct	Correlation Coefficient	-.432	-.019	**.610****	.225	.382	-.436	.417
	Sig. (2-tailed)	.065	.437	**.006**	.355	.107	.062	.075
	N	19	19	19	19	19	19	19
possessive	Correlation Coefficient	**-.485***	-.028	.373	**.786****	.108	-.188	-.102
	Sig. (2-tailed)	**.036**	.908	.116	**.000**	.659	.440	.679
	N	19	19	19	19	19	19	19

		SWITCHING						
SWITCHING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
noun	Correlation Coefficient	1	-.236	**-.796****	**-.583****	-.155	.181	-.265
	Sig. (2-tailed)	.	.331	**.000**	**.009**	.526	.459	.273
	N	19	19	19	19	19	19	19
indef. article + noun	Correlation Coefficient		1	-.114	-.171	-.118	.398	.279
	Sig. (2-tailed)		.	.641	.483	.629	.092	.247
	N		19	19	19	19	19	19
def. article + noun	Correlation Coefficient			1	**.515***	.178	**-.619****	.134
	Sig. (2-tailed)			.	**.024**	.467	**.005**	.584
	N			19	19	19	19	19
er	Correlation Coefficient				1	.159	-.298	-.139
	Sig. (2-tailed)				.	.517	.215	.571
	N				19	19	19	19
der	Correlation Coefficient					1	-.161	-.121
	Sig. (2-tailed)					.	.509	.623
	N					19	19	19

		SWITCHING						
SWITCHING		**noun**	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
zero incorrect	Correlation Coefficient						1	.177
	Sig. (2-tailed)						.	.470
	N						19	19
possessive	Correlation Coefficient							1
	Sig. (2-tailed)							.
	N							19

11.5 Correlations between participant characteristics and referring expressions

11.5.1 Introducing correlated with age

	INTRODUCING				
AGE	noun	indef. article + noun	def. article + noun	zero incorrect	pronoun
Correlation Coefficient	-.402	.296	.389	**-.490***	-.281
Sig. (2-tailed)	.088	.218	.100	**.033**	.244
N	19	19	19	19	19

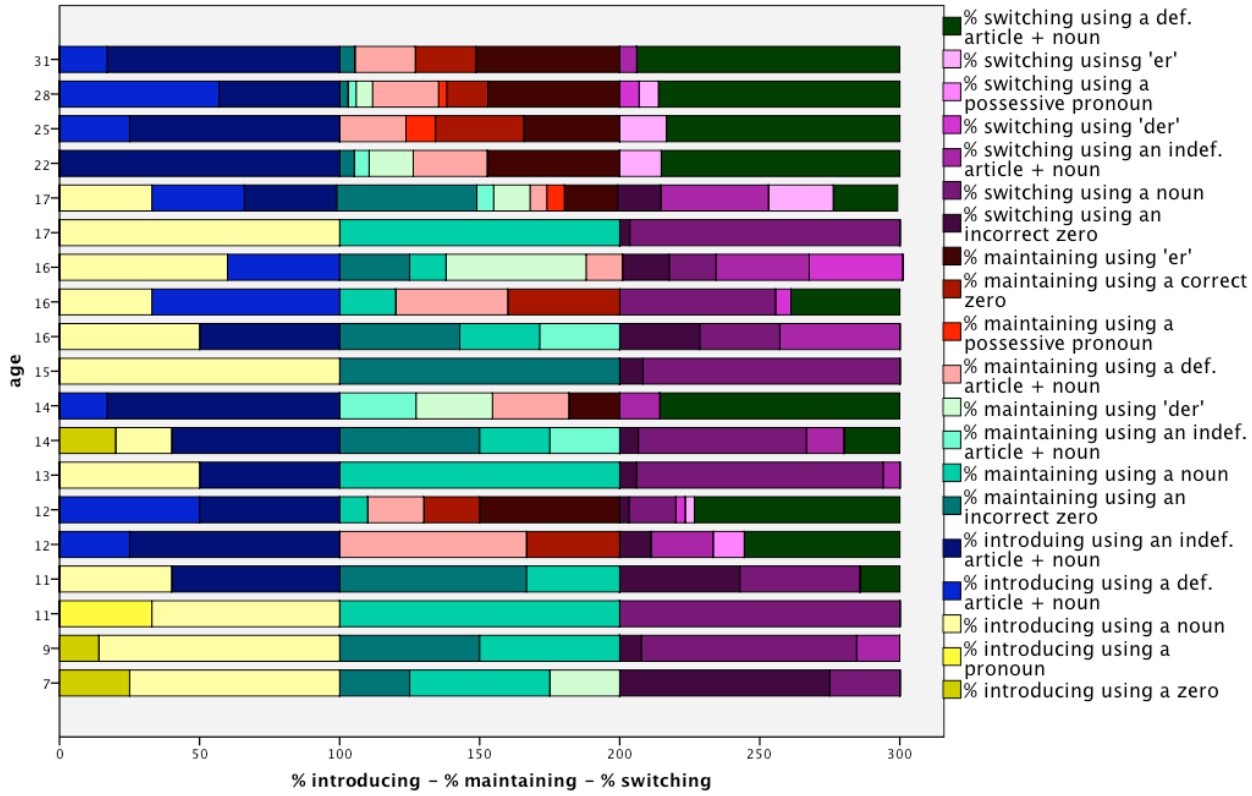
11.5.2 Maintaining correlated with age

AGE	MAINTAINING							
	noun	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**zero correct**	**possessive**
Correlation Coefficient	**-.562***	.292	.424	**.576****	.136	-.100	.310	.310
Sig. (2-tailed)	**.012**	.225	.070	**.010**	.580	.683	.196	.196
N	19	19	19	19	19	19	19	19

11.5.3 Switching correlated with age

AGE	SWITCHING						
	noun	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
Correlation Coefficient	**-.467***	.002	**.527***	**.492***	.207	**-.469***	-.194
Sig. (2-tailed)	**.044**	.994	**.020**	**.032**	.394	**.043**	.425
N	19	19	19	19	19	19	19

11.5.4 Introducing, maintaining, switching and age: overview



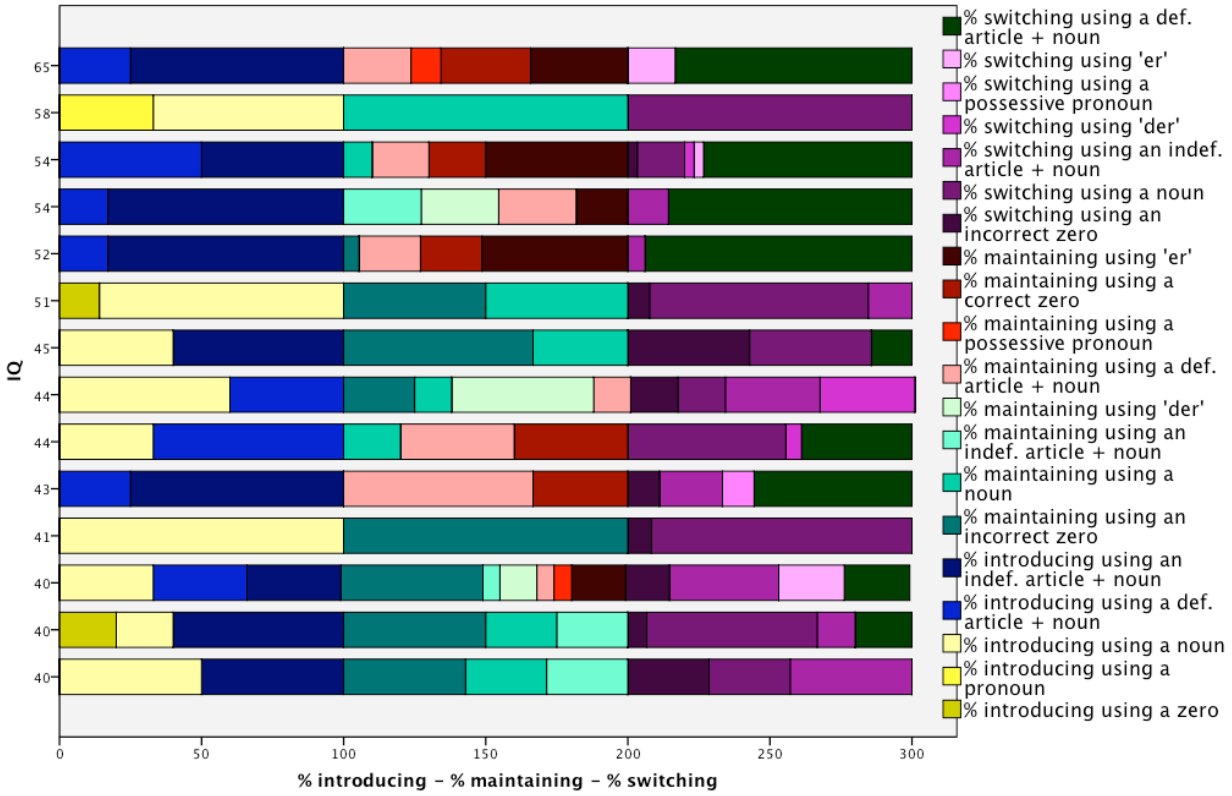
11.5.5 Introducing correlated with IQ

IQ		INTRODUCING				
		noun	indef. article + noun	def. article + noun	zero incorrect	pronoun
IQ	Correlation Coefficient	-.287	.211	.128	-.229	.381
	Sig. (2-tailed)	.321	.468	.663	.432	.179
	N	14	14	14	14	14
language comprehension	Correlation Coefficient	**-.544***	**.559***	.021	-.117	.063
	Sig. (2-tailed)	**.036**	**.030**	.940	.677	.823
	N	15	15	15	15	15
logical thinking	Correlation Coefficient	-.016	-.093	.007	-.099	.401
	Sig. (2-tailed)	.950	.715	.783	.695	.099
	N	18	18	18	18	18
working memory	Correlation Coefficient	-.387	.249	.274	-.292	.171
	Sig. (2-tailed)	.139	.352	.304	.273	.526
	N	16	16	16	16	16
processing speed	Correlation Coefficient	-.369	.266	.073	-.031	.284
	Sig. (2-tailed)	.146	.303	.078	.906	.269
	N	17	17	17	17	17

