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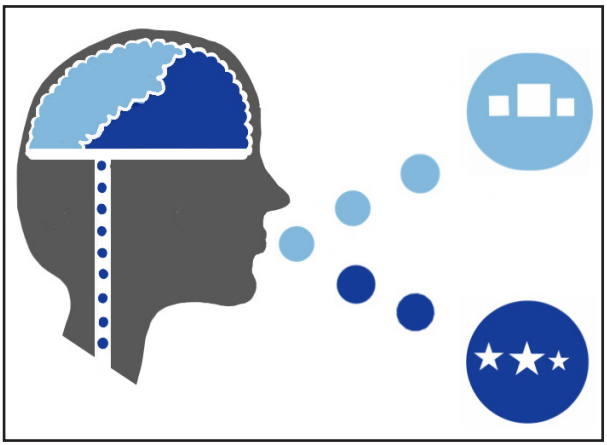
# Cognitive Language Acquisition Training in a Classroom Setting

Ora Melles



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Band 29

University
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Bibliographische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliographie; detaillierte bibliographische Informationen sind im Internet über http://dnb.d-nb.de/ abrufbar.

Diese Arbeit hat der Fakultät Humanwissenschaften der Otto-Friedrich-Universität Bamberg als Dissertation vorgelegen.
Gutachterin: Prof. Dr. Marianne Schüpbach
Gutachterin: Prof. Dr. Sabine Weinert
Tag der mündlichen Prüfung: 17.05.2018



Herstellung und Druck: Digital Print Group, Nürnberg
Umschlaggestaltung: University of Bamberg Press, Larissa Günther


http://www.uni-bamberg.de/ubp/

ISSN: 1866-8674
ISBN: 978-3-86309-609-0 (Druckausgabe)
eISBN: 978-3-86309-610-6 (Online-Ausgabe)
URN: urn:nbn:de:bvb:473-opus4-528256
DOI: http://dx.doi.org/10.20378/irbo-52825

To my Ima and Abba

**Acknowledgement**

The writing of this dissertation has been a journey for me. Several people assisted me in this process, and without their assistance I would not have been able to complete this work.

With appreciation and respect, I would like to thank my advisor and committee chair Prof. Dr. Marianne Schüpbach, for giving me the freedom to explore the questions addressed in this paper. Her valuable comments significantly improved the quality of my work. I would also like to thank Prof. Dr. Sabine Weinert for her constructive feedback and discussions. A very special thank you is extended to Dr. Jan Willem Nieuwenboom for his assistance on the research design and statistical sections.

I would like to give a special mention to Erika Gruner. She sparked my interest in *Sprachspezifisches Hirnfunktionstraining,* a treatment method for children with language learning problems. Her enthusiasm for helping children with learning problems was and is contagious.

Also, I am particularly grateful to the 16 teachers who participated in this project with their 279 students and for giving their time for the various experiments that comprise this dissertation. Clearly without them, this study would have not been possible.

I would also like to acknowledge my friends Danielle Lapidoth and Lynn Campbell for meaningful discussions and continuous support throughout this process.

Finally, I would like to thank my husband, Michael, and daughters Leah, Maya and Dahlia. Their love, support and flexibility helped me reach my educational and professional goals.

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## List of Abbreviations

| | |
|---|---|
| AAE | African American English |
| AC | Attention and Concentration |
| ADHD | Attention Deficit Hyperactivity Disorder |
| APD | Auditory Processing Disorder |
| ASHA | American Speech and Hearing Association |
| CLAT | Cognitive Language Acquisition Training |
| CREB | Cyclic AMP-response element binding protein |
| DRM | Dual Route Model |
| FWM | Functional Working Memory model |
| GLM | General Linear Model |
| GSL | German as a Second Language |
| H. German | High German |
| L. German | Low German |
| LTM | Long-term memory |
| NICHD | National Institute of Child Health and Development |
| NRP | National Reading Panel |
| OECD | The Organisation for Economic Co-operation and Development |
| RNA | Ribonucleic acid |
| SCT | *Star Counting Test* |
| SH | Sprachspezifisches Hirnfunktionstraining zur Verbesserung der Lese- und Scheibleistungen |
| SSD | Speech Sound Disorders |
| SSE | Sentence Structure Effect |
| SWM | Spatial Working Memory |
| VSSP | Visuospatial Memory/Sketchpad |
| VWM | Visual Working Memory |
| WM | Working Memory |

## 1 Introduction

This thesis is concerned with the efficacy of a cognitive language acquisition program in a classroom setting in Switzerland. It spans learning, language acquisition, linguistics and cognition. In general, this empirical study aims to discover if a language acquisition program which focuses on a conscious, self-regulatory awareness of language can provide more intense language-focused lessons than is normally provided in a classroom setting, and if, as might be expected, a cognitive awareness of language can improve attention and concentration.

Literacy can be defined in a variety of ways and is a complex and dynamic term. What literacy means, how it is acquired, and how to measure its effect are all open for discussion. In 2002, the United Nations, after much debate, determined that literacy is "crucial to the acquisition, by every child youth and adult, of essential life skills that enable them to address the challenges they can face in life and represent an essential step in basic education, which is indispensable for effective participation in the societies and economies of the twenty-first century" (UNGA, A/RES/56/116, 2001). Most would agree that both oral competencies and writing skills have consequences for literacy development (see Chapter 1: Definition of Terms).

Reading and writing are fundamental language skills, ("scholastic literacy skills") every child is expected to learn during early primary school years. These skills are the building blocks of essay writing, reading comprehension, oral language comprehension and communication which will influence human cognition throughout school and the lifespan (Huntington & Bender, 1993; Silva, Faisca, Ingvar, Petersson, & Reis, 2012; Weinert, 2006). It is expected that students will be able to generalize these learned skills and apply them to a setting within and outside of the classroom setting.

Unfortunately, not all children manage to reach this objective. Due to recent concerns of inequality in educational achievement among pupils, UNESCO has urged delivering literacy programs that:

> *[are] effectively achieved only when it is planned and implemented in local contexts of language and culture, ensuring gender equity and equality, fulfilling learning aspirations of local communities and groups of people. Literacy must be related to various dimensions of personal and social life, as well as to development. Thus, literacy efforts must be related to a comprehensive package of economic, social and cultural policies cutting across multiple sectors* (Literacy For All, 2007, p. 17).

Additionally, UNESCO argues that programs must give due attention to *"bi and multilingual contexts"* (The Scope of Life, 2007, p. 22). As a result there is a plethora of both academic and popular literature on the nature of learning among non-typically developing children and second language learners (see Chapter 1: Definition of Terms).

Variances in academic performance have been typically linked to a variety of reasons; among them are social and economic discrepancies (Hartas, 2011; Robins, Ghosh, Rosales, & Treiman, 2014), ability and motivation. In written and oral language among typically developed children, numerous studies have demonstrated that deficits occur due to weaknesses in working memory—the inability to retain and recall memories, and to produce and perceive speech and access lexical representations (e.g. Gathercole, Alloway, Willis, & Adams, 2006).

Working memory (WM) capacity refers to the storage of information over a very short time and it is central for a wide range of cognitive activities and for academic achievement. It decides which material needs to be stored in long-term memory (LTM) to be retrieved at a later time. It differs from short-term memory in that it relies on storage and manipulation of information rather than just the storage of information. In language acquisition and speech and therapy, working memory is of

prime importance in improving educational outcomes (de Abreu, Gathercole, & Martin, 2011; Gathercole et al., 2006).

Recently, there have been studies attempting to increase working memory, mostly through adaptive computer programs in an individual or small group setting, in an attempt to improve academic results (Figure 1). Several working memory-training programs have been effective in improving attention and concentration, but the effects of positive outcomes have not been transferable to academic fields. Due to this lack of evidence, it has been suggested that working memory is linked to academic achievement through an additional unexplored cognitive component (Peng & Miller, 2016; Figure 2). The teasing-out of this component is of primary interest in this thesis.

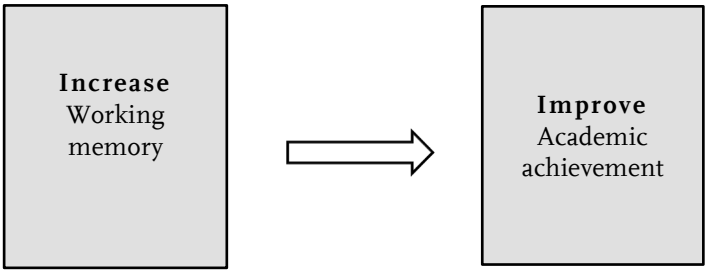


**Figure 1.** Traditional Working Memory Paradigm

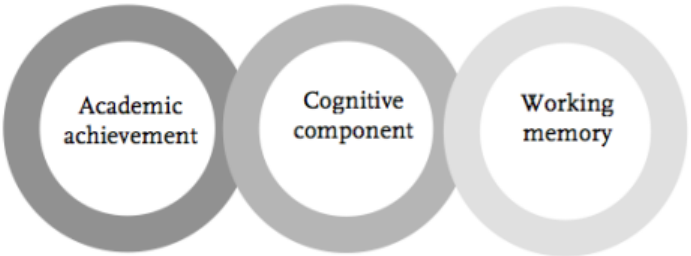


**Figure 2.** New Working Memory Paradigm

## Setting and Education System in Switzerland

Switzerland poses an interesting situation in language learning. It has a population of approximately 8 million (2015) of which almost 25% are not Swiss citizens (Nguyen, 2016). Switzerland is composed of 26 cantons, which vary in size, language and population density. Four official languages, depending on the canton, are spoken in the Switzerland: German, French, Italian and Romansch. In some cantons, two languages are spoken. In the German parts of Switzerland, Alemannic dialects are spoken.

In Switzerland children do not have school choice in public primary school and must either attend local schools that are state funded or a private school. Educational requirements and high-school matriculation rates for students in the cantons differ. The Intercantonal Agreement on Harmonization of Compulsory Education (HarmoS Agreement) took effect in 2009 and requires signatory cantons to offer 8 years of compulsory education (2 years of kindergarten and 6 years of primary school) and 3 years of secondary education by school year 2015/2016.

The first 9 years of school (primary and lower secondary) are compulsory in Switzerland. The minimum age for kindergarten is either 4 or 5 years and kindergarten lasts two years. After primary school (first 5 or 6 school years), children are streamed into one of two school systems, which vary in the amount of theoretical and practical education offered. In German-speaking Switzerland, roughly 20% of students attend Grammar Schools, *Gymnasium,* which leads to the academic matriculation exams (Statistik, 2016). If these tests are passed, the student can attend a university. Those who choose to pursue a more practical option can combine an apprenticeship with education and complete a more specific career matriculation exam, which correlates to their chosen career path (Table 1). In comparison, approximately 47% of German students completed high school in 2010 (Abitur, 2016; Student Numbers in Germany, 2016), while 37% of students completed high school in Switzerland (Education in Switzerland, 2017). Due to bilateral agreements, students

from Germany and Austria can attend Swiss universities based on the same requirements required by Swiss students and vice versa.

Requirements and educational outcomes in Switzerland can vary greatly. Canton Solothurn and canton Bern are two cantons with similar educational requirements (Bern Lehrplan, 1995; Lehrplan 21, n.d.; Solothurn Lehrplan, 2007), educational curriculums, educational outcomes (Table 1), and similar dialects (High Western Alemannic dialects).

**Table 1.** Canton Bern and Solothurn Educational Comparison

| | Bern | Solothurn |
|---|---|---|
| Years of kindergarten (required years) | 0 | 0 |
| Years of kindergarten (provided) | 1 | 2 |
| Years of primary school | 6 | 6 |
| Years of mandatory secondary school | 3 | 3 |
| Percentage students with academic matriculation | 17.9% | 14.7% |
| Percentage students with career matriculation | 16.3% | 12.3% |

(Statistics from: Statistiks, 2016)

## Aim of Study

During the past three decades, a large body of research has been generated on the benefits of working memory, self-regulatory cognition (metacognition) and effective methods of teaching language, in a controlled setting. Metacognition has become increasingly important in understanding how an individual learns. Yet assessing the role of metacognition in language learning (metalinguistic) and working memory is difficult because it is exclusively internal process, unlike writing, speaking or reading aloud.