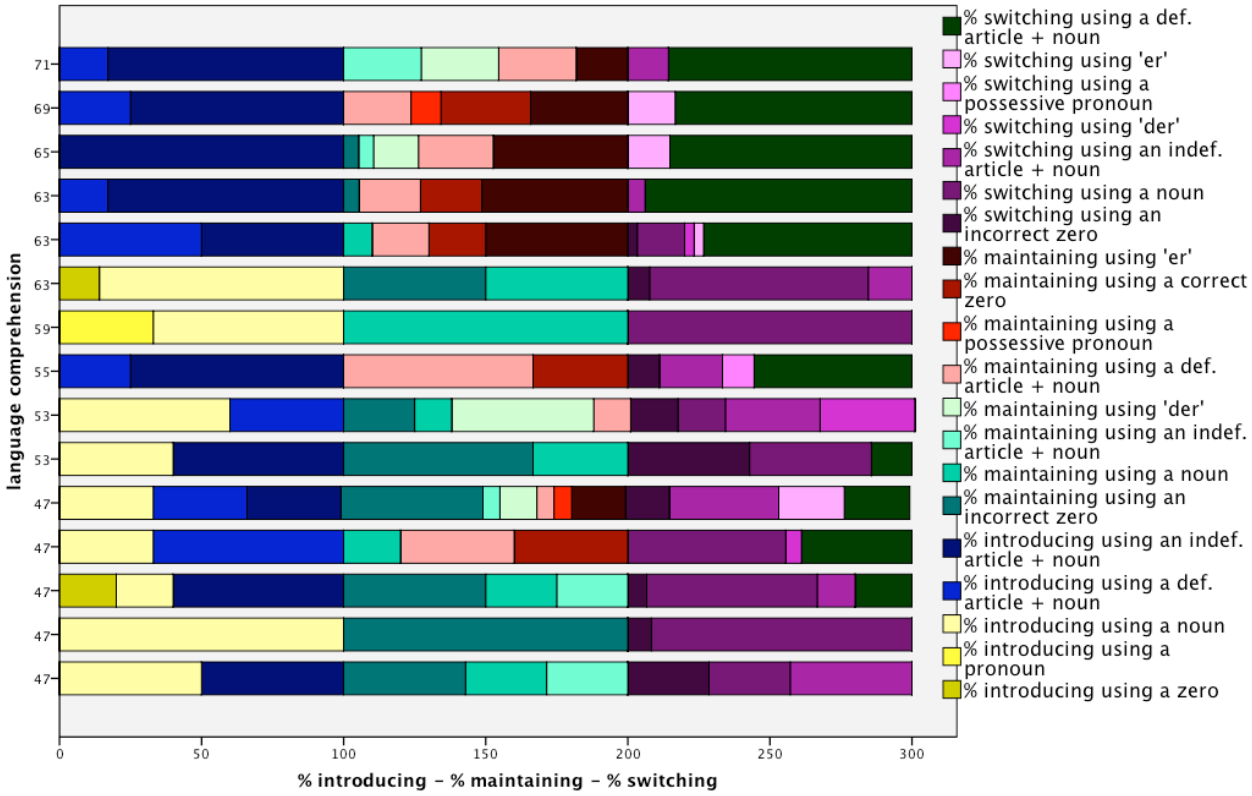
IQ		MAINTAINING							
		noun	indef. article + noun	def. article + noun	er	der	zero incorrect	zero correct	possessive
IQ	Correlation Coefficient	.015	-.459	.283	.449	-.080	**-.598***	.266	.094
	Sig. (2-tailed)	.959	.099	.326	.108	.786	**.024**	.359	.748
	N	14	14	14	14	14	14	14	14
language comprehension	Correlation Coefficient	-.281	-.133	.427	**.594***	.223	**-.540***	.146	.008
	Sig. (2-tailed)	.310	.637	.112	**.020**	.425	**.038**	.604	.776
	N	15	15	15	15	15	15	15	15
logical thinking	Correlation Coefficient	.243	-.381	.159	.183	-.014	**-.543***	.126	.045
	Sig. (2-tailed)	.330	.119	.529	.466	.955	**.020**	.617	.086
	N	18	18	18	18	18	18	18	18
working memory	Correlation Coefficient	-.353	-.377	.434	**.580***	.142	-.443	.357	.059
	Sig. (2-tailed)	.180	.150	.093	**.019**	.600	.086	.174	.829
	N	16	16	16	16	16	16	16	16
processing speed	Correlation Coefficient	-.108	-.198	.319	.362	-.097	-.433	.280	.089
	Sig. (2-tailed)	.679	.447	.212	.154	.712	.083	.276	.735
	N	17	17	17	17	17	17	17	17

IQ		SWITCHING						
		noun	indef. article + noun	def. article + noun	er	der	zero incorrect	possessive
IQ	Correlation Coefficient	-.118	**-.560***	.391	.157	.055	**-.649***	-.173
	Sig. (2-tailed)	.688	**.037**	.166	.592	.851	**.012**	.554
	N	14	14	14	14	14	14	14
language comprehension	Correlation Coefficient	-.467	-.264	**.601***	.263	-.161	**-.583***	.000
	Sig. (2-tailed)	.079	.342	**.018**	.344	.567	**.023**	1
	N	15	15	15	15	15	15	15
logical thinking	Correlation Coefficient	.110	**-.489***	.090	.199	.189	**-.562***	-.212
	Sig. (2-tailed)	.663	**.039**	.721	.428	.453	**.015**	.398
	N	18	18	18	18	18	18	18
working memory	Correlation Coefficient	-.247	**-.625****	.489	.322	.306	**-.689****	-.200
	Sig. (2-tailed)	.357	**.010**	.055	.224	.249	**.003**	.458
	N	16	16	16	16	16	16	16
processing speed	Correlation Coefficient	-.121	**-.595***	.437	.293	-.035	**-.578***	.000
	Sig. (2-tailed)	.643	**.012**	.079	.253	.895	**.015**	1
	N	17	17	17	17	17	17	17

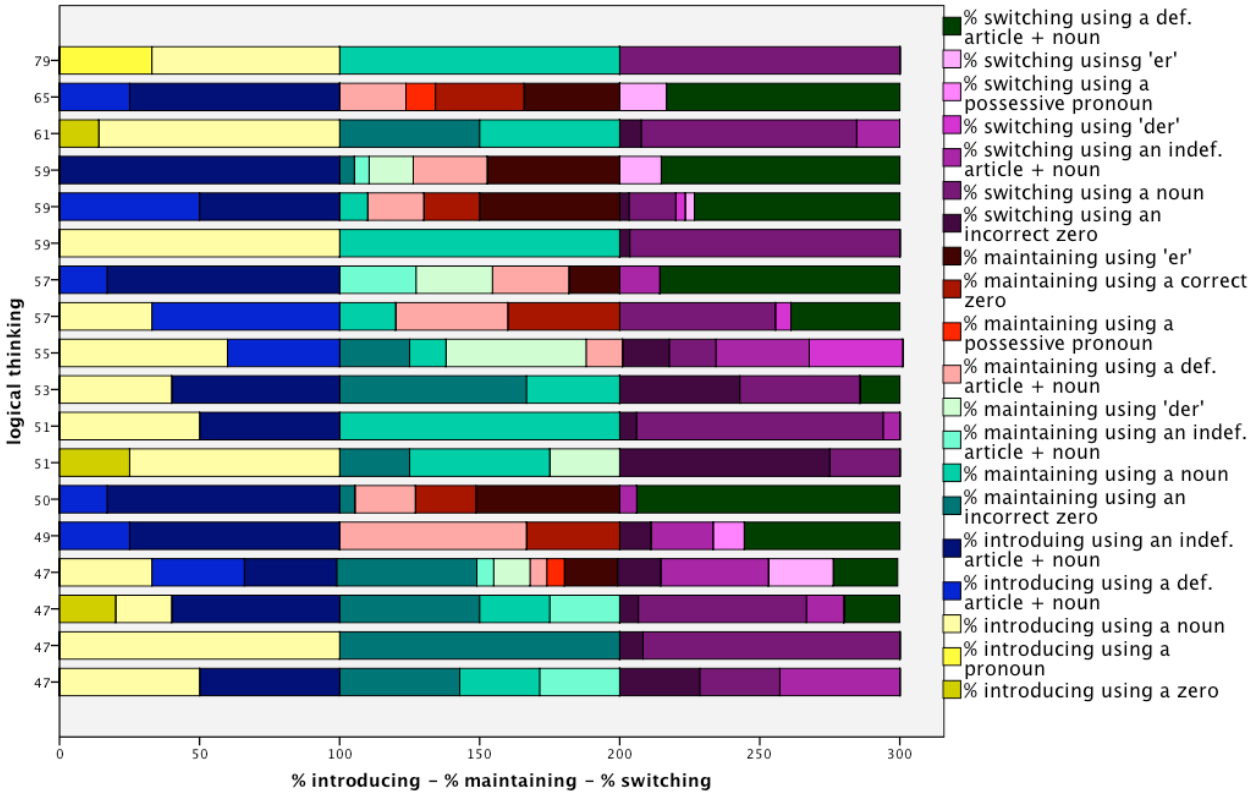
11.5.8 Introducing, maintaining, switching and IQ: overview