In language learning, children who speak one language think in that language, whereas children who are learning a new language must be aware of the differences between the first and the second languages. However, for children who speak a dialect, the differences between the dialect language and the standard language are small enough that a child could manage by relying on implicit recall. Therefore, dialect speakers pose an interesting conundrum in this "New Working Memory Paradigm" (Figure 2), as there is a mismatch between their active and passive use of language because they have *"no preconceptions of orthographic standards for their native language"* (Ehrensberger-Dow, 2006, p. 2). To switch from dialect to print, either a subconscious or conscious regulatory process should occur.

To discern this component, we evaluated the effects of a language acquisition program, which implemented methods of self-regulatory techniques, on the areas effected by print-speech mismatch in dialect speakers, at three different times, pre-intervention (baseline), immediately post-intervention and finally, four months after the intervention was completed. Stronger positive improvements on these print-speech mismatch items (in the intervention group), would point to a cognitive regulatory relationship between standard language and dialect. A more significant improvement in attention and concentration among the intervention group would suggest that this cognitive component links working memory and academic achievement.

**Therefore, the aim of this study is to identify, highlight and analyze this self-regulatory component and to determine its relationship to working memory and academic achievement.**

### Definition of Terms

As there are several terms referred to within this project, they are specifically defined as followed:

**Language:** *"[the] communication among human beings that is characterized by the use of arbitrary spoken or written symbols with agreed-upon meanings. More broadly, language may be defined as communication in general; it is regarded by some linguists as a form of knowledge, that is, of thought or cognition"* (Language, 2016, p. 1).

**Learning:** *"refers to the change in a subject´s behavior to a given situation brought about by his repeated experiences in that situation, provided that the behavior change cannot be explained on the basis of native response tendencies, maturation or temporary states of the subject´s fatigue, drugs, etc."* (Hilgard & Bower, 1975, p. 17).

**Linguistic markers affected through print-speech mismatch:** specific written language tasks in a classroom setting may be influenced by the mismatch of dialect and standard language; specifically: vocabulary depth, rhyme sensitivity, grammatical awareness and spelling.

**Literacy:** the *"ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts"* (UNESCO, 2004, p. 13).

**Perception of speech:** the ability to decipher the different sounds in words rather than the meaning of the words. In this dissertation, perception of speech is used interchangeably with phonological awareness.

**Typical learners:** average ability learners who do not need additional educational support. This group may include students who are fast, bright or gifted learners.

**Non-typical learners: s**tudents who need additional educational support. This support can take place within or outside the classroom setting. Although this group can also include fast, bright or gifted learners, in this study, non-typical learners are weaker in one or more academic subject than the typical learner in that subject.

**Monolinguals:** children who speak either standard or dialect at home but are assumed to speak dialect within a classroom setting as it is a social norm in Swiss speaking schoolhouses in Switzerland.

**Bi/Multilingual:** children who speak either another language at home (i.e. Albanian, French, Italian), or two or more languages at home (Romanian and Arabic, for example). These children speak dialect during school time.

**German as second language learners: t**hese students are relatively new to Switzerland and receive additional standard German language support during or after school.

**Self-regulation:** in this study, this term refers to the regulation of thinking and the ability to select strategies for solving a task, and detecting and correcting errors in both speech and print (see: Roebers, 2017).

## Organization of Thesis

This thesis is divided into six chapters:

Chapter Two presents the theoretical framework of this dissertation. It begins with language in Switzerland, then delves into the current view of memory and language acquisition, bridges working memory and language through metacognitive processes and continues by addressing criteria for a successful language intervention program. Finally the framework of a multifaceted cognitive language intervention program used by the speech pathology department in Zurich, Switzerland is introduced.

Chapter Three describes the specific research questions posed and the hypothesis made based on the research conducted.

Chapter Four initially outlines how the sampling took place, describes the rationale and the methods used to evaluate and transform the initially cognitive language intervention program. Part three of this chapter describes the evaluation instrument, and finally the method used to analyze the data is presented.

In Chapter Five the composition of the sample is described and the results of the intervention group and the control group are compared based on both print-speech mismatched subtasks and attention and concentration.

Finally, in Chapter Six, the research is summarized, interpreted, and its practical contribution reflected upon.

## 2 Review of the Literature

This chapter is divided into five main sections: The first introduces the Swiss diglossia and its relevance to this study. The second section discusses how learning acquisition is related to memory processes. The third section discusses the importance of self-regulatory processes. The fourth section expounds on areas of research influencing linguistic competences relevant to reading and writing, and the fifth describes a language therapy program that was used by the University of Zurich pathology department.

The review of literature in this thesis focuses on aspects of language acquisition that are of interest in a typical classroom. Although extensive research has been made on different aspects of language, working memory and linguistic awareness, little is known about how self-regulatory processes in language learning affect working memory. Since so few articles have dealt with linguistic intervention studies within a typical classroom setting, those involving preschool children, middle school children and special needs students, both in small class and individualized lessons, have been included in this review.

### 2.1 The Swiss Diglossia

Children first formulate thoughts in the language of their family. As they mature they begin interacting with others, and acquire the language of their peers. Family language and peer language is usually the same in monolingual children, but very different in bi and multi- lingual children. In dialect-speaking children, such as in Switzerland, spoken language is somewhere in between. Once children begin school, the mismatch between the language spoken at home and at school becomes relevant. Some children are capable of "dealing" with these differences, excelling throughout their academic career, while others may lag behind and struggle academically.

Initially, at reaching school age children learn the basics of literacy, how to read and write. Eventually, by the third year of school, typically developed children are expected to know how to read and write. At this stage of education, it is surmised that students begin reading for pleasure and for information (Spears, Chall, Jacobs, & Baldwin, 1992). The relationship between reading and writing has been argued to be reciprocal (Fitzgerald & Shanahan, 2000; Kent & Wanzek, 2016; Shanahan, 2006) and neuroimaging of the brain has shown overlapping of active areas in the brain (Pugh et al., 2006). Writing, however, is a more complicated process than reading and involves *"an excessive number of simultaneous demands or constraints. Viewed this way, a writer in the act is a thinker on full-time cognitive overload"* (Flower & Hayes, 1980, p. 33). However, the relationship between written literacy (reading and writing), and oral literacy (listening and speaking) has been less explored in typically developed children. Switzerland poses an interesting situation in studying such a relationship.

There are four national languages in Switzerland: French, German, Italian and Romansch. German speakers comprise the largest portion of the population, and are clustered in the north and east of the country. In 17 of the 26 cantons (states), German is the official language but there are actually two vernacular languages, or everyday languages, used by the population: Swiss German (dialect) and High German (standard German). Hence, Switzerland is referred to as a diglossia: in linguistic terms, a Swiss German dialect (L. German) and High German (H. German) are concurrently used in each Swiss community.

Ferguson originally summarized diglossia as:

> *[...] a relatively stable language situation in which, in addition to the primary dialects of the language (which may include a standard or regional standards), there is a very divergent, highly codified (often grammatically more complex) superposed variety, the vehicle of a large and respected body of written literature, either of an earlier period or in another speech community,*

> *which is learned largely by formal education and is used for most written and formal spoken purposes but is not used by any section of the community for ordinary conversation* (Ferguson, 1959, p. 435).

Switzerland is not unique in having linguistic varieties. In many countries there are different dialects spoken among same language speakers, differing in pronunciation, vocabulary and grammar (i.e. in English: Cockney, spoken by working class people in and around London, England; Literary High Burmese, used in formal writing and informal Spoken Low Burmese; African American vernacular English spoken mostly by African-Americans). But the use of dialect in Switzerland is rather unique as it is composed of a language and various dialects that are not only intertwined, but also used in a parallel fashion. This dialect form is regarded as more important in the local Swiss German community than the High (H.) form of the language (Guntern, 2012). The H. variety of German, standard German, which is spoken in Switzerland, is the same that is spoken by its neighbors, Germany, Austria and Liechtenstein. Swiss German, or Low (L.) German refers to the various dialects that are spoken in each of the German speaking cantons. These dialects can be difficult for German speakers outside of Switzerland to understand.

The role of dialect and standard German in Switzerland have changed throughout history: In the late 1800s and early 1900s, standard German was spoken alongside Swiss German in many public settings in Switzerland, and standard German was even spoken in the homes of many upper-class families; however, during the 1920s and 1930s there was a movement toward speaking dialect more and standard German less. Today, the different regional dialects are used in many official situations such as town talks, meetings, religious assemblies and in some cases, radio and television newscasts (Rash, 2000; Snow, 2010). Swiss German is a form of modern diglossia as it is spoken and respected by its population as much as, or even more than, the standard German variation (Snow, 2010). Other than on institutionalized forms of communica-

tion—academic environment, news broadcasts and with people who do not speak dialect—German is not the language of communication among Swiss German people (Ender & Strassl, 2009). In fact, since the 1980's, dialect writing, which has no standard language orthography, has also become more accepted and gained favor in personal writing such as on emails, SMS, chat rooms, note taking (Siebenhaar, 2006) and even written in some children's books, i.e. *De Adi mit em Teddybär* by Terri Klauser (Klauser, 2016) or *De chli Drache Kokosnuss chunt id Schuel* by Ingo Siegner (Siegner & Berri, 2014).

Around the age of 6 to 7, Swiss children begin primary school. Swiss German children have two forms of German to learn: standard German and dialect. H. German is the language in the classroom or the language of work, "Sprache der Arbeitszeit" while L. German, dialect, is the language for recreational time, "Sprache der Freizeit". Neither of these forms of language can be ignored, as one is important for academic success while the other is critical to social acceptance. As a result, there is an underlining negative attitude towards standard German in the community (Rash, 2000), and standard German maintains an awkward status in German speaking Switzerland: other than in the classroom, on official letters to parents and team members, or with those who do not speak dialect, standard German is not used. In fact, outside of the classroom (on school trips or in the hallway) and when communicating with parents, teachers usually speak L. German.

> *Dialect for Swiss German speakers is identity [...] a kind of self-satisfaction, a delight in one's own Eigenart or special nature. [...] It is the private language [...] not a very large group in the wider world, and they value it as the most personal mark of identity. For Swiss Germans Schwyzerdütsch is the mother tongue, above all, the language of childhood, family, the heart [...]* (Steinberg, 1996, p. 142).

In German dialect speakers in Switzerland, a passive knowledge of standard language is usually acquired through television or other electronic media (Rash, 2000). In fact, Swiss German people often call standard German "Schriftdeutsch" (written German) as if it is not spoken language but only a written one. L. German, dialect, because it is often infused by "Swiss" grammar and French vocabulary, is called "Schweizer Standardsprache", Swiss-German Standard Language—a language that differs depending on the regional dialect. Generally, teachers talk during school time up to 70% of the time and students listen (Polli, 2013). Active use of the language is reduced to very little by children who speak either L. German or a second language at home. These children hear and use fewer idiomatic phrases, vocabulary and grammar in standard German than individuals who are spoken to and actively practice H. German during most of the day (Pavlou & Papapavlou, 2007).

Given that a difference between a written language and a spoken language in Switzerland is desired and encouraged by the population, most Swiss children are not competent in standard German before beginning school. Once school-aged, Swiss children must learn to think in a *"new language"* (Guntern, 2012, p. 102), requiring a new cognitive ability to understand and distinguish between the communicated oral language and the written oral language (Rozin & Gleitman, 1977).

There is a dearth of research investigating writing abilities among children in a modern diglossia. However, we can assume that diglossia in Switzerland is similar to that in Hong Kong (Cantonese and Mandarin) and Arab-speaking countries (Amya and Futs´ha) as it is not as ingrained in local society (school, SMS, radio). Comparable to German speaking Switzerland, the dialect form in these countries is the mother tongue of all "native" speakers and eventually, the literary form is acquired during formal education (Liow & Poon, 1998; Saiegh-Haddad, 2004). In Arabic, like in Swiss German, *"there is a significant linguistic gap in many domains: phonology, morphology, syntax, vocabulary and*

*semantics"* (Leikin, Ibrahim, & Eghbaria, 2014, p. 737) between the spoken and written form of the language.

Differences between oral and written language can exist in the seven components (1–7) of literacy that have been defined in language learning (Berendes, Weinert, Zimmermann, & Artelt, 2013; Weinert, 2010): (1) Prosody, rhythmic prosodic component: variations of intonation, stress and rhythmic structuring of the language; (2) Phonology: the organization of sounds in language; (3) Morphology: the manner in which words are formed (stems, prefixes, suffixes); (4) Syntax: the arrangement of words and phrases in a sentence; (5) Lexicon/vocabulary: word meaning and structure of the lexicon; (6) Semantics: meaning of the sentence; (7) Pragmatics: context adequate use of language.

Dialect-speaking children in German speaking Switzerland have few chances to actively use standard German. Hence, several researchers have argued that in this type of diglossia, the written form of the language must be taught as a foreign language (Ferguson, 1959; Kaye & Rosenhouse, 1997).

### 2.1.1 Second Language Relating to Dialect

In 1981, Cummins distinguished between two different kinds of second language skills: interpersonal communication skills and cognitive academic language skills. Social language develops easily and is cognitively undemanding. It can be learned through interactions with others and can be supplemented by facial expressions, body language and visual clues, while academic language is more abstract and can be found in more formal settings like school, town meetings, etc. Academic language is context-reduced and cognitively demanding. In the case of a bilingual individual, these two language skills usually develop one after the other. Data from studies of bilingual children show that social language is mastered approximately after two years of exposure while for academic language 5–7 years are needed to reach proficiency (Cummins, 1981). This distinction between two types of language is also outlined by

Gibbons (1991) as playground language and classroom language, and are related to Gee´s earlier distinction between primary and secondary discourses. Gee explains the language spoken by different groups of people thusly:

> *Discourses are ways of behaving, interacting, valuing, thinking, believing, speaking, and often reading and writing, that are accepted as instantiations of particular identities (or "types of people") by specific groups, whether families of a certain sort, lawyers of a certain sort, bikers of a certain sort [...]. Discourses are ways of being "people like us." They are "ways of being in the world"; they are "forms of life"; they are socially situated identities. They are, thus, always and everywhere social and products of social histories* (Gee, 1990, p. 3).

### 2.1.2 Hypothesis on the Relationship Between Dialect and Standard Language

We know that the ability to shift from dialect to the standard language is critical to academic success. But what remains unclear is the actual relationship between dialect and standard language. Previous research on language has not dealt with what exactly causes one student to be more proficient in language learning than another. So far, two hypotheses have been suggested for this discrepancy between learners: One implies a sub-conscious process, the linguistic inference (mismatch hypothesis), and the other, an awareness to linguistic differences, linguistic awareness/ flexibility hypothesis.

The linguistic inference hypothesis proposes that the difference between spoken word production and written word production is mismatched and results in increase error rates. This mismatch causes those speaking dialect to require more cognitive resources when using the standard language (e.g. Charity, Scarborough, & Griffin, 2004; Ellis, 2005; Harris & Schroeder, 2013; Labov, 1972; Terry, 2014). As a result, language

learning becomes progressively easier as less cognitive resources need to be used.

Therefore the linguistic awareness/flexibility hypothesis proposes that some children are able to shift more easily between formal (standard) language and informal language (dialect) due to a stronger ability to analyze and manipulate linguistic code independent of its meaning (Roth & Speece, 1996; Terry, 2014; Terry & Connor, 2010). The uses of such self-regulatory strategies are hypothesized to be important in writing situations in elementary school (Graham, McKeown, Kiuhara, & Harris, 2012). For children who do not possess the ability to develop this competency, a mismatch between print and speech is often the cause academic difficulties (Frost et al., 2009).

## 2.2 From Working Memory to Long-term Memory

Without a doubt, it is important to understand the role of memory in language learning. For information to become a memory, it must first be sensed by our senses and then moved from working memory to long-term memory (LTM). Working memory and long-term memory are closely related. It is important to remember that WM functions both on its own and as scaffold to LTM. Working Memory is a cognitive system that holds information through repetition, and transfers and retrieves information from long-term memory. Each time a word or item is repeated in the WM, its association in the LTM becomes stronger causing the Hebb effect. The Hebb effect is created when certain material is repeated often enough so that it is eventually kept in long-term memory (Hebb, 1961). People who have a strong WM are more efficient in tapping and retrieving information from their long-term memory. LTM is medically defined as:

> *The phase of memory process considered the permanent storehouse of information that has been registered, encoded, passed into short-term memory, then coded, rehearsed, and finally transferred and stored for future retrieval; material and information re-*

> *tained in LTM underlie cognitive abilities* ("Long-term Memory", 2012).

A word is kept in the long-term memory when there is a link between its phonological form and its meaning. The more a word is heard, the likelier it is to make it into the long-term memory.

Adults can typically remember 5 or 6 words in a sequence of unrelated words. However, if the words form a coherent sentence, they can retain 15 to 20 words (Rose & Craik, 2012). Kandel and co-authors discovered that short-term memories are transformed into long-term memories through two stages: short-term memory involves changes in existing pathways in the brain. The brain gets a signal that involves an existing protein, kinase A; this protein involves another molecule in the cell called the cyclic AMP-response element binding protein (CREB). In long-term memory, CREB activates gene expression. The genes that are activated by CREB are special proteins that change the structure and activity of nerve cells, hence changing the neural pathways in the brain (Kandel, 2000; Latham, 2006). During consolidation, these synaptic changes involving new Ribonucleic acid (RNA) and proteins in the hippocampus are synthesized. Once stronger links to the sensory regions are created that allow access to memories without the help of the hippocampus—automatic output can be produced without the assistance of the sensory regions used initially (Preston, 2007).

As material is mastered, a two stage process begins: in the first stage, new brain activity associated with WM is decreased and chunks of information are created. Chunking was introduced by the psychologist George A. Miller in his paper "*The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity For Processing Information"* (Miller, 1956) and refers to the largest meaningful unit that a person recognizes. In the second stage of mastering material, the functional brain reorganizes and changes its structure—a process that is referred to as brain plasticity. Brain plasticity can occur through learning new mate-

rial as is evident in studies of drivers, juggling exercises and bilingual learners. Reorganization is created once expertise in a subject is stronger and can later be used as "building templates or retrieval structures" (Guida, Gobet, Tardieu, & Nicolas, 2012).

In order to weave together concepts of memory and learning, some researchers emphasize the possibility of training long-term memory by learning chunks of information and acquiring retrieval structures and/or templates. In chunking, one learns chunks rather than word-by-word or letter-by-letter (Guida et al., 2012; Mathy & Feldman, 2012). For example, I-B-M-C-E-O-U-B-S would be more difficult to remember than its "chunked" version: IBM-CEO-UBS. The three acronyms in the previous example are embedded in long-term memory as recognizable, meaningful units. In 1993, Michael Lewis coined the term "lexical approach", learning through meaningful strings of words, (Gobet et al., 2001; Lewis, 1993; Ordás, 2015). In this method, lexical chunks are repeated in order to transfer them into the long-term memory. Some examples of lexical chunks are: "sense of humor," "a long way off," and "upside down". Although it has not received much attention in typical classroom teaching, it is a commonly used method to learn and improve grammatical structures in second language acquisition (Fang, 2016; Jingwei, 2012).

Bonhage et al. (2014) examined neuroimages of brain activation of sentence structures and commented:

> *Sentence structure activates a network of prefrontal, middle temporal, hippocampal, and inferior parietal brain areas during encoding. Therefore, we propose that the brain mechanisms underlying the SSE [Sentence Structure Effect] most probably involve (a) chunking, because of easier, hippocampal supported, relational binding of items according to grammatical rules, and (b) the association of items with LTM contents during encoding* (Bonhage, Fiebach, Bahlmann, & Mueller, 2014, p. 1669).

This alludes to a cognitive, reflective component in memory—meaning becomes an important link between working memory and long-term memory. For example, compare the following two Hebrew sentences:

1. Ani holechet la autobus. (I am going to the bus.)
2. Ani holechet la makolet. (I am going to the supermarket.)

Both sentences have the same number of syllables (nine) and are similar in their syntax. However, it would be easier for an English speaking person to remember sentence number one than sentence number two since the word 'autobus' can be retrieved from the lexical memory (familiarity with the phonemes 'auto' and 'bus') and could be intellectually compensated for, while sentence number two does not contain words which can be retrieved from the lexical memory. Therefore, to avoid the limited space that is available in WM, LTM is activated to learn new material (Burgess & Hitch, 2006).

Once memories are in long-term memory, they need to be retrieved when needed. When recalling, the brain needs to replay the pattern of neural activity that was remembered. There are two main ways of accessing this information: recognition and recalling. Recognition is based on association; in recall, information is reconstructed. For prior knowledge to be activated, information from long-term memory must be transferred to WM. If new information is relevant to the existing knowledge, it can be integrated in LTM. This information will then benefit recall, recognition, and cognition (Mayer, 1983).

In order to improve language acquisition aptitude, information in working memory must be correctly recited and consolidated into LTM so that it can be used to make new connections in learning at a later time. By the same token, consolidation can have negative consequences too. If information is recited incorrectly, incorrect consolidated schemes could be placed into the long-term memory creating contradictory information that will later be relied upon.

### 2.2.1 Baddeley and Hitch Working Memory Model

There are several different models of WM. The "Functional Working Memory model" (FWM), for example, suggests that there are individual differences in WM and that there is storage and a processing system in one "resource pool". If one space becomes "packed", the other system must give way (Just & Carpenter, 1992). Ericsson and Kintsch propose a model, the Long-Term Working Memory Model, in which they argue that an expanded capacity of WM allows people, especially experts, to process much work from long-term memory at one time, almost shifting almost imperceptibly from WM to long-term memory (Ericsson & Kintsch, 1995). Cowan suggests that information in memory can be either held in its activated or non-activated form. If it is in its non-activated form, it represents LTM. Memory, in this model, is activated by sensory input (Cowan, 1999).

The "Phonological Loop" model/ "Multicomponent Model of Working Memory" of WM, initially developed by Baddeley and Hitch (1974) and later revised and updated, is among the most studied WM models and it consists of several systems that function together: the phonological loop and the visuospatial sketchpad—the two slave systems, the central executive and the episodic buffer (e.g. Baddeley, 2000; Baddeley & Hitch, 1974). Both the FWM and the Multicomponent Model of Working Memory make a distinction between the language component and the visuospatial component of WM. Baddeley and Hitch´s WM model is discussed more fully in this dissertation, as there is a plethora of research and evidence pertaining to it and its various components (Figure 3).

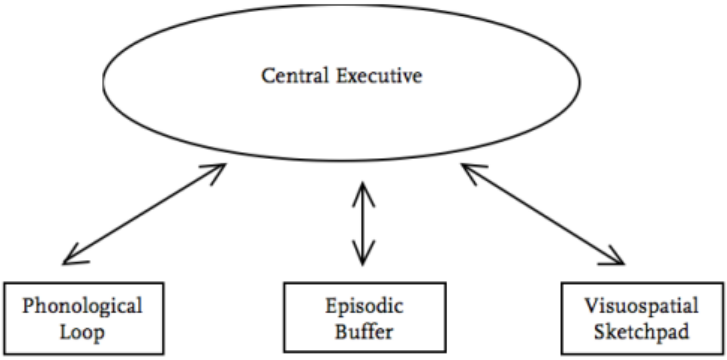


**Figure 3.** Baddeley´s Multicomponent Model of Working Memory
Adapted from: "Diagram showing the four main elements of Baddeley´s model of working memory" (licensed under CC BY 3.0).

### Phonological Loop: phonological store and articulation control process

The phonological loop deals with sound and phonological association. Based on Baddeley and Hitch´s model, there are two parts to the phonological loop: One part is the phonological store and the other part is the articulation and control process. The phonological store is linked to speech perception and phonological awareness. Verbal speech and visually presented phonological code are passed through this section. The second part of the phonological loop, the articulation and control process, is linked to speech production and is used to rehearse and store either vocal or visual information. Information can only be kept in this part by subvocal repetition. In this manner, information can be transferred into long-term memory.