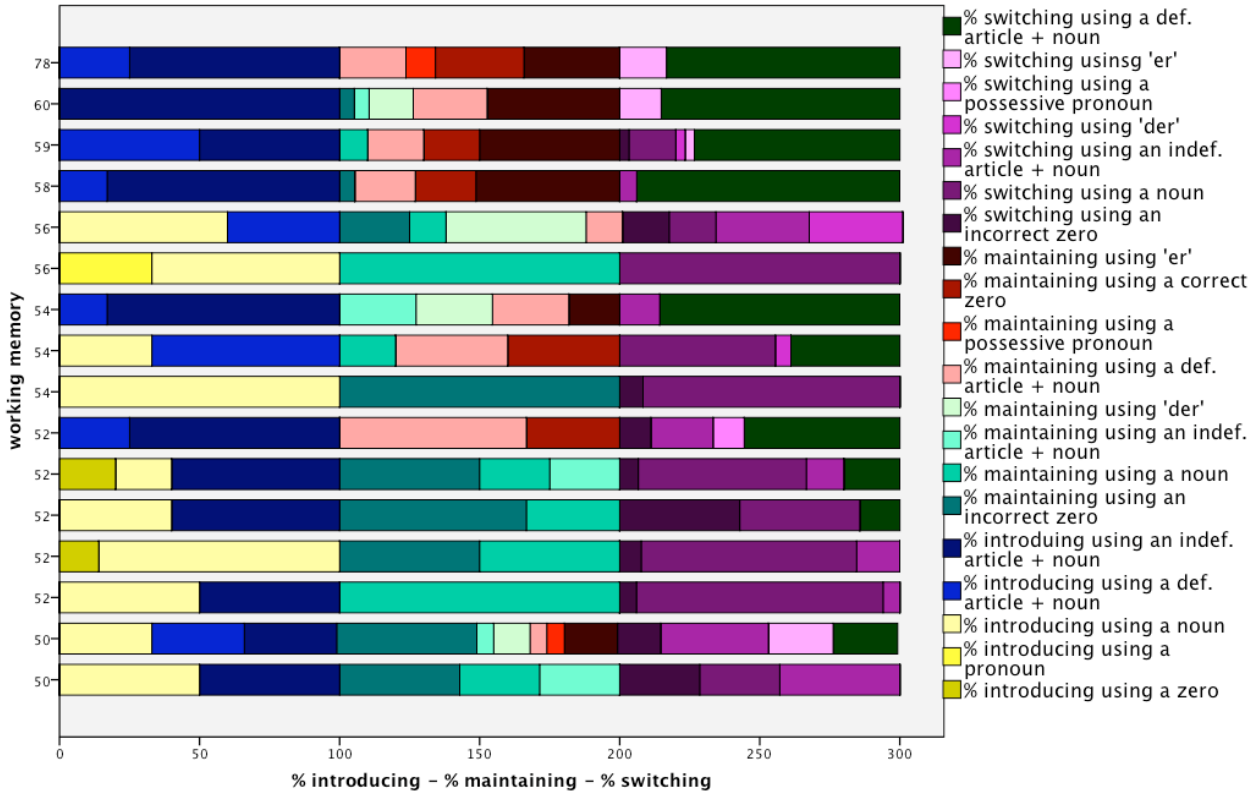
11.5.9 Introducing, maintaining, switching and language comprehension



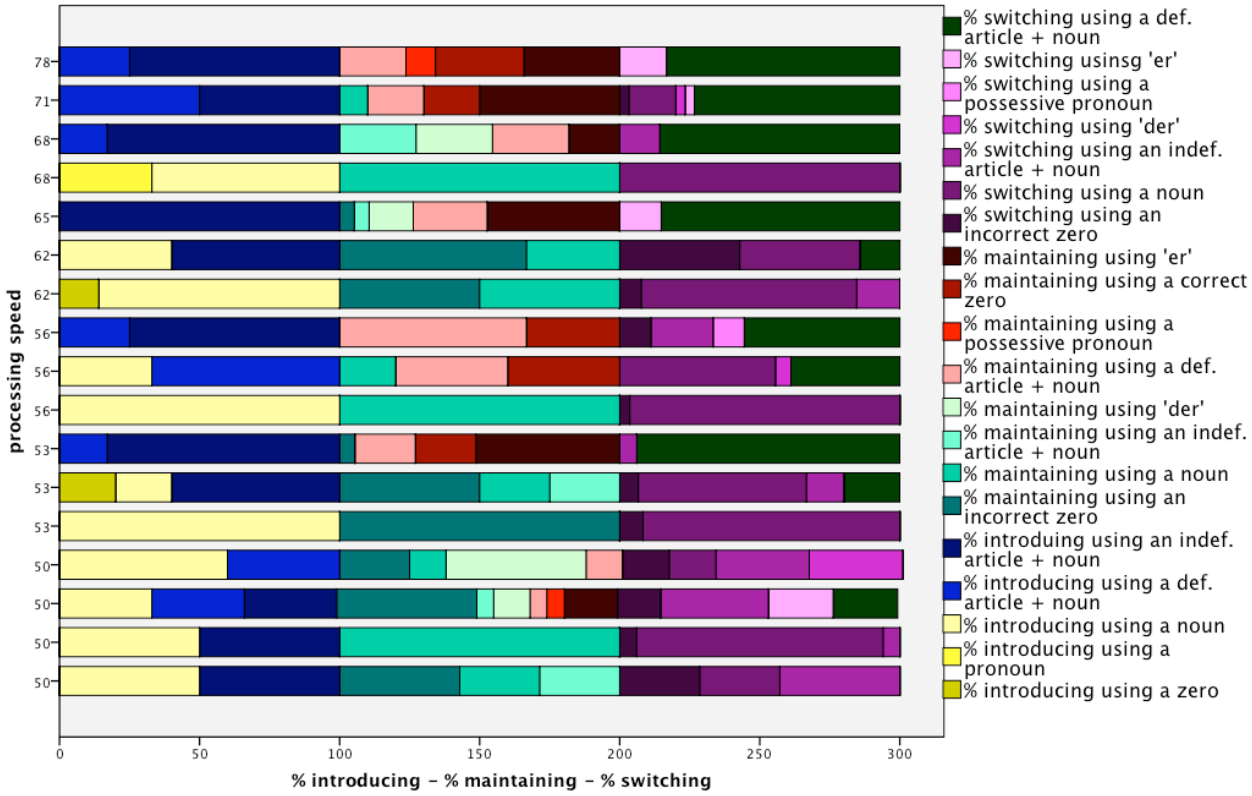
11.5.10 Introducing, maintaining, switching and logical thinking



11.5.11 Introducing, maintaining, switching and working memory



11.5.12 Introducing, maintaining, switching and processing speed



11.6 Correlations between language measures and referring expressions

11.6.1 Introducing correlated with language measures

		INTRODUCING				
LANGUAGE MEASURES		**noun**	indef. article + noun	def. article + noun	**zero incorrect**	**pronoun**
GRAMMAR	Correlation Coefficient	**-.829****	**.541***	**.685****	-.350	-.265
	Sig. (2-tailed)	**.000**	**.017**	**.001**	.142	.273
	N	19	19	19	19	19
plural	Correlation Coefficient	**-.802****	**.535***	**.679****	-.323	-.323
	Sig. (2-tailed)	**.000**	**.018**	**.001**	.177	.177
	N	19	19	19	19	19
past participle	Correlation Coefficient	**-.770****	.441	**.736****	-.364	-.266
	Sig. (2-tailed)	**.000**	.059	**.000**	.125	.272
	N	19	19	19	19	19
TYPE-TOKEN RATIO	Correlation Coefficient	.035	-.211	-.288	.282	.215
	Sig. (2-tailed)	.141	.385	.232	.243	.376
	N	19	19	19	19	19
type	Correlation Coefficient	**-.791****	**.539***	**.618****	-.303	-.345
	Sig. (2-tailed)	**.000**	**.017**	**.005**	.208	.149
	N	19	19	19	19	19
token	Correlation Coefficient	**-.758****	**.544***	**.534***	-.292	-.387
	Sig. (2-tailed)	**.000**	**.014**	**.018**	.226	.101
	N	19	19	19	19	19
LEMMATA	Correlation Coefficient	**-.804****	**.568***	**.584****	-.278	-.344
	Sig. (2-tailed)	**.000**	**.011**	**.009**	.250	.149
	N	19	19	19	19	19