Phonological WM significantly influences early lexical learning as it has been observed and compared between the vocabulary of children growing up monolingual in Germany and/or bilingual (Ebert et al., 2013; Weinert, Ebert, Lockl, & Kuger, 2012). In their study of preschoolers, Ebert et al. (2013) concluded that phonological WM capacity has a great-

er impact on the vocabulary development of children with non-German language backgrounds than on that of monolingual children.

### Visuospatial Memory/ Sketchpad

Visuospatial memory/sketchpad (VSSP) is the second component of WM. It stores visual and spatial information such as items that we see: letter shapes, word shapes and pictorial information (Baddeley, 2012). Specifically, the visual working memory (VWM) is responsible for shapes and colors whereas spatial working memory (SWM) is responsible for information about locations and movements. There is a growing amount of evidence (through the study of brain damage) that one type of memory, spatial or visual, can be impaired while the second memory type stays intact (Carlesimo, Perri, Turriziani, Tomaiuolo, & Caltagirone, 2001) and that different neural substrates are activated by the spatial memory (Courtney, Petit, Maisog, Ungerleider, & Haxby, 1998). The VWM and the SWM seem to work independently from one another, but VWM requires resources from SWM in retaining shapes and integrated color-shape objects (Wood, 2011). SWM (3-dimensional) can be affected by stimulation as seen in the structural changes of the brain in taxi drivers in London (Maguire & Gadian, 2000) and in coordination exercises (Draganski et al., 2004; Martin, Moritz, & Hall, 1999) and differences in VWM (2-dimensional) can be seen in brain imagery of literate adults compared to illiterate adults.

### Central Executive: the core of the working memory

At the core of Baddeley and Hitch´s WM model lies the central executive, which oversees and directs the phonological loop and the visuospatial sketchpad. It is responsible for regulatory functions including attention, inhibition, switching, planning, and the simultaneous storage and processing of information (Baddeley, 2003). Cartwright expanded this definition to add *"planning, strategic processing, focused attention, inhibition, reflecting on others' perspectives (metacognition), organization, cognitive flexibility, memory, and response to feedback"* (Cartwright, 2012, p.25). The central executive of WM controls attention,

deciding whether to ignore or attend to different stimuli. It is essential for reasoning, combining, disassembling and exploring information (Diamond & Ling, 2016).

Children with weaker control processes are thought to have more difficulties solving problems because they recall more irrelevant information (Alloway et al., 2009; Gathercole, Alloway, Kirkwood, Elliott, & Hilton, 2008; Passolunghi & Siegel, 2004). In academic subjects, these stimulants are numerous and being able to control them plays an important role in educational attainment (Bull, Espy, & Wiebe, 2008) especially in reading (Colé, Duncan, & Blaye, 2014; Corso, Cromley, Sperb, & Salles, 2016; Cutting, Materek, Colé, Levine, & Mahone, 2009). Unlike the phonological loop and the visuospatial sketchpad, the central executive cannot store information.

#### Episodic Buffer

"*The episodic buffer is a temporary multidimensional store that forms an interface between the subsystems of WM, LTM and the central executive*" (Baddeley, Allen, & Hitch, 2011, p. 1393). This "store" is very important in the WM system because it has the ability to bind information from a number of different dimensions into unitized chunks. These chunks become individual units in the process and are easier to process (Baddeley et al., 2011). For this reason, memorizing a group of related items is easier than a group of unrelated items, sentence learning is easier than the learning a list of words and three two digit numbers are easier to remember than six individual numbers.

### 2.2.2 Working Memory Interventions

People with weak WM are not able to filter unimportant information from their surroundings, even when instructed to do so; their brains will attempt to store too much information and this in turn consumes an unnecessarily high amount of storage space, while people with strong WM store only relevant information (Vogel, McCollough, & Machizaw,

2005). The critical question is, what role can WM training play in a typical classroom?

There have been three main waves of research concerning working memory: the first, enthusiasm for its positive effects on cognitive abilities, the second, skepticism surrounding these claims, and finally, the third, clarifying the specific effects created by the different training programs (Morra & Borella, 2015).

WM is very important in academic and social performance. The attention aspect of WM includes the alerting, orienting and executive attention required in a classroom setting (Posner, Rothbart, & Tang, 2015). Classroom situations produce a flow of information which children have to process. It is no wonder that the training effects of WM have been studied so frequently (e.g. Alloway, Gathercole, Kirkwood, & Elliott, 2009; Claire-Thompson, Stevens, Hunt, & Bolder, 2011; Ford, Pelham, & Ross, 1984). However, WM performance is difficult to assess as WM scores can fluctuate over the course of a day or even an hour, impacting academic performance (Dirk & Schmiedek, 2016).

#### 2.2.2.1 Computerized Working Memory Training

Traditionally, WM training is adaptive and places emphasis on training the spatial component of WM. This component, often trained through adaptive computer programs, is useful in improving general fluid intelligence results since WM and general intelligence tasks often overlap (block design, figural reasoning, folding tests, matrix reasoning) (de Abreu, Conway, & Gathercole, 2010; Shipstead, Redick, & Engle, 2012). Furthermore, computerized programs are enjoyable and include training that is similar to popular computer programs, such as hitting the spacebar when a symbol appears on the screen (Rabiner, Skinner, Murray, & Malone, 2010). Adaptive training of WM has been studied on typical and non-typical developed pre-school children, primary school children, adults (Holmes, Gathercole, & Dunning, 2009) and children

with ADHD (Klingberg, Forssberg, & Westerberg, 2002; Olesen, Westerberg, & Klingberg, 2004).

Initially, WM training was designed to strengthen WM so that an individual could manage successively more difficult cognitive tasks, training students on adaptive and non-adaptive tasks. For children with low WM capacities, WM training on adaptive computerized training programs showed mixed results (Alloway, Bibile, & Lau, 2013). For example, adaptive training yielded significant improvements on the performance of untrained WM tasks after an adaptive WM program, but there were no significant improvements on digit and short word recall either in the short or in the long-term (Dunning, Holmes, & Gathercole, 2013; Holmes et al., 2009). In literacy, reading and writing abilities have been associated with WM abilities (e.g. Berninger et al., 2010; Seigneuric & Ehrlich, 2005). In some cases, such as in the study by Holmes et al. (2009), the group that received adaptive training did show significant improvements in mathematics ability 6-months post training, but there was no direct comparison to their control group at 6-months post training. Therefore, Holmes et al. (2009) hypothesized that the impact of adaptive WM training was not measurable immediately after intervention on academic performance because the effect of improved WM capacity needed time to work before it could be evaluated.

In the second wave of WM research, researchers continued to argue that WM played an important role within the classroom setting (e.g. Melby-Lervåg, Lyster, & Hulme, 2012), especially on being able to consolidate information in the presence of near-constant distractions. However, in 2013, Melby-Lervåg & Hulme (2013) in a meta-analysis study involving 23 publications on both adults and children sparked a new debate as they concluded there was no convincing evidence that WM training could be generalized to other skills. The relationship between the training effects of WM on academic performance among primary school-aged children became more controversial as concerns over the reliability of the testing methods surfaced. For instance, Randall and Tyldesley

(2016) found in their review of 81 English written training/intervention programs analyzing the effects of WM training/intervention on other academic fields, including mathematics, that only eight works were scientifically viable. All eight studies presented short-term and longer, follow-up effects for WM, and five of these claimed no improvement in WM in literacy. Only one study on children with special needs yielded significant improvements in reading comprehension, with a large effect size (Dahlin, 2011; Randall & Tyldesley, 2016). And an additional meta-analysis of 15 studies and 630 participants, comparing an intervention group to a control group, attention training improved significantly attention tasks with a medium effect size. However, neither the duration of the attention training or the type of implementer (teacher, parent, computer or researcher) influenced the training effects on attention (Peng & Miller, 2016). Recently, Melby-Lervåg and co-authors conducted another meta-analysis on 87 publications and concluded that *"working memory training programs appear to produce short-term, specific training effects that do not generalize to measures of "real-world" cognitive skills"* (Melby-Lervåg, Redick, & Hulme, 2016, p. 512).

#### 2.2.2.2 Non-computerized WM Programs

Within a classroom setting several computer-less intervention programs have been implemented to improve WM capabilities of both typically and non-typically developed students. For example, Colmar et al. (2016), in a program called Memory Mates, attempted to improve academic performance of third grade students by supporting students through WM strategies and by teaching teachers how to implement these strategies within a classroom setting. This small experimental study showed no significant quantitative change in the experimental group in regards to academic improvement after five weeks of intervention (Colmar, Davis, & Sheldon, 2016; Table 2).

In a semi-classroom setting, a non-computerized preventive program aimed at improving the WM executive function of participants within a

classroom setting, a series of activities was administered 30 minutes each school day for children between the ages of 4 and 6, twice a week for six weeks. Training involved one task for the entire group, one for two children and one for an individual child. Using analysis of variance, tasks which were related to WM, inference and control and cognitive flexibility processes were evaluated (i.e. make opposite gestures than the experimenter, finding differences between images). The children involved in this study showed significant improvement in WM, interference control and cognitive flexibility (Röthlisberger, Neuenschwander, Cimeli, Michel, & Roebers, 2012) but the transfer effect to other academic fields, was not tested. And, long-term effects of the program were not evaluated. In this experiment, Röthlisberger et al. (2012), yielded positive effects for developing executive functions in such a setting, and without the use of a computer.

The transfer effect of training WM within a classroom setting has also been examined in the field of mathematics. Repeated tests were conducted among typically developed preschool children and results showed more effect with domain specific training (only math activities) on mathematical skills than the domain general training (math activities and working memory training) after four weeks of intervention. The intervention group had two thirty-minute sessions for four weeks. WM-training games by the domain general group included activities in which information had to be held in WM and manipulated. For example, when sitting in a circle, a child rolls a dice and the next player repeats the number on a dice that was rolled before (Kyttälä, Kanerva, & Kroesbergen, 2015).

Unfortunately, the studies cited above are several of the very few conducted in this field. There have been very few studies on the effect of training of WM (Table 2), without the use of a computer, or within a classroom setting. In the meta-analysis study by Peng and Miller (2016), 11 out of 17 studies involved computerized intervention programs, and classroom teachers conducted only two interventions. Of the two con-

ducted by teachers, one involved preschool children and the other, older adults (Peng & Miller, 2016). Typically, these computerized training programs involve the visuospatial loop from Baddeley and Hitch´s model, and there was a direct transfer effect on attention and concentration tasks, which are related to visual and spatial information. However, the effect of WM training on academics, especially as an exclusive independent factor in its influence on learning achievement, is hotly debated. Peng and Miller (2016), argue that improvements in WM must not manifest themselves in better academic abilities but that:

> *[...] improvement on attention does not necessarily mean individuals can automatically apply this improved attention to other tasks. It may be equally important to teach meta-cognitive strategies (e.g., self-regulation strategies) that can help individuals learn when and how to use their acquired attention skills to facilitate learning* (Peng & Miller, 2016, p. 85).

What does this actually mean? What would such metacognitive strategies look like?

**Table 2.** Non-Computerized Programs

| Program | Time | School Level | Effect |
|---|---|---|---|
| Memory Mates, Colmar et al., 2016 | 5 weeks | Grade 3 | — |
| Small group WM intervention, Röthlisberger et al., 2012 | 6 hrs. | Pre-school | WM, cognitive flexibility & cognitive flexibility |
| Counting and WM training, Kyttälä et al., 2015 | 4 hrs. | Pre-school | — |

## 2.3 Bridging the Gap Between WM and Linguistic Competence

John Flavell first coined the term metacognition in 1979. Metacognition is *"thinking about thinking"* (Flavell, 1979, p. 906), a process requiring higher order thinking. It is crucial in training programs and it is used to monitor the progress of learning. There are two types of metacognition awareness: declarative and procedural. Declarative knowledge describes the ability to evaluate one´s knowledge, learning and remembering; procedural knowledge is the perception of the difficulty of a task (self-reflective), and regulating ongoing cognitive processes. The executive functions of the working memory and metacognition share similar theoretical features as both are top-down processes, update information in memory through developmental stages, show similar developmental timetables—with accelerated progress during the elementary school years, and have been shown to be associated with *"comparable brain regions"* (Roebers & Feurer, 2016, p. 42). Costa describes this process as:

> *Being conscious of our own thinking and problem solving while thinking is known as metacognition [...] Good problem solvers plan a course of action before they begin a task, monitor themselves while executing that plan, back up or adjust the plan consciously, and evaluate themselves upon completion* (Costa, 2008, p. 109).

Likewise, Chick et al. (2009) argue that metacognition is the *"active, higher-order processing through reflecting on, monitoring, self-regulating, evaluating, and directing the thinking and learning processes"* (Chick, Karis, & Kernahan, 2009, p. 4). Caruthers agrees that metacognitive processes involve *"direct attention, resolve conflicts, activate explicit long-term memories, and control and manipulate the contents of working memory"* (Carruthers, 2014, p. 138).

One component of metacognition is metalinguistics. It is the ability to think explicitly about a language and *"the ability to reflect upon language as well as comprehend and produce it"* (Cazden, 1972, p. 303). Metalinguistics is a metacognitive ability that focuses specifically on language learning. There are several models for metalinguistics, which focus on the relationship between attention and concentration, and language learning.

### 2.3.1 Models of Metalinguistic Awareness

Piaget (1978) explains the relationship between *"knowing that"* and *"knowing who"* as a reciprocal relationship, progressing from the *"periphery to the center of consciousness"* (Piaget, 1978, p. 213). This knowledge does not originate in the individual or the thing; rather an individual becomes aware of this relationship gradually. Initially, individuals form experiences from a given situation and then subconsciously anticipate and plan for reoccurrence. However, after they assimilate the knowledge, they can explain and reflect on it. This is a three-stage process. First comes a focus on the result of the action. Then, conceptualization and ideas begin to draw together because the individual begins to anticipate what is to come. Finally, the last level involves reflected abstraction. Only at the last level are children able to conceptualize what would happen if the condition were modified.

An expanded view is posited by Sinclair et al. (1978) who believe that the fact of a word´s being written makes it unnecessary to reflect upon that word. Sinclair et al. (1978) draw an analogy from Piaget´s "the child´s conception of the physical world" to "the child´s conception of language" (Sinclair, Jarvella, & Levels, 1978, preface). In their work they too describe a gradual relationship between uttering and being sensitive to language and understanding the nuances in languages. Their theory of metalinguistics incorporates reading and writing, arguing that, unlike vocabulary learning, the written word eliminates the need for reflection of language as *"a written word or text remains present to be studied*

*repeatedly; it need not be held in memory to be reflected upon"* (Sinclair et al., 1978, p. 4). For this reason, once a word or text is written, there is no need to hold it in memory because it is present at all times, while words that are said, need to be held in memory or they will "disappear".

My research is more in line with Bialystok´s (1999) view. She suggests that metacognitive tasks involve a single construct that has two components: an analysis component, *"the ability to represent increasingly explicit and abstract structures"* and a control component, *"the ability to selectively attend to specific aspects of representation"* (Bialystok, 1999, p. 636). Furthermore, these two components are related: *"the availability of more explicit representation permits the execution of higher levels of attention control"* (Bialystok, 1999, p. 636) and develop on their own. Improvements in linguistic abilities are the result of incremental development caused by the interaction of the two components. This progress eventually enables children to go from simple language to an intentional language, which can also involve reading, writing and metacognitive problem solving. Hence, language is assumed to change from implicit knowledge to explicit knowledge. Critics of this model point out that Bialystok´s model does not address how analysis and control develop, and if some types of communication competence (symbolic, for example) would contribute more to this change (Paiva, 2003).

Similar to Bialystok, the Representational Redescription (RR) model (Karmiloff-Smith, 1992) of language acquisition distinguishes between three knowledge phases which are cyclically repeated and pass through four increasingly higher levels of representation. In the first phase, a child focuses on a specific domain, such as language, at a micro domain level, and repeats it until achieving what Karmiloff-Smith calls *behavioral mastery*. In this phase, the child had increasingly successful performances with the task. In the second and third phases, procedural interactions that occurred in the first phase are recorded into *abstract redescriptions*. At this phase, implicitly learned knowledge gradually becomes explicit—a more conscious linguistic access, and is used instead

of external data. This causes the "over-generalization" of rules, such as for the plurals of nouns; for example: Mom has big foots. This is the phase when children begin to exhibit metalinguistic awareness. Finally, in the third phase, children reach some vague threshold and reconcile explicit and conscious knowledge, constantly reassessing it as it becomes accessible.

Gombert´s theory of language acquisition (1992) differentiates between two levels of metacognition. The first, the epilinguistic level, is unconscious and automatic, while the second, the metalinguistic level, is conscious, chosen and can be actively applied when desired:

> *1) [...] The phase of acquisition of first linguistic skills, in which, pre-programmed formats, correspondences between linguistic forms and reinforced pragmatic contexts are stored in an implicit and instance- bound format; 2) the phase of acquisition of epilinguistic control in which linguistic knowledge is reorganized in a multifunctional format which cannot be consciously accessed; 3) the phase of acquisition of metalinguistic awareness, triggered by an external demand for intentional control of the organization established in phase 2* (Gombert, 2003, p. 3).

Krashen, however, maintains that metalinguistic awareness does not accelerate the rate at which second language is acquired as it does not indicate that an individual will be apply this gained knowledge. In the "Monitor Model" he proposes five hypotheses for language learning: 1) Second language is acquired in the same way as first language, non-consciously and through exposure; 2) The consciously learned system "monitors" and controls what has been learned; 3) Second language learning is acquired through a predictable sequence based on need; 4) Second language is acquired when comprehensible input given is a bit beyond what is understood; 5) Various internal reasons, for instance, anxiety, motivation, and boredom influence the acquisition of language. Krashen argues that too much monitoring slows down learning and

interferes with language learning and that explicit language never becomes implicit (Krashen, 1984); however, most research in the field of language has contradicted this theory (e.g. Bialystok, 1986; Gregg, 1984; Lightbown & Spada, 2006) arguing that language learned changes from declarative to procedural knowledge through practice. Kroll and Linck, for instance, argue that not only linguistic representations change with increased practice and proficiency but also the skill with which they can be applied (Kroll & Linck, 2007).

Overall, these theories highlight several similar features of metalinguistic awareness. First, there is a gradual increase of knowledge that can be assimilated into more general knowledge. Second, children become more aware of this knowledge as they increase their knowledge. In second language learning and special education, theories have attempted to understand the role of metalinguistics in acquiring language.

### 2.3.2 The Metalinguistic Classroom

In a metalinguistic classroom, students reflect about the whys of the subject manner either through explicit guidance of the teacher, cuing the students onto the process, or by gaining knowledge of rules. The students´ aim is to eventually internalize the teacher´s questions so they become the students´ question, through the student´s inner voice (Larson, 2009; see: 2.3.1). Children who exhibit metalinguistic awareness are able *"delete or substitute sounds (phonemic awareness), replace endings on words (morphemic awareness) and understand multiple meaning sentences (semantic and/ or syntactic awareness)"* (Zipke, 2011, p. 349).

Apel et al. (2012) investigated the role of the simultaneous influence of three different metalinguistic skills: phonemic awareness, orthographic awareness and morphological awareness; oral skills and naming skills, to determine how they affected reading and spelling skills on 56 second and third grade students. Testing included a derivational suffix task,

orthographic awareness task of correct spelling (dictation), receptive vocabulary, rapid automatized naming test, spelling and reading. Of the three metalinguistic skills tested (phonemic awareness, orthographic awareness and morphological awareness), regression analysis revealed significant correlation of morphological awareness for spelling, word recognition and reading. Furthermore, orthographic awareness was strongly related to word recognition (Apel, Wilson-Fowler, Brimo, & Perrin, 2012). The relationship between the two, however, is unclear: Do children who exhibit stronger orthographic awareness skills have a stronger morphological awareness or vice versa?

In 1962, Peal and Lambert, controlling for age, socio-economic status, gender, etc. found that bilinguals significantly outperformed monolinguals on several measures of verbal and cognitive measures. Since then, several studies have reported similar results: In 1986, Bialystok compared monolingual children and bilingual on a series of grammar-related tasks. When tasks had to do with conflict judgment and required control to deal with the conflict, bilingual children outperformed monolinguals (e.g. Bialystok, 1986; Huber & Lasagabaster, 2000). Here too the relationship is unclear: Does speaking two languages create a heightened metalinguistic awareness in children or does a strong metalinguistic awareness influence the ability to speak two languages?

Research focusing on metacognitive or metalinguistic awareness has indicated that even after short interventions, students can improve their performance in reading comprehension, in short and long-term (Carretti, Caldarola, Tencati & Cornoldi, 2014), in vocabulary learning (Safataj & Amiryousefi, 2016) grammar (Becerra, Ayure, Ordoñez, & Bohórquez, 2015) among weak students (Partanen, Jansson, Lisspers, & Sundin, 2015) and with bilingual speakers (van Steensel, Oostdam, van Gelderen, & van Schooten, 2016). There is also positive evidence, especially with weaker students, that arithmetic can benefit from a combined

metacognitive and WM intervention program, within a classroom setting and with a trained teacher (Cornoldi, Carretti, Drusi, & Tencati, 2015).

Yet not all children know how to actively use metacognition to improve linguistic skills. Teachers must be aware of which activities and techniques are effective and teach them to their students. Based on the metalinguistic models, these language competencies can be strengthened, creating a spiral affect, and assimilated into long-term memory. Only then can they be used to acquire new material. In the next section, metacognitive/metalinguistic aspects of linguistic competences will be discussed more fully.

## 2.4 Language Communication Competences

The four modalities of communication are speaking, listening, writing and reading. Listening and reading are "receptive skills", while speaking and writing are "productive skills". Native language speakers usually learn first to listen then speak then read and finally write. Once a communication skill begins to be acquired, the modalities intertwine and reciprocally affect each of the competencies (Berendes et al., 2013). Although they serve different purposes, reading and writing can be perceived as two sides of the same coin, and have overlapping active areas in the brain (Berninger, Cartwright, Yates, Swanson, & Abbot, 1994; Pugh et al., 2006). Since reading and writing usually follow and are supported by listening and speaking, skills gained through listening and speaking can be used to gain fluency in reading and writing. This paradigm is flawed in dialect-speaking communities as speaking and listening differ from what is read and written.

Language serves two purposes: one to communicate with others and the other, the metacognitive aspect, to communicate with one´s self (Nelson, 2005). The relation between early stages of communication competences to literacy development is multi-faceted and a weakness in one competence can affect the ability in one or more of the others. In order

to strengthen each component of the communication competences, it is useful to discuss conditions that are more common in creating gaps in these achievements, and assess the separable components of language, as is done when creating language diagnoses and determining disorders.

Very little work has been done on the effect of language metacognitive programs in a diglossia. Therefore, it has been difficult until now to determine exactly what (if anything) needs to be done to improve speakers´ competences in written German. One reference point might be the examination of treatments developed to assist students with special linguistic needs.

Learning disabilities is the term used to describe a group of conditions which create a gap between a child´s potential and achievement but which do not indicate a weakness in intelligence. Some common learning disabilities are: auditory processing disorder (APD), dyslexia, dyscalculia, and executive functions disorder.

Neither the Learning Disabilities Association of America nor the American Psychiatric Association recommend specific tests to evaluate deficits in reading or writing. Therefore, evaluations can be inconsistent. In fact, although there are many descriptive research studies on the various learning disabilities, there is no consensus on their diagnosis or treatment; furthermore, only a few focus on treatments to improve general academic literacy aptitude rather than a specific aspect of literacy, such as reading comprehension (McCartney, Boyle, & Ellis, 2015) or vocabulary (Motsch & Marks, 2015).