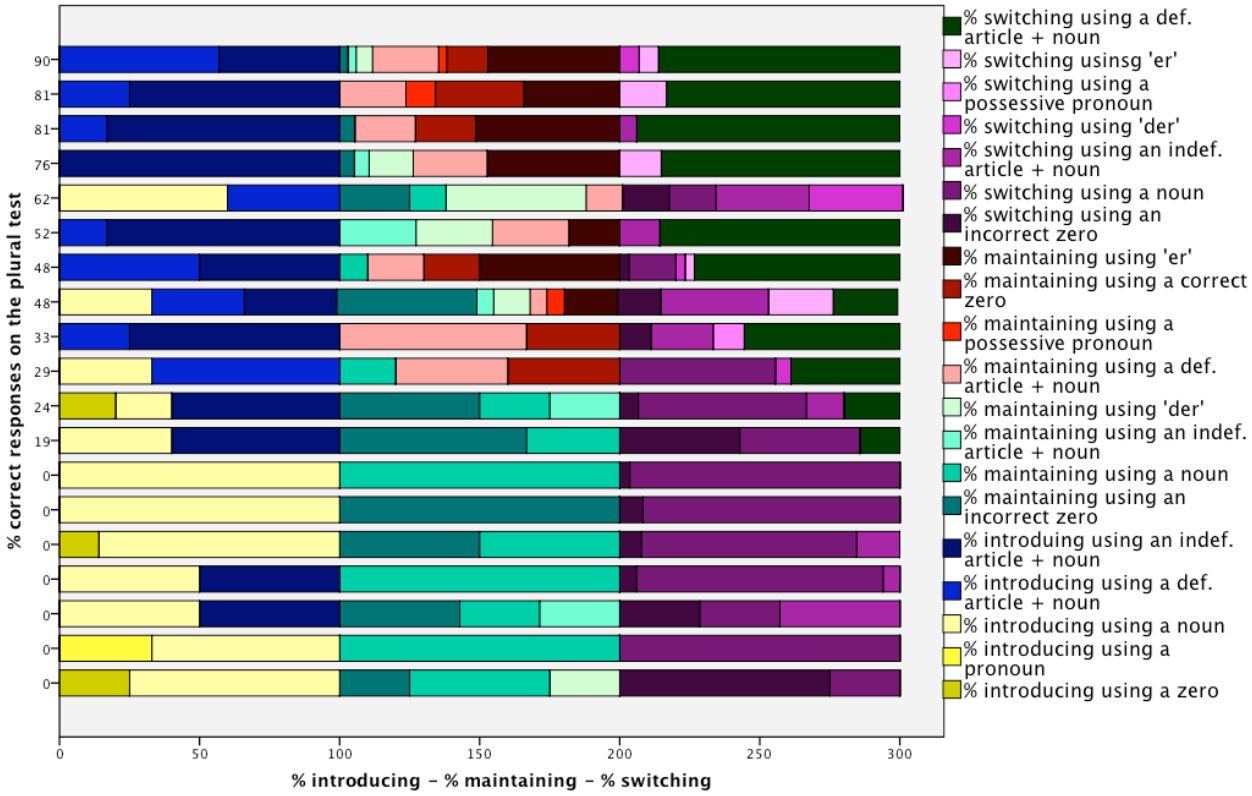
11.6.2 Maintaining correlated with language measures

LANGUAGE MEASURES		MAINTAINING							
		noun	indef. article + noun	def. article + noun	er	der	zero incorrect	zero correct	possessive
GRAMMAR	Correlation Coefficient	**-.723****	.192	**.776****	**.815****	.375	-.233	**.514***	.354
	Sig. (2-tailed)	**.000**	.431	**.000**	**.000**	.113	.337	**.024**	.137
	N	19	19	19	19	19	19	19	19
plural	Correlation Coefficient	**-.741****	.230	**.728****	**.790****	.395	-.169	**.483***	**.508***
	Sig. (2-tailed)	**.000**	.343	**.000**	**.000**	.094	.488	**.036**	**.026**
	N	19	19	19	19	19	19	19	19
past participle	Correlation Coefficient	**-.645****	.155	**.822****	**.667****	.391	-.290	**.517***	.190
	Sig. (2-tailed)	**.003**	.526	**.000**	**.002**	.097	.228	**.023**	.437
	N	19	19	19	19	19	19	19	19
TYPE-TOKEN RATIO	Correlation Coefficient	.183	.079	-.341	**-.552***	.106	**.483***	-.361	-.222
	Sig. (2-tailed)	.454	.749	.153	**.014**	.665	**.036**	.128	.360
	N	19	19	19	19	19	19	19	19
type	Correlation Coefficient	**-.829****	.094	**.767****	**.817****	.268	-.188	**.619****	**.496***
	Sig. (2-tailed)	**.000**	.703	**.000**	**.000**	.267	.440	**.005**	**.031**
	N	19	19	19	19	19	19	19	19
token	Correlation Coefficient	**-.780****	.126	**.705****	**.846****	.106	-.238	**.598****	**.470***
	Sig. (2-tailed)	**.000**	.609	**.001**	**.000**	.665	.327	**.007**	**.042**
	N	19	19	19	19	19	19	19	19
LEMMATA	Correlation Coefficient	**-.834****	.126	**.746****	**.824****	.219	-.161	**.617****	**.467***
	Sig. (2-tailed)	**.000**	.609	**.000**	**.000**	.367	.511	**.005**	**.044**
	N	19	19	19	19	19	19	19	19

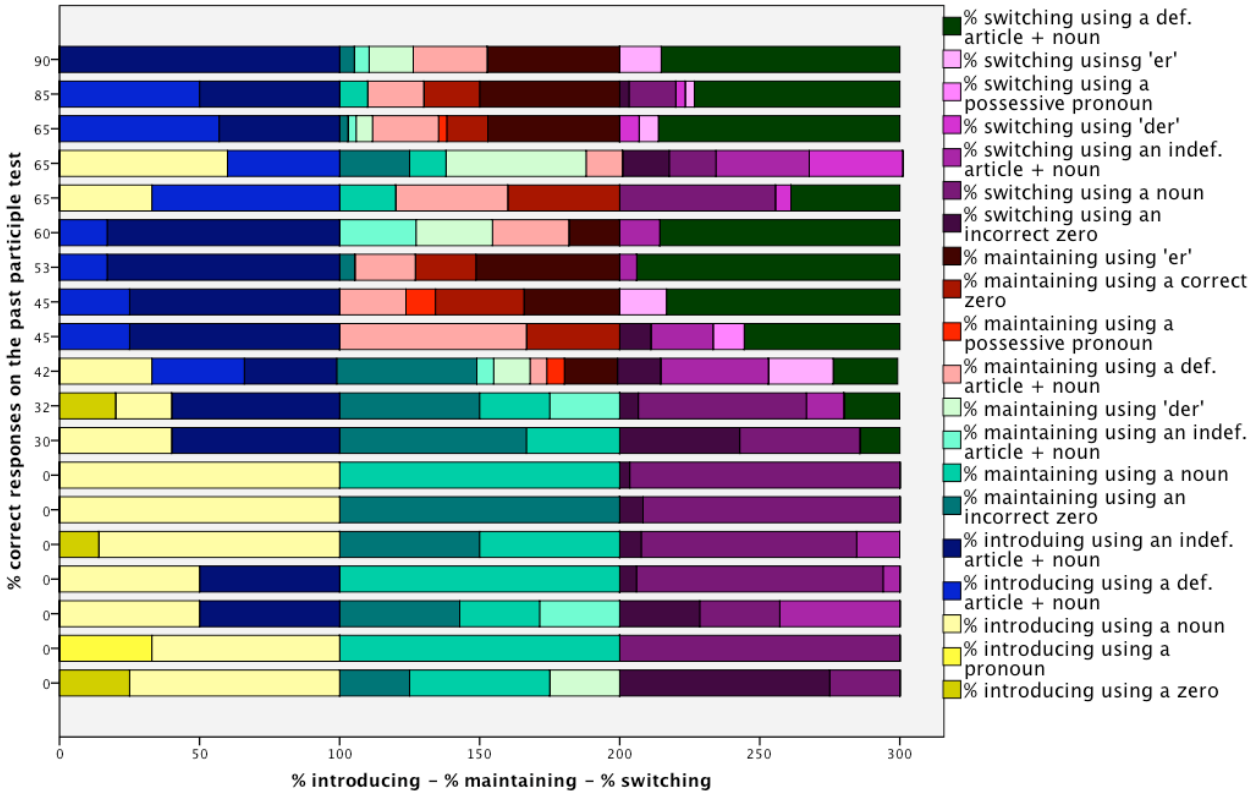
11.6.3 Switching correlated with language measures