But recent studies show that direct versus indirect and individual versus group modes of speech-and-language therapy of children with language impairments, speech and language therapy assistance working with small groups of 6–11 year old children can deliver effective service to children with primary language impairments who do not require the specialist skills of a speech and language therapist (Boyle, McCartney,

Forbes, & O'Hare, 2007). Therefore, in a classroom situation, teachers need to be able deliver a diverse range of learning services to a varied group of children. To do so, they should be aware of the most efficient methods of teaching to reach the largest number of students in their class.

There is a debate about how services should be delivered and numerous studies have attempted to evaluate different teaching strategies that make learning more efficient. Language can be taught implicitly or explicitly. Implicit teaching involves learning information without awareness or conscious attempts (Reber, 1996) and requires only minimal attention (Seger, 1994).

In explicit approaches,

> *teachers plan lessons based on clear objectives that progress purposefully from less challenging to more challenging skills and content. They provide direct explanations and modeling of concepts, skills, and strategies, along with extended opportunities for guided and independent practice with clear corrective and positive feedback* (Denton, Fletcher, Taylor, Barth, & Vaughn, 2014, p. 269).

Explicitly teaching key concepts such as phonics, or vocabulary, involves either bottom-up approaches or top-down approaches. Bottom-up approaches start with basic language units and then develop into more complex structures (from form level to meaning level). Activities might be oral or written and include segmenting, decoding, and identifying structural features. Top-down approaches begin with looking at language as a whole and concentrating on the gist of the text (from sentence to word or grammatical level). Activities might include: visualizing, logical thinking, metacognition, and divergent thinking, explicit and implicit teaching, for instance, and the use of visual displays to key students onto concepts or processes learned, could also be incorporated (Ciullo, Falcomata, & Vaughn, 2015; Hooks & Peach, 1993).

Ellis and co-authors (1994) referred to explicit teaching as providing a series of instructional supports for the students (Ellis et al., 1994). But Heward (2003) argues that such teaching ignores the whole child and that processes are more important than the parts that make them (such as phonics or decoding skills). Archer and Hughes (2011), also acknowledge the risk of teaching isolated skills, as students might not be able to generalize the skill taught. Yet by acknowledging that some children are not able to achieve proficiency of a language only through an implicit input method, explicit teaching enables students to focus on the specific isolated skill they are to acquire, giving them an additional tool to apply.

### 2.4.1 Oral Communication Competencies: Listening and Speaking

Hearing is defined by the Merriam-Webster dictionary as "the process, function, or power of perceiving sound; *specifically*: the special sense by which noises and tones are received as stimuli" (hearing, 2015) while listening is defined as "to hear something with thoughtful attention: give consideration <*listen* to a plea>" (listening, 2015). Children hear a lot during class time but they do not always need to listen to what is being said; as there is a lot going on within a classroom, some sounds are irrelevant, disruptive and/or meaningless.

#### Listening interventions programs

In relation to language development, listening skills are the first to develop. After babies begin to imitate the sounds they hear, probably speech sounds begin and slowly words follow. It is important to realize that the listening is a very complex process. Wolfgramm et al. (Wolfgramm, Suter, & Göksel, 2016, p. 27) explain this process in four levels: First, *"intention"*, deciding to listen and selecting what to listen to. Second, decoding the message by segmenting phonemes that exist in a stream of sound, and interpreting what was heard. Third the mental creation of what was heard and comparing it with knowledge stored in

working memory, while the LTM pays attention to the process. Finally, information heard is systematically stored into LTM (Anderson, 1995; Goh, 2000; Wolfgramm et al., 2016). Moreover, these various processing levels are assumed to not act in isolation, but rather in parallel, both in bottom-up (from the phoneme level up) and top-down (making use of prior knowledge) processing (Anderson, 1995; Flowerdew & Miller, 2005; Vandergrift, 2007). Since three fourths of what is learned at school by students is a result of listening in class (Hunsaker, 1990), of course it must then be considered a critical component of language acquisition.

Although this thesis is primarily interested in the language skills of typically developed children in a diglossia rather than children with learning deficiencies, there is very little research on how to exactly teach and assess listening skills in a typical classroom setting (rather than one with second language learners (Arono1, 2014; Call, 1985; Thompson, Leintz, Nevers, & Witkowski, 2004). One point of reference to determine how listening skills are improved is to examine intervention programs used for children with listening disorders, and another reference point is to examine how second language learners are taught language.

Many disorders are associated with a degraded auditory process, making language acquisition more difficult. One of the most common disorders is Auditory Processing Disorder (APD) which affects approximately 2 to 7% of school age children (Team, n.d.). This disorder refers to a plethora of behaviors and symptoms including: difficulties in remembering, following speech directions, remembering names and finding correct words during speech (Mostafa, 2007). The American Speech Language Hearing Association (ASHA) defines the central auditory processes as the auditory system mechanisms and processes responsible for: sound localization and lateralization; auditory discrimination; auditory pattern recognition; temporal aspects of audition including temporal resolution, temporal masking, temporal integration, and temporal ordering; auditory performance with competing acoustic signals and auditory performance with degraded acoustic signals (ASHA, 2000).

ASHA recommends that speech therapists use two approaches in dealing with APD. The first is to enhance language resources such as the understanding of parts of speech, segmenting, rhyming and identifying syllables—explicit approaches. The second is to improve sound quality for the students (for instance, by seating students closer to the teacher, speaking more carefully to stress important words and using visual aids and gestures)—implicit approaches (Chermak & Musiek, 2014; Guidelines, 2006; Sharma, Purdy, & Kelly, 2012). Beyond these two simple classroom approaches, there seems to be no strong evidence to support any specific treatment methods for APD. Perhaps this is not surprising, given that there is no consensus concerning a definition, or a diagnosis test, or a treatment for the symptoms of APD (Fey et al., 2011) because APD deals with several language mechanisms that work in unison (Medwetsky, 2011).

By far, most listening research comes from the field of second language learning and foreign language learning. In language learning, listening skills are valued as a tool for drawing students' attention to a new form or meaning of language. These language forms can then be analyzed through explicit teaching through a variety of activities which enable students to compare the second language to the first. Crosslinguistic research, however, warns that since first language knowledge influences second language acquisition, linguistic interferences account for errors in the second language learned (Leung & Williams, 2014). Therefore, second language teaching usually employs explicit grammatical teaching such as structural features, linguistic units but also shadowing (repeating a portion of a dialogue verbatim using the same pronunciation and intonation and increasing the capacity of the phonological loop). Through shadowing, students use correct sentence structure and vocabulary (Hamada, 2016; Khuziakhmetov & Porchesku, 2016; Moskovsky, Jiang, Libert, & Fagan, 2015). In second language learning, students *"become more aware of how they can use what they already know to fill gaps in their understanding"* (Vandergrift, 2004, pp. 10–11) in contrast to first language learning, which is implicit (MacWhinney, 2008).

One of the problems in teaching listening in a classroom setting is that the environment is often loud and disruptive and students might struggle to hear what is said. As a result, this can compromise learning and achievement (Dockrell & Shield, 2012). While teachers teach, some sounds of words "disappear" in the classroom. In addition, some sounds are more visible while spoken, such as the "b" sound, but others are less so, for example the "g" sound; therefore, students cannot depend on visual cues from the teacher. As language skills develop, however, children have more access to the lexical and phonological representations of words and they become more effective at speech reading, especially when they are familiar with the vocabulary used (Jerger, Damian, Tye-Murray, & Abdi, 2014).

Research has shown listening skills are important in language learning and they are closely related to improvements in other language skills (Morris & Leavey, 2006). Therefore it might be beneficial to train students to focus on both visual cues and linguistic features of language when learning a language. In a diglossia, however, activating knowledge from long-term memory cannot help integrate existing schemes or relevant prior knowledge to prepare, support and speed up the processing of the new information (Imhof, 2010) as there is a mismatch between LTM and new information processed in WM.

**Speech intervention programs**

During the first years of life, the second oral competency develops. *"Speech is produced by precisely coordinated muscle actions in the head, neck, chest, and abdomen"* ("What Is Voice?", 2016, para., 4). Speech studies have shown that children with speech impediments are at risk for delayed acquisition of literacy skills (Anthony et al., 2011; Bird, Bishop, & Freeman, 1995). There are two main types of speech: one, which is spoken to oneself, and the other, spoken to others.

Private speech and inner speech are forms of communication intended for one's self. Jean Piaget (Piaget, 1978) and Lev Vygotski (Vygotski &

Cole, 1978) identified private speech as a form of communication for children between two and seven which tends to disappear with age around the entrance in school. This "self talk", or language for one´s self, can be used as a tool to aid in self-regulation and guidance. Therefore, the inner language is the link between the external input and the self (Aro, Poikkeus, Laakso, Tolvanen, & Ahonen, 2015).

Physiologically, when speaking the brain forms an internal copy of the sound of the voice in parallel with the overt sound (Greenlee et al., 2011; Howard, 2011) and it has been shown to produce a brain signal called corollary discharge, which is a component of motor control. This is the same signal shown to be created when one uses inner language. Through this mechanism, inner language is believed to reduce the impact of external sounds, preventing a confusion between the "outside" sound and "self produced" sound (Scott, 2013). Several studies have shown that patients with apraxia of speech, when focusing on inner speech and implicit phoneme manipulation (manipulation of individual sounds in a word), activate the primary motor area and the primary sensory motor cortex, which is used in speech planning (Aleman et al., 2005; Farias, Davis, & Wilson, 2014). These areas of the brain are active during conscious inner speech and are essential for phonological processing (Paulesu, Frith, Frackowiak, 1993).

There are two types of inner speech, both being non-vocal (Figure 4): one is without mouth movements and the other, with mouth movements (overt). Several studies of overt and inner speech (repeating sounds in spoken language) have indicated that they cause overlapping brain activation and separate activations in different regions of the brain (e.g. Ryding, Bradvik, & Ingvar, 1996; Shuster & Lemieux, 2005).

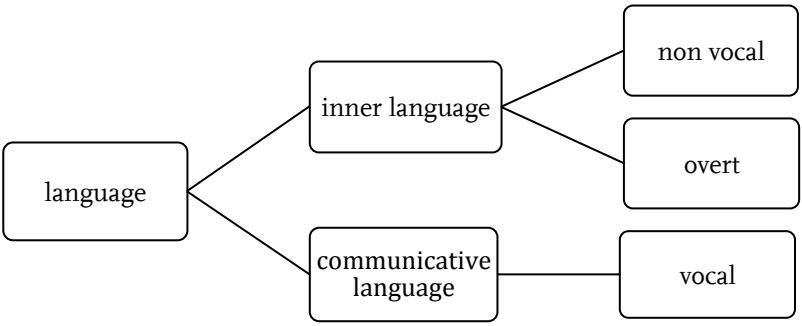


**Figure 4.** Types of Speech/ Language

Statistically, approximately 6% of school age children have some form of Speech Sound Disorders (SSD) (ASHA, 2000). Most intervention methods for children with SSD involve either phonological awareness or auditory discrimination training to improve speech problems (Oliveira, Lousada, & Jesus, 2015). A comparative study of 95 children with SSD showed that phonological awareness in children with SSD and those without SSD were governed by the same phonological awareness variables, but children with SSD had a more significant risk of delaying the development of phonological awareness skills. Also, for the children with SSD, speech perception and receptive vocabulary skills predicted their phonological awareness abilities (Rvachew & Grawburg, 2006).

A study conducted by the speech pathology department at a French university combined a six-week individual speech therapy with a group therapy component and a structured home program component. The treatment targeted bottom-up strategies such as speech accuracy, production, vocabulary knowledge and phonological awareness skills of 65 four year olds. Individual therapy consisted of either articulation representations (output approach) in which French-speaking children practiced correct articulation of using bottom-up approaches: identifying phonemes in isolation, syllables, words, sentences and phrases. The

other half of the students received input-oriented individual therapy. Here the therapy targeted phonemic perception and children were given knowledge about acoustic-phonetic characteristics of the specific phonemes or word structures (Rvachew & Brosseau-Lapré, 2015), a top-down form of therapy. At the conclusion of the individualized program, children were assigned to random home program conditions, based on strategies parents could learn to apply with their children, creating four intervention groups. Finally, all children received phonological awareness group therapy. The individual speech therapy component lasted six weeks and each session took one hour. Then the children received six weeks of group therapy. All the treated groups significantly improved speech articulation accuracy and phonological awareness with a moderate effect size, compared with a nonrandomized control group.