LANGUAGE MEASURES		SWITCHING						
		noun	indef. article + noun	def. article + noun	er	der	zero incorrect	possessive
GRAMMAR	Correlation Coefficient	**-.788****	-.091	**.859****	**.606****	**.504***	**-.517***	.000
	Sig. (2-tailed)	**.000**	.712	**.000**	**.006**	**.028**	**.023**	1
	N	19	19	19	19	19	19	19
plural	Correlation Coefficient	**-.808****	-.030	**.854****	**.604****	.439	**-.507***	-.066
	Sig. (2-tailed)	**.000**	.904	**.000**	**.006**	.060	**.027**	.787
	N	19	19	19	19	19	19	19
past participle	Correlation Coefficient	**-.700****	-.086	**.773****	**.494***	**.617****	**-.460***	.066
	Sig. (2-tailed)	**.001**	.727	**.000**	**.032**	**.005**	**.048**	.787
	N	19	19	19	19	19	19	19
TYPE-TOKEN RATIO	Correlation Coefficient	.185	.194	**-.459***	-.367	-.130	**.642****	.086
	Sig. (2-tailed)	.447	.425	**.048**	.123	.595	**.003**	.726
	N	19	19	19	19	19	19	19
type	Correlation Coefficient	**-.831****	-.253	**.903****	**.630****	.261	-.445	.129
	Sig. (2-tailed)	**.000**	.296	**.000**	**.004**	.281	.056	.598
	N	19	19	19	19	19	19	19
token	Correlation Coefficient	**-.716****	-.229	**.908****	**.612****	.141	**-.576****	.086
	Sig. (2-tailed)	**.001**	.346	**.000**	**.005**	.563	**.010**	.726
	N	19	19	19	19	19	19	19
LEMMATA	Correlation Coefficient	**-.810****	-.252	**.925****	**.606****	.220	**-.463***	.129
	Sig. (2-tailed)	**.000**	.298	**.000**	**.006**	.365	**.046**	.598
	N	19	19	19	19	19	19	19

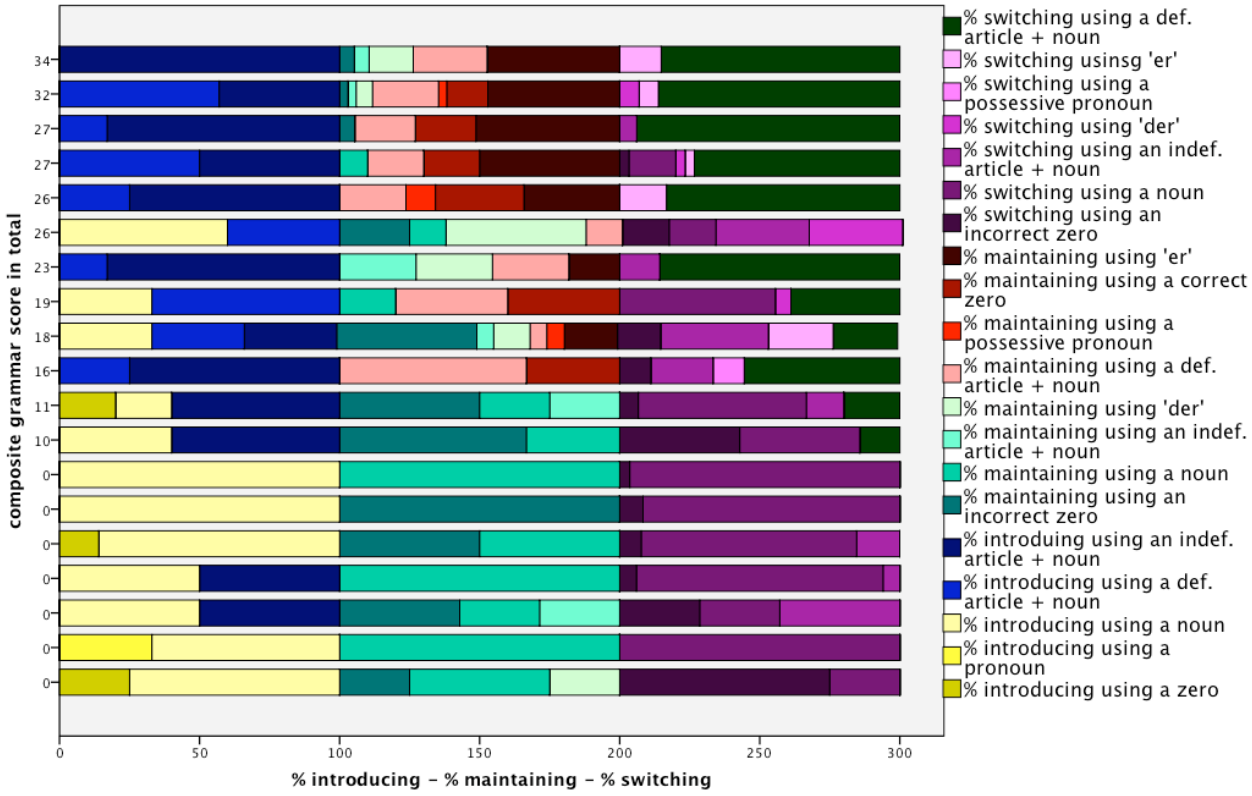
11.6.4 Introducing, maintaining, switching and the plural test



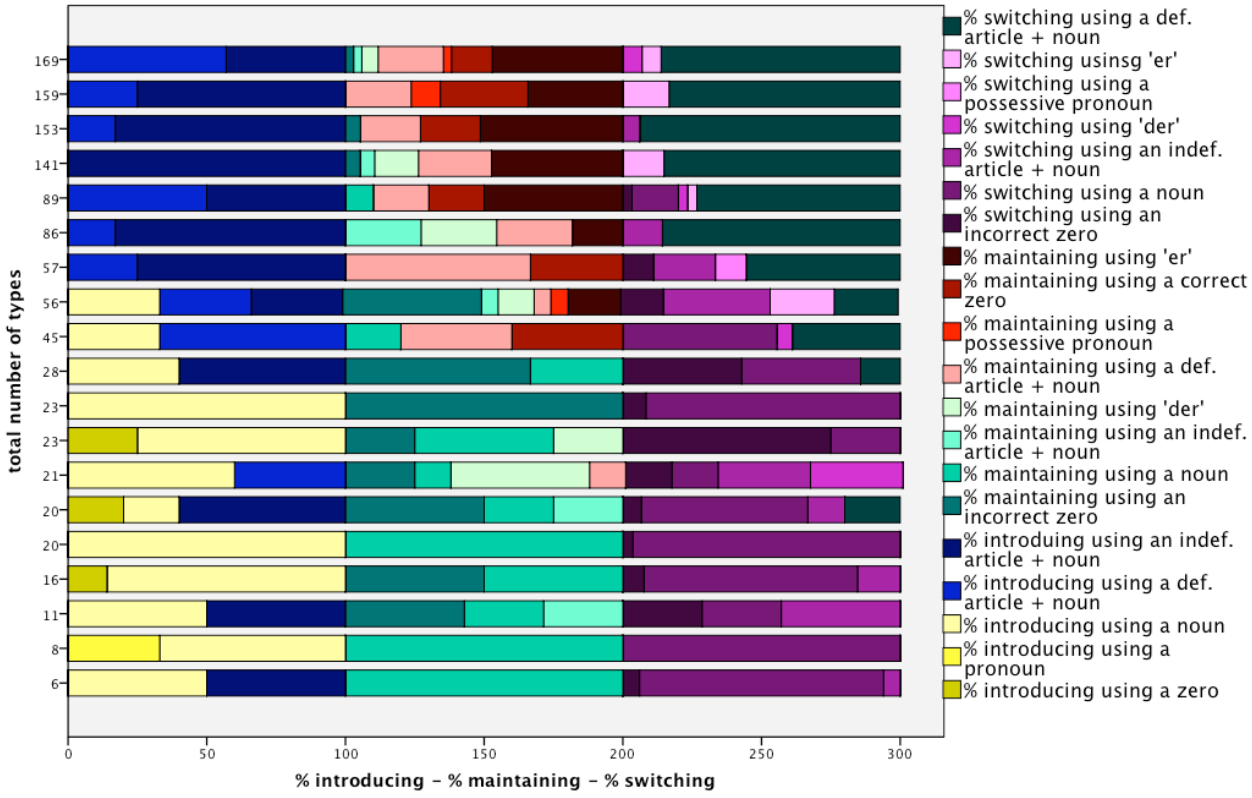
11.6.5 Introducing, maintaining, switching and the past participle test