Also, combining articulation and visual photos of the mouth has been shown to help move children from the pre-alphabetic stage of development to the partial alphabetic stage of development (Boyer & Ehri, 2011; Castiglioni-Spalten & Ehri, 2003). In 35 to 40 minute sessions in six weeks of articulation training combining articulation and speech, using viewer games, a study of 19 7 to 10 year olds with clinically diagnosed dyslexia, showed significantly close links between auditory and articulation mechanisms in phonology (Joly-Pottuz, Mercier, Leynaud, & Habib, 2008). Based on Baddeley and Hitch´s model, through this repetition both the visuospatial loop and the phonological WM loop are being used to transfer information into long-term memory.

Language on the other hand, is used to express written or spoken language and encompasses both speech and meaning. Surprisingly, traditional forms of language improvement activities in a classroom setting, such as memorization and repetition, which are also beneficial for the phonological loop and long-term memory, are rarely conducted during class time as they are often considered old-fashioned and useless (Beran, 2004; Leithauser, 2013). Although these types of language practices have been practiced, documented, and used as a learning device since ancient

Greek times, creating a "tenuous attention to detail" and language patterns (Beran, 2004), there is limited research on efficacy of memorizing sentences in first language learning in typical learners (but more so in second language learning and special learners through the use of modeling and imitating) (e.g. Jessop, Suzuki, & Tomita, 2007).

What is known, however, is that in overt language, articulation and acoustic features are used to communicate with others. Communication, although one sided, begins shortly after birth (crying, yawning). By the age of approximately five the child is able to fully talk and has acquired basic language. Yet what is the effect when communication skills mastered before pre-school differ than those in school? During instruction time, in the German-speaking parts of Switzerland, students speak in H. German. But during independent work, students are typically allowed to speak in dialect to each other. In primary school classroom instruction, there is rarely direct speech instruction; rather, discussions and presentations are usually conducted during the lessons to enforce correct vocabulary and grammar skills. Since the quality of phonological awareness—the awareness of sound in spoken words—plays an important role in developing the WM system and is linked to early reading, writing and speaking skills, it is interesting to observe the influence of the Swiss German diglossia on the written linguistic performance of children.

Across the Atlantic, the effect of speech on written language skills of typically developed African American children who speak African American English (AAE) has been studied widely. Among this population there are significant correlations indicating a greater incidence of incorrect spelling of words that are pronounced differently in AAE to standard American English (e.g. Gatlin & Wanzek, 2015; Terry & Connor, 2010; Kohler et al., 2007). Even spelling errors of British English speakers and American English speakers is correlated with aspects in their dialects (Treiman & Barry, 2000; Treiman, Goswami, Tincoff, & Leevers, 1997). Interestingly there is a correlation between print-speech mismatch in

transparent languages (such as Greek) as well as in opaque languages (such as English) (Pittas & Nunes, 2014).

Inner speech is used in "typical" classroom situations as a metalinguistic tool and a form a top-down method to guide students through assignments, exercises and thought processes, helping students think in a structured but creative manner (Moffett, 1985). However, it is difficult to monitor whether and what they are thinking. When learning a language, students are encouraged to use inner speech to improve language proficiency. Not surprisingly, it is assumed that when articulation is suppressed, the resulting word recognition weakens (Dahlen & Caldwell-Harris, 2013), as it not transferred from phonological WM to LTM. This is also in accordance with the motor theory of speech perception: articulation rather than acoustic features represent phonemes in the brain (Liberman, 1999).

Although dialect-speaking children do not necessarily have listening or speech problems, they do have fewer opportunities to learn language implicitly by hearing others or practicing standard language. There is almost a one-to-one correlation between programs targeting listening and speech. Activities that are used to improve observational listening skills are similar to those involved in speech therapy: active involvement and explicit teaching of the tools needed to improve listening or speech (Table 3).

**Table 3.** Speech and Listening Intervention Tasks

| Listening Intervention | Speech Intervention |
|---|---|
| Auditory training | Auditory training |
| Re-stating/shadowing | Re-stating/shadowing |
| Identifying phonemes, syllables; rhyming | Identifying phonemes, syllables; rhyming |
| | Articulation |
| Signal enhancement (visual cues) | Visual presentation (mirror, photos) |

### 2.4.2 Literacy Communication Competences: Reading and Writing

Based on Dyslexia International, 10% of a given population has a neurologically based reading disorder (Dyslexia International, 2014) and by some figures, up to 17% of German speaking children in German-speaking countries suffer from reading and writing disabilities (Döhla & Heim, 2016). Beyond the very early primary school years, children´s vocabularies grow especially through reading.

Since many words are used in writing but not in speech, those who read more increase their vocabulary more quickly than slower, more hesitant readers. Weak students with limited exposure to text will simply not build the same amount of "sight vocabulary" as their stronger peers (Chall, 1983). And the discrepancy in the performance of good and weak readers will grow in time, causing an effect described as the Matthew Effect (Cain & Oakhill, 2011; Nagy & Scott, 2000; Stanovich, 1986; Weinert, Ebert, & Dubowy, 2010).

#### 2.4.2.1 Reading Competences

Literacy skills are those skills needed for reading and writing. The National Reading Panel (NRP, 2000) and the National Institute of Child Health and Development (NICHD, 2000) identified five areas important to effective reading instruction: phonemic awareness (a subset of phonological awareness), phonics (a method of blending sounds), fluency, vocabulary and comprehension (NICHD, 2000; Sousa, 2006). The first four criteria are necessary for literacy comprehension, the ultimate "goal" of reading, but all of the pillars are interconnected (Figure 5).

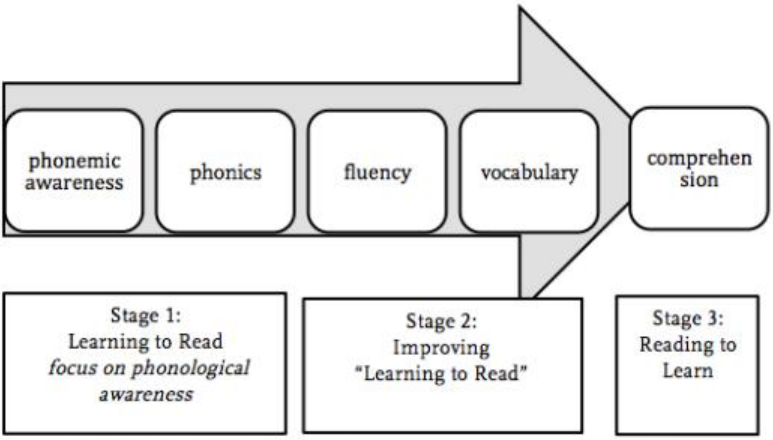


**Figure 5.** Pillars of Reading Success (Based on: Ehri et al., 2001)

From processing auditory language to reading and writing, students unconsciously develop phonological awareness: an understanding that words are made of sounds and the ability to manipulate the sounds in words. In processing written language, *"verbal sounds are first perceived as phonemes, words are then collated with the vocabulary for perception of meaning, the relationship of the words are evaluated next to understanding them as sentences by syntactic processing"* (Honjo, 1999, p. 34). Eventually in typical learners, once they are able to identify and manipulate small units of phonemes, around the age of four, they begin to pair sounds with letters and then blend single sounds of letters to words. Therefore, reading, writing and comprehension begins in the later stage of development, initially around the age of 6, and during upper primary school, around the age of 8, a more conscious awareness of written language develops (Gillon, 2000).

### Stage One: Phonological Awareness

Phonological awareness varies greatly among children up to the middle childhood years. These differences are closely linked to the ability chil-

dren have to acquire language by initiating word-recognition development and the learning of new vocabulary (Skebo et al., 2013). Children with poor phonological awareness but normal nonverbal cognitive abilities have been shown to have weak vocabulary skills and learn new words more slowly and less efficiently than children with normal or high phonological awareness. Also, the ease with which a subject learns novel words has been strongly linked to a phonological awareness (Gathercole & Hitch, 1997; Service, 1992; Service & Craik, 1993) and has been shown to correlate to the success a child will have in reading, writing (Silva et al., 2012) and spelling (Gindri, Keske-Soares, & Mota, 2007). However, it is difficult to determine whether undeveloped phonological awareness leads to weak vocabulary or vice versa, or if there is an additional unexplored component that influences the development of this paradigm. Furthermore, there is also evidence to suggest an interaction between phonological awareness and working memory in typical primary school children (e.g. Kaushanskaya, Ji Sook, Gangopadhyay, Davidson, & Weismer, 2017) and in children with reading disabilities (e.g. Sesma, Mahone, Levine, Eason, & Cutting, 2009). In any case, it is indisputable that phonological awareness training explains a variance in reading and writing success, though the effect size of the training remains small, independent of language (Pfost, 2015). Yet over the past three decades, much research has been done outside of the classroom to study and assist children with weak phonological awareness skills in order to improve long-term reading skills (Bradley & Bryant, 1985; Ehri et al., 2001; Wise, D'Angelo, & Chen, 2016).

Phonological awareness develops through critical stages of increasing complexity. Phonological awareness, however, differs from phonemic awareness: phonological awareness is the awareness of auditory and oral manipulation of sound while phonemic awareness is the awareness that words are made out of individual sounds. Phonemes are the smallest unit of spoken language. In English, there are 36 phonemes: 12 vowels, 13 diphthongs and 24 consonants. In German, 45 phonemes: 17 vowels, 3 diphthongs and 25 consonants ("What languages in Europe", n.d.). In

the first stage of phonological acquisition, between the ages of three and four, rhyme and segmentation are refined in speech production (Tolchinsky, 2003). Eventually the ability to recognize rhyme is established by the age of five (Brooks & Macwhinney, 2000; MacLean, Bryant, & Bradley, 1987). Once there is the realization that there is a correlation between spoken words and written words, the next stage is recognizing that each sound is represented by phonemes, which are correspondingly represented by letters. At this stage children also begin to reflect on language structures and meaning. However, this is not necessarily a conscious process (Berendes et al., 2013).

As sound units are understood, the structure of the word begins to make sense because reading is based on sound structures. The awareness of the sound structure of a word versus a letter is termed phonological awareness and can be recognized through rhyme and syllable perception and measured with a variety of tasks including: alliteration, phoneme isolation and spoonerism (Shaywitz, 2003). Phonological awareness plays a key role in literacy development (e.g. Gillon, 2000) and a certain level of phonological awareness needs to be achieved before beginning to read. (However, at this stage reading has still not yet begun.)

Once children recognize that letters represent sounds, phonics is the most common method of teaching reading and writing this correspondence between sound: teaching children to read by learning the phonetic value of letters. The ability of isolating the different segments of the word, noticing them and then being able to manipulate them, is a more advanced stage of phonological awareness and is referred to as phonemic awareness. These stages, in a more narrow sense, would also be comparable to those observed in written language.

Although there is some controversy concerning the teaching of phonics versus other, non-phonetic, reading language instruction (e.g. Adams, 1998), the National Reading Panel concluded after a meta-analysis that *"systematic phonics instruction enhances children's success in learning*

*to read and [...] is significantly more effective than instruction that teaches little or no phonics"* (National Early Literacy Panel, 2008, p. 9). This report, however, has received some critical attention. Hammill and Swanson (2006), for example, argue that the report is one-sided and phonics is not more effective than other methods in learning to reading. Educators, they claim, should focus on comprehension and decoding such as whole word instruction, recognizing words as whole units (Hammill & Swanson, 2006). Yet it is generally agreed that phonics instruction is an important part of mastering the reading process (Hattie, 2009). Based on a two year longitudinal study by Muter et al. (2004), among 90 English speakers range 4 years 2 months to 5 years 2 months, there are only two predictors of reading skills during the second year of school: the ability to manipulate phonemes in spoken words and letter knowledge. However, reading comprehension was predicted by prior word recognition skills, vocabulary knowledge and grammatical skills (Muter, Hulme, Snowling, & Stevenson, 2004).