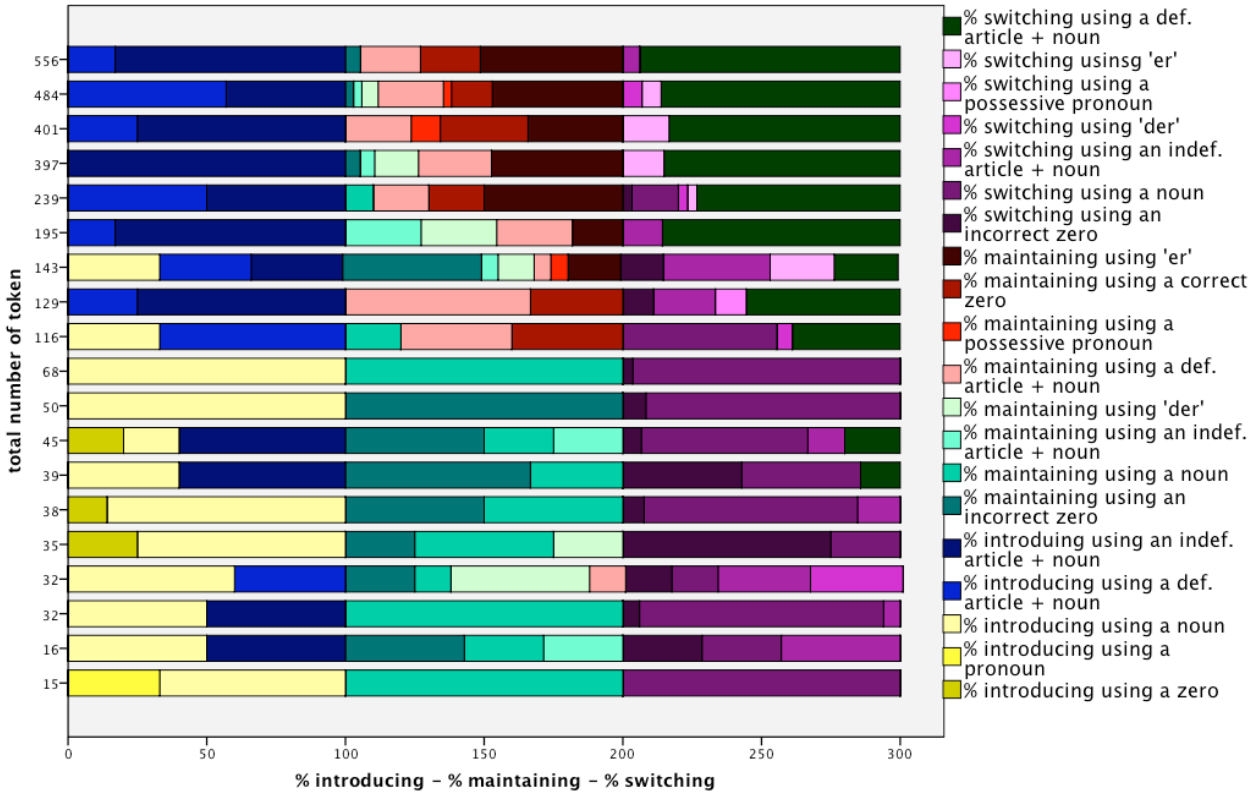
11.6.6 Introducing, maintaining, switching and the composite grammar score



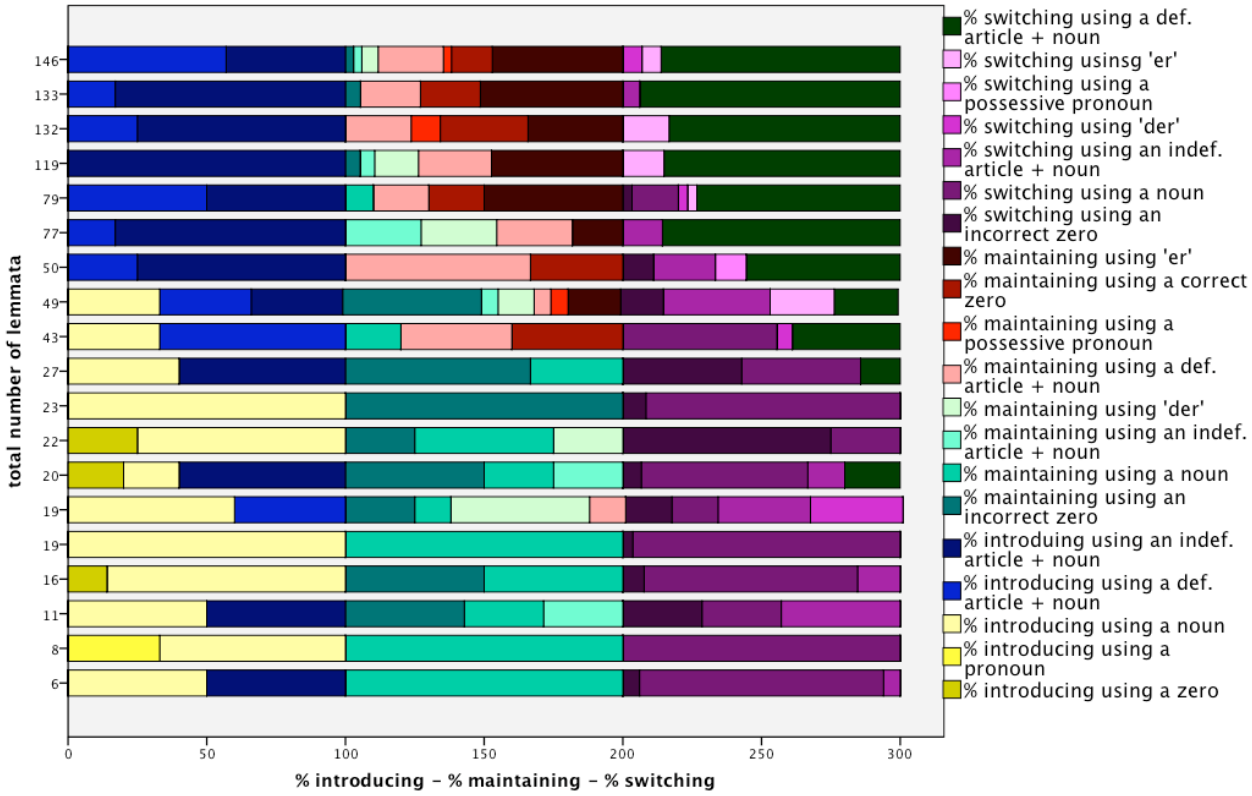
11.6.7 Introducing, maintaining, switching and total number of types



11.6.8 Introducing, maintaining, switching and total number of token



11.6.9 Introducing, maintaining, switching and total number of lemmata



11.6.10 Introducing correlated with number and type of utterance

UTTERANCES		INTRODUCING				
		noun	indef. article + noun	def. article + noun	**zero incorrect**	**pronoun**
NUMBER OF UTTERANCES	Correlation Coefficient	**-.469***	.342	.379	-.378	-.387
	Sig. (2-tailed)	**.043**	.152	.110	.111	.101
	N	19	19	19	19	19
descriptive utterances	Correlation Coefficient	**.827****	**-.570***	**-.676****	.281	.345
	Sig. (2-tailed)	**.000**	**.011**	**.001**	.244	.148
	N	19	19	19	19	19
non-descriptive utterances	Correlation Coefficient	**-.827****	**.570***	**.676****	-.281	-.345
	Sig. (2-tailed)	**.000**	**.011**	**.001**	.244	.148
	N	19	19	19	19	19

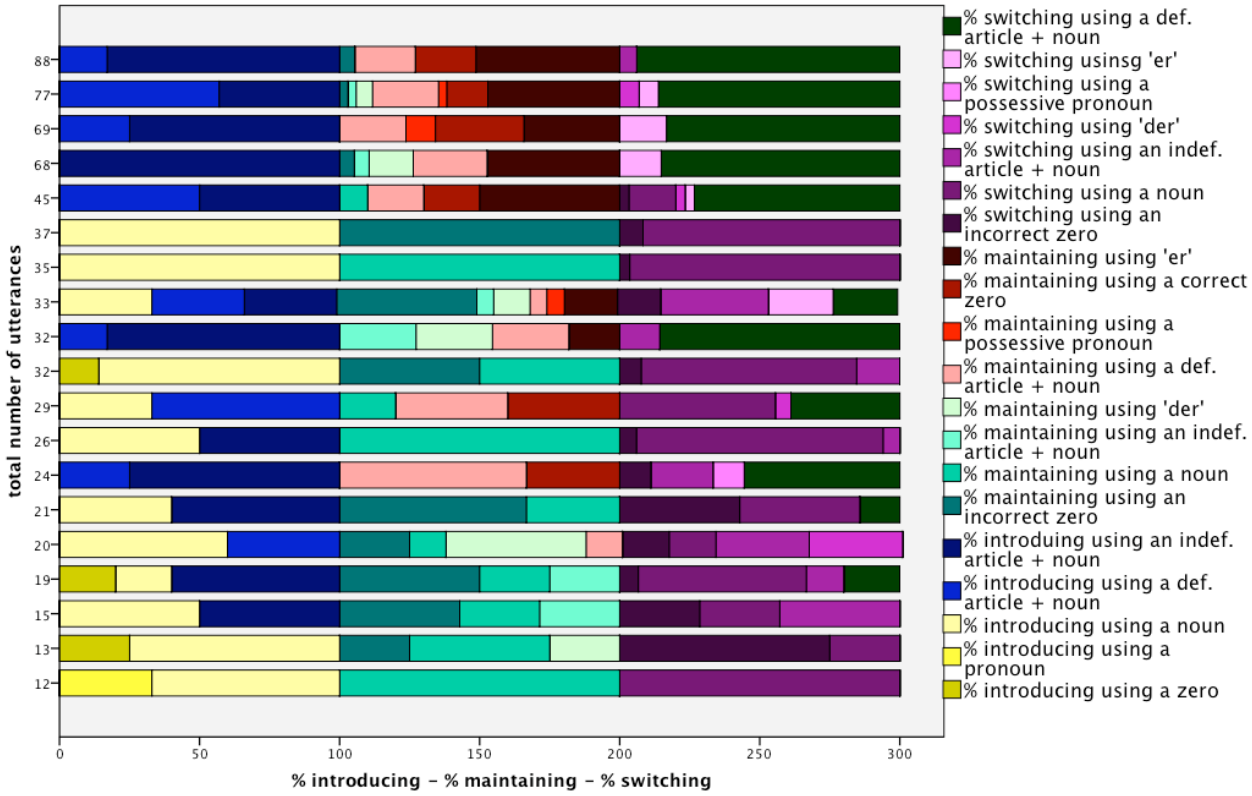
11.6.11 Maintaining correlated with number and type of utterance

UTTERANCES		MAINTAINING							
		noun	indef. article + noun	def. article + noun	er	der	zero incorrect	zero correct	possessive
NUMBER OF UTTERANCES	Correlation Coefficient	**-.630****	-.035	**.456***	**.784****	-.018	-.145	.043	.443
	Sig. (2-tailed)	**.004**	.887	**.049**	**.000**	.941	.554	.066	.057
	N	19	19	19	19	19	19	19	19
descriptive utterances	Correlation Coefficient	**.775****	-.322	**-.803****	**-.748****	-.439	.218	**-.518***	**-.607****
	Sig. (2-tailed)	**.000**	.179	**.000**	**.000**	.060	.370	**.023**	**.006**
	N	19	19	19	19	19	19	19	19
non-descriptive utterances	Correlation Coefficient	**-.775****	.322	**.803****	**.748****	.439	-.218	**.518***	**.607****
	Sig. (2-tailed)	**.000**	.179	**.000**	**.000**	.060	.370	**.023**	**.006**
	N	19	19	19	19	19	19	19	19

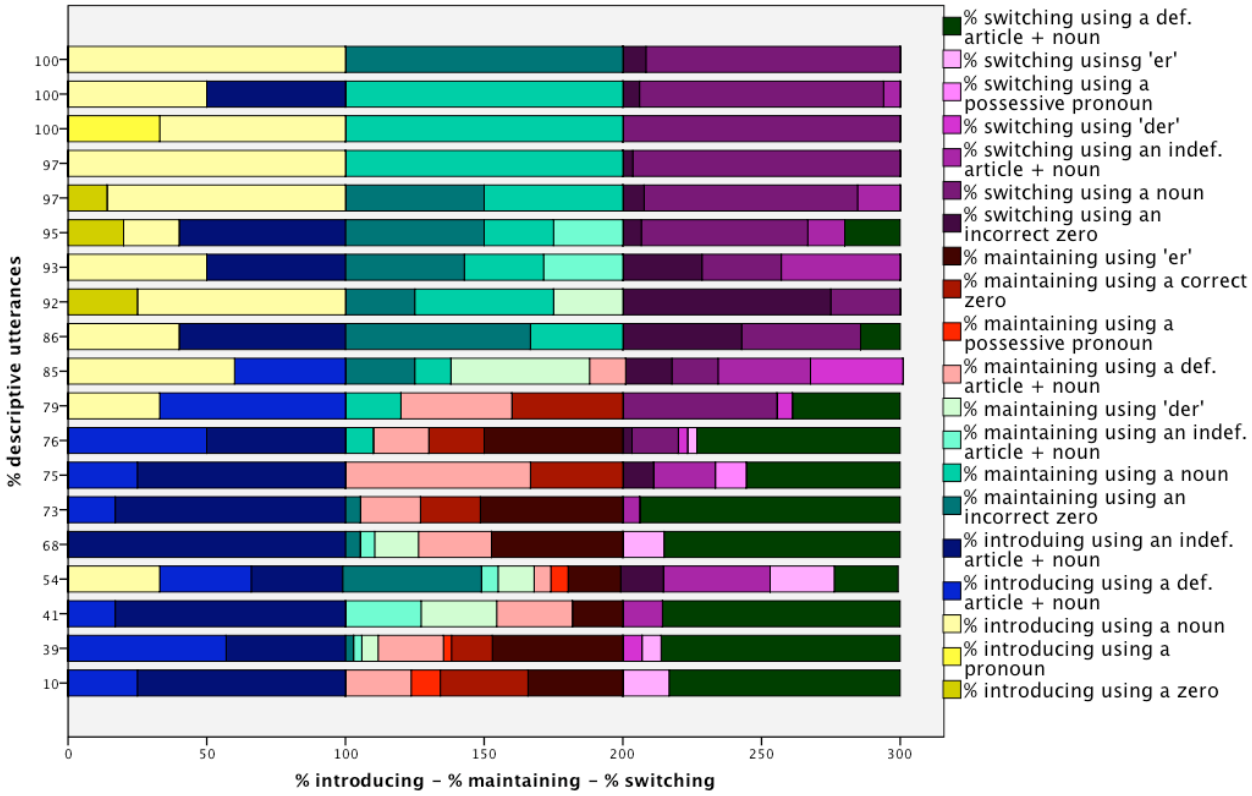
11.6.12 Switching correlated with number and type of utterance

UTTERANCES		SWITCHING						
		noun	indef. article + noun	def. article + noun	**er**	**der**	**zero incorrect**	**possessive**
NUMBER OF UTTERANCES	Correlation Coefficient	**-.464***	-.279	**.663****	**.586****	.138	**-.565***	-.129
	Sig. (2-tailed)	**.046**	.247	**.002**	**.008**	.574	**.012**	.598
	N	19	19	19	19	19	19	19
descriptive utterances	Correlation Coefficient	**.941****	-.057	**-.858****	**-.667****	-.259	.355	-.129
	Sig. (2-tailed)	**.000**	.817	**.000**	**.002**	.285	.136	.598
	N	19	19	19	19	19	19	19
non-descriptive utterances	Correlation Coefficient	**-.941****	.057	**.858****	**.667****	.259	-.355	.129
	Sig. (2-tailed)	**.000**	.817	**.000**	**.002**	.285	.136	.598
	N	19	19	19	19	19	19	19

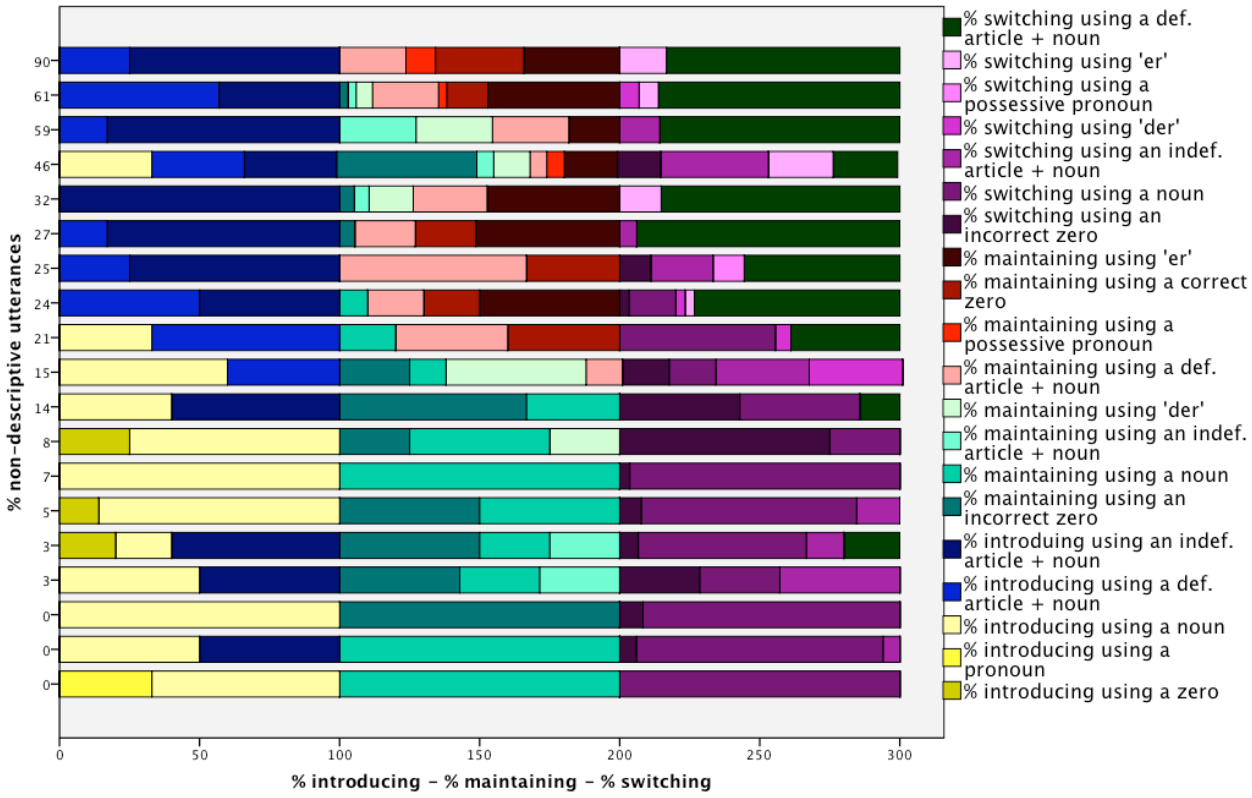
11.6.13 Introducing, maintaining, switching and number of utterances



11.6.14 Introducing, maintaining, switching and descriptive utterances



11.6.15 Introducing, maintaining, switching and non-descriptive utterances



		PARTICIPANT CHARACTERISTICS and LANGUAGE MEASURES					
PARTICIPANT CHARACTERISTICS and LANGUAGE MEASURES		age	IQ	grammar	types	token	utterances
age	Correlation Coefficient	1	-.161	**.588****	**.534***	**.628****	**.677****
	Sig. (2-tailed)	.	.584	**.008**	**.019**	**.004**	**.001**
	N	19	14	19	19	19	19
IQ	Correlation Coefficient		1	.424	.387	.303	.333
	Sig. (2-tailed)		.	.130	.171	.292	.244
	N		14	14	14	14	14
grammar	Correlation Coefficient			1	**.863****	**.794****	**.626****
	Sig. (2-tailed)			.	**.000**	**.000**	**.004**
	N			19	19	19	19
total nr of types	Correlation Coefficient				1	**.929****	**.735****
	Sig. (2-tailed)				.	**.000**	**.000**
	N				19	19	19
total nr of token	Correlation Coefficient					1	**.872****
	Sig. (2-tailed)					.	**.000**
	N					19	19
total nr of utterances	Correlation Coefficient						1
	Sig. (2-tailed)						.
	N						19

13 Abstract in English

English and Italian-speaking individuals with Down Syndrome (=DS) use linguistic devices atypically, when referring to characters in a story. The present study investigated Austrian German-speaking DS individuals‘ use of nominal and pronominal reference and co-reference when introducing, maintaining and switching animate story characters in an oral picture story (*Frog, where are you?* by Mercer Mayer (1969)), and correlated these results with individuals‘ IQ (HAWIK-IV), morphosyntactic skills (Laaha et al.‘s (2006) reduced plural test and W. U. Dressler‘s unpublished past participle test) as well as lexical skills (types, token, lemmata as counted in the pictures story), in order to explain the interrelationship between textual skills, grammatical skills, lexical skills and IQ.

Initially 30 individuals with DS participated in the study. After excluding individuals with co-morbid psychiatric disorders, such as Alzheimer‘s or autism, 19 participants were included in the analysis. Their age ranged from 7.8 to 30.2 years chronological age (=CA) (M=16, SD=6), and their IQ at the 50° percentile ranged between 40 and 65 points (M=47.92, SD=7.87).

Spearman correlations between the pre-tests showed that IQ was not significantly correlated with CA, morphosyntactic skills, or lexical skills. CA, morphosyntactic skills and lexical skills correlated significantly. Results for the main tests showed that the *grammatically and textually correct* use of referential devices correlated positively with morphosyntactic and lexical skills. Maintaining characters using the pronoun ‘er’ (*he*) additionally correlated positively with working memory and language comprehension. The *grammatically and textually incorrect* use of referential devices correlated negatively with morphosyntactic skills, lexical skills and IQ (i.e. switching characters using an incorrect zero form), or lower IQ only (i.e. maintaining characters using an incorrect zero form). The *grammatically correct, but textually incorrect* use of referential devices correlated negatively with IQ only (i.e. switching characters using an indefinite article + noun). Moreover, linguistically/cognitively advanced participants used the personal pronoun ‘er’. Use of the pronoun was positively correlated with CA, morphosyntactic skills, lexical skills, the percentage of non-descriptive utterances, language comprehension and working memory. Individuals used this form for maintaining reference to story characters, especially the boy. However, it was not the predominant referential form for maintaining.

To conclude, this study indicates that in DS morphosyntactic and lexical development progresses with CA, and language (grammatical) development is independent from IQ. Furthermore, it shows that the *textually correct use* of co-reference correlates positively with morphosyntactic and lexical skills. And the *textually incorrect use* of co-reference can be independent from these linguistic skills and correlate negatively with IQ. This might be due to a reduced theory of mind. Finally, the development of reference and co-reference in DS is atypical. This shows especially, in DS individuals‘ use of the pronoun ‘er’. DS individuals do not use the thematic subject strategy. The present study is the first to show that the atypical use of a personal pronoun (‘er’) in DS is correlated with individuals‘ reduced working memory.

14 Abstract in German

Die vorliegende Studie untersuchte den Gebrauch von nominaler und pronominaler Referenz und Koreferenz beim Einführen, Beibehalten und Wechseln von belebten Charakteren in einer mündlich erzählten Bildgeschichte von österreichischen, Deutsch sprechende Menschen mit DS. Die Ergebnisse wurden korreliert mit dem IQ (HAWIK-IV), morphosyntaktischen Fähigkeiten (Laaha et al.‘s (2006) gekürzter nominaler Pluraltest und W. U. Dresslers unpublizierter Perfekttest), und lexikalischen Fähigkeiten (Anzahl aller Wörter, Anzahl der unterschiedlichen Wörter, Anzahl der Lemmata). Dies ermöglichte es, die Beziehung zwischen textuellen Fähigkeiten, morphosyntaktischen (=morph.) Fähigkeiten, lexikalischen (=lex.) Fähigkeiten und IQ darzustellen.

19 TestteilnehmerInnen mit DS wurden analysiert. Ihr Alter reichte von 7.8 bis 30.2 Jahren chronologisches Alter (=CA) (M=16, SD=6), und ihr IQ beim 50. Perzentil lag zwischen 40 und 65 Punkten (M=47.92, SD=7.87).

Spearman Korrelationen zwischen den Vor-Tests ergaben, dass der IQ nicht mit dem CA, morph. Fähigkeiten, oder lex. Fähigkeiten korrelierte. CA, morph. Fähigkeiten und lex. Fähigkeiten korrelierten jedoch signifikant. Ergebnisse der Haupttests ergaben, dass *grammatikalischer und textuell korrekter Gebrauch* von referentiellen Mitteln positiv mit morph. und lex. Fähigkeiten korrelierte. Beim Personalpronomen ‘er’ korrelierte das Beibehalten eines Charakters zusätzlich mit dem Arbeitsgedächtnis und dem Sprachverständnis. Der *grammatikalisch und textuell inkorrekte Gebrauch* von referentiellen Mitteln korrelierte negativ mit morph. Fähigkeiten, lex. Fähigkeiten und IQ (i.e. Wechsel zwischen Charakteren mit inkorrekter Null-Form), oder nur IQ (i.e. Beibehalten von Charakteren mit inkorrekter Null-Form). Der *grammatikalisch korrekte, aber textuell inkorrekte* Gebrauch von referentiellen Mitteln korrelierte negativ mit dem IQ (i.e. Wechsel zwischen Charakteren mit einem indefiniten Artikel + Nomen). Weiters, konnte gezeigt werden, dass sprachlich/kognitiv fortgeschrittene TeilnehmerInnen das Personalpronomen ‘er‘ verwendeten. Der Gebrauch korrelierte positiv mit CA, morph. Fähigkeiten, lex. Fähigkeiten, dem Prozentsatz an nicht-deskriptiven Äußerungen, dem Sprachverstehen, und Arbeitsgedächtnis. ‘Er‘ wurde verwendet, um die Referenz auf Charaktere beizubehalten, vor allem den Buben. Jedoch war ‘er‘ nicht die häufigste Form.

Zusammenfassend kann man sagen, dass sich bei DS morph. und lex. Fähigkeiten parallel zum CA entwickeln, und Sprache (Grammatik) unabhängig vom IQ ist. Weiters wurde gezeigt, dass der textuell korrekte Gebrauch von Koreferenz positiv mit morph. und lex. Fähigkeiten korreliert. Der textuell inkorrekte Gebrauch von Koreferenz kann unabhängig von diesen sprachlichen Fähigkeiten sein, und negativ mit dem IQ korrelieren. Der Grund dafür kann eine geringer entwickelte ‘Theory of Mind’ sein. Schlussendlich, ist die Entwicklung von Referenz und Koreferenz bei DS atypisch. Das zeigt sich v.a. im Gebrauch von ‘er‘. Menschen mit DS wenden die so-genannte thematic-subject strategy nicht an. Die vorliegende Studie zeigt als erste, dass dieser atypische Gebrauch des Personalpronomens ‘er‘ mit dem Arbeitsgedächtnis korreliert.

15 Curriculum Vitae

MONIKA BONIECKI

BILDUNGSWEG

ab 10/03	*Diplomstudium Sprachwissenschaft* Universität Wien
10/02 – 06/11	*Lehramtsstudium Anglistik/Germanistik* Universität Wien
09/94 – 06/02	*Schulausbildung* Haydn Gymnasium und Realgymnasium, GRG5

AUSLANDSAUFENTHALTE

09/05 – 05/06	*Erasmus Auslandsstudium* University of Edinburgh, Scotland
09/00 – 03/01	*Schüleraustausch* Sir Thomas Rich's Grammar School, Gloucester, UK

MITARBEIT AN FORSCHUNGSPROJEKTEN

ab 2012	*Projektmitarbeit zu irregulärer Verbmorphologie im Fremdspracherwerb Englisch* Institut für Anglistik und Amerikanistik, Wien
2010	*Projektmitarbeit zu sprachl. Kompetenz in Downsyndrom* ÖAW, Wien
2009	*Projektmitarbeit zu sprachl. online Tests für Erwachsene* Institut für Sprachwissenschaft, Wien
2008	*Projektmitarbeit zu sprachl. Kompetenz in Downsyndrom* ÖAW, Wien
2008	*Projektbeitrag zu CLIL an österr. HTLs* Institut für Anglistik und Amerikanistik, Wien

PUBLIKATIONSMITARBEIT

Libben, G., M. Boniecki, M. Martha, K. Mittermann, K. Korecky-Kröll & W.U. Dressler (2009), 'Interfixation in German Compounds: What Factors Govern Acceptability Judgements?', *Italian Journal of Linguistics,* 21, 1, 149-180.

AUSZEICHNUNGEN

Student Award 2011 des Instituts für Anglistik und Amerikanistik, Wien

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