These results are also replicated in studies on the effect of phonological awareness in pre-school children with and without a risk of dyslexia, i.e., children with a parent with dyslexia (Elbro & Petersen, 2004), and in students learning a second language (Masoura & Gathercole, 2005). In fact, although intrinsic motivation has shown to be important in reading competencies, especially in secondary school (Miyamoto, Pfost, & Artelt, 2017) and self-regulatory behavior has a substantial positive effect on academic achievement (Edossa, Schroeders, Weinert, & Artelt, 2018), previous research has argued that phonological awareness is one of most important factor in a child´s success in reading and can yield positive outcomes later in school (NICHD, 2000).

Although most children are aware that there is a relationship between print and speech before entering school, in a diglossia the inner spoken language and the written word differ. Until recently it remained unclear how this inner voice reflected phonological awareness in dialect speakers while reading. For example, for children who do not read aloud, is their

inner voice in dialect or in the standard language? To answer this question, Filik and Barber (2011), compared the reading behavior of British English speaking adults to discover if their reading behavior mismatched or matched with their expectation of rhyme. Then they recorded the eye movement of the participants while reading limericks. The eye movement of the readers indicated if the words rhymed or not (as it reevaluated the rhyme pattern). Their experiment indicated that depending on the individual's regional accent, the end of the words in the limerick rhymed or did not rhyme (Ashby, Bontrager, Dey, & Archer, 2013; Filik & Barber, 2011). How this mismatch of speech and print affects children, however, is unclear.

Since phonological awareness skills are so important in achieving literacy, several phonological awareness intervention programs have also been implemented within a classroom setting. These intervention programs ranged from two and a half months, to an entire academic school year:

In a 10-week intervention program for preschool children, phonological awareness material was adapted to the individual teaching curriculum of the class teacher for implementation. The material included a reading component (top-down) and bottom-up activities such as segmentation, rhyme identification and generation of initial sounds. This intervention showed short-term improvements by the students (McIntosh, Crosbie, Holm, Dodd, & Thomas, 2007). However, follow-up study by Henning et al. in 2009, two years later, showed no sustained improvement due to the intervention (Henning, McIntosh, Arnott, & Dodd, 2010).

Phonological intervention programs (Table 4) have also been implemented within a classroom setting with "non-typical learners". In a study comparing the performance of three groups of mixed ability kindergarten classes for approximately 20 weeks, 15 minutes, three days a week: Group 1 had phonological awareness training only with their classroom teacher; group 2 had phonological awareness training with their class teacher and a student peer in a program called PALS and

group 3 was the control group. In the PALS group academically stronger students, "the Coaches", were paired with a peer and assisted them in a one to one setting in learning the letters in the alphabet, sight words and simple sentences; for example, the Coach would ask the student: "What sound?" and then model the correct answer; for example: "This sound is [letter sound]. What sound?" In this study, special needs students in the phonological awareness group and PALS group (group 2) outperformed the students in the other two groups (group 1 and group 3) (Fuchs et al., 2002). Unexpectedly, however, the group that received only phonological awareness training with their teacher (group 1) attained comparable results to the control group whose program was composed of mostly whole word methods. The long-term effects of the intervention were not evaluated and neither were the effects of the program on "the Coaches".

Justice et al. (2010) conducted a 30-week intervention, twice a week for approximately 20 minutes per day for preschool children. Their intervention combined teacher-directed instructions with explicit skills focus. The teachers in the program received lesson plans with objectives, materials and activities, and were also given suggested language for instruction. As in the McIntosh et al. (2007), this intervention also included a reading component (Justice et al., 2010). In this intervention, students improved both measures of language (i.e., grammar and vocabulary) and measures of literacy (i.e., rhyme, alliteration) immediately after the completion of the program, but there were no sustained improvements in the children´s performance.

In a yearlong classroom intervention in the UK, for preschool children, Shapiro et al. (2008) included intense periodic phonological awareness program focusing on four phonemic skills (bottom-up) and a reading component (top-down). The phonemic skills practiced: synthesis, phoneme segmentation, phonic skills, and vocabulary reading, were implemented for two minutes each. At the end of the session, the classroom teachers read a story to their class. The intervention took 12 minutes a day, three times a day, an entire year, and replaced a part of the regular

class curriculum. Training was conducted both individually with the teacher and as a whole class. This intervention showed significant immediate and sustained effects on reading development for students with poor phonological awareness, and typical learners, more so three months after the intervention was completed than immediately after the intervention (Shapiro & Solity, 2008). These results supported the claim that immediate recall of the phonological segments that have already been encountered and are stored in the long-term memory (Alloway, 2005; Masoura & Gathercole, 2005), new language information, both in native and foreign language, becomes increasingly easier to build upon (Masoura & Gathercole, 2005).

Although Hatcher et al. (2004) showed that additional phonological awareness training is unnecessary for typically developed students (Hatcher, Hulme, & Snowling, 2004), in a meta-analysis by the UK National Reading Panel Report (Torgerson, Brooks, & Hall, 2006) it was concluded that phonological awareness training can be beneficial to all learners. Only four out of the 14 studies, however, included typical learners, and all of these were either after school programs or small group interventions (Shapiro & Solity, 2008). The National Reading Panel Report also argued that phonological training benefitted "*young children who were at risk of failure, young children who were progressing normally, and children who were older and learning disabled. Instruction led to higher phonemic awareness for all three groups, but the younger children benefited most. It appears that phonemic awareness is best taught in kindergarten and first grade.*" Due to these findings, the panel suggested *"From these data, it would seem wise to ensure that 14–18 hours of phonemic awareness teaching be provided to young children (approximately 15 minutes per day for a semester of kindergarten)"* (Shanahan, 2005, p. 8).

In summary, the duration of a phonological awareness training program impacts its effectiveness. The longer the program runs, the likelier it is to have a sustained effect on the pupils.

**Table 4.** Phonological Awareness Sample Tasks

| | |
|---|---|
| Clapping syllables | Identifying rhyming words |
| Identifying initial or end sounds | Tracking words in a sentence |
| Responding to alliterations | Blending sounds |

### Stage Two: Fluency and Vocabulary

The Council for Learning Difficulties defines fluency as *"the ability to read connected text quickly, accurately, and with expression. In doing so, there is no noticeable cognitive effort that is associated with decoding the words on the page"* (Rasplica & Cummings, 2013, para. 1). As readers gain fluency they can reroute read vocabulary through a phonological process whereby they decipher the word through the individual phonemes or visually; through orthographic representations in the memory store (Gillon, 2000), or through a visual-phonological route (Ehri, 1992) in which both orthographic representation and phonemic awareness work together in order to read and understand a word. As a result vocabulary starts to expand through sustained, repeated contact with written material.

However, not all children are in a position to increase their vocabulary in this manner. Fortunately, vocabulary can grow (albeit less rapidly) through conversation and instruction. Whereas reading is implicit and top-down, language instruction is explicit and bottom-up. Most children receive implicit input in a family setting, which is why children come to school able to express themselves verbally. However the level of implicit input varies and not all children respond equally to explicit input or instruction.

Children start school with a substantial difference in their understanding and use of words (Roulstone, Law, Rush, Clegg, & Peters, 2011). Biemiller and Slonim suggest that this is due to life situations rather than intellectual ability and recommend more should be done to improve vocabulary acquisition (Biemiller & Slonim, 2001).

Therefore, many advocated a three tier system to decide which words to teach at each elementary school level: Tier 1 involves basic words, those acquired at home and casual settings; Tier 2 are high frequency words that are more likely to appear in a variety of texts, such as "coincidence" or "merchant" and Tier 3 are those which are special to one topic and are infrequently used (Beck, McKeown, & Kucan, 2002; Beck, McKeown, & Kucan, 2008; Weinert, 2016). Since many Tier 1 words are used at home setting, (i.e., baby, mother, pot, pan) these words are more likely to already exist in long-term memory when a child enters school, as they were used by a caregiver/parent. Tier 3 words have to be explicitly taught, or repeated more often, in order to be transported from phonological WM into LTM. There is, however, little academic expectation that children entering school know Tier 3 words as these words appear in text rarely.

Obviously, depending on the language spoken at home, knowledge of Tier 1, Tier 2 and T2 words actively used differ (Schuth, Köhne, & Weinert, 2017). Also, the positive effect of high quality caregiver/parent—child instruction has been numerously documented in its importance in the development of a child´s vocabulary and is indisputable in its effect (Cabell, Justice, McGinty, DeCoster, & Forston, 2015; Mashburn et al., 2008). At the same time, the quality and quantity of literature read by parents and children can promote vocabulary skills too (Deckner, Adamson, & Bakeman, 2006).

As mentioned previously, vocabulary knowledge can also improve through reading. Based on Barry´s dual route theory, there are two main

cognitive routes in which phonological awareness can improve through reading (Barry, 1994):

- Phonological route: unknown words are assembled phonologically. In this route, words are assembled by the phonological knowledge of the phoneme-grapheme relationship. Awareness in phoneme-grapheme relationship can then be perceived when students can read words that they are not familiar with.
- Lexical route: retrieval of whole words from a stored orthographic representation from long-term memory. In this case, the individual phonemes are irrelevant for creating the word.

Skilled readers use both routes to access meaning from printed word (Gillon, 2000), and through repeated readings, fluency will improve (Logan, 1997). *"Through repetitive reading of passages, students decrease their decoding time which allows the additional time to be focused on finding meaning in what they are reading. As students become more fluent in their repetitive reading of passages, subsequent passages of equal or greater difficulty became easier"* (Martin, Elfreth, & Feng, 2014, para. 5). This indicates that the efficiency of decoding new information into long-term memory is increasing and can be used to help acquire information processed in phonological WM, leaving more time to analyze and interpret words, sentences and/or longer texts. The logical question then arises how to improve vocabulary knowledge if a child is not yet a fluent reader (or does not read often) and/or does not have access to a large vocabulary in his or her social environment? For children with weaker memories, implicit language instruction through storybooks with target words has shown to help extend vocabulary depth in kindergarten children (Damhuis, Segers, & Verhoeven, 2014).

To gain fluency, new readers often use overt inner speech: lip movement with either no sound or by whispering. Parents or teachers may use

scaffolding to help a child initiate the reading process with more difficult words, keying the child to the correct phonemic representations (Pentimonti & Justice, 2010). Phonetic representations in a transparent language, like German, are easier to learn than in an opaque language, as there is a one-to-one representation of phoneme to sound (Seymour, Aro, & Erskine, 2003).

The elaboration of the dual-route theory of reading aloud by Coltheart, an extended version of that proposed by Seidenberg and McClelland (Seidenberg & McClelland, 1989) describes the mastery of reading aloud as a process in which print is first identified as either "regular" or "irregular" words. Regular words (i.e., cat, day) can be read through grapheme-phoneme correspondence rules, but irregular words (i.e., knife, right) violate these rules and have to go through a lexical route which is accessible through three systems: an orthographic lexicon, which represents knowledge of the spelling of the word; a phonological lexicon, which represents knowledge of the pronunciation of a word; and finally, a semantic system which stores information about the meaning of a word (Coltheart, 2006). In Switzerland, the "phonological lexicon" and the "semantic system" sometimes differ in pronunciation rules and vocabulary meanings from H. German.

In a study by Karpicke et al. (2016) two techniques to enhance learning were compared in primary school children (mean age of 10): Initially, all the students were given 24 words to study simultaneously. Then both groups received a list of category words but one group was given a list of completed words with category cues (fruit: banana) and the other group received the category cue and the stem word (fruit: ba_____). In the final stage, the students were asked to recall the words they were initially given. Results indicated that the retrieval method (the more challenging learning process) was more effective in learning vocabulary independent of initial reading comprehension abilities of the children (Karpicke, Blunt, & Smith, 2016).

The effectiveness of implicit and explicit instruction on the breadth and depth of vocabulary development of typically developed kindergarten children was also examined in a study by Damhuis et al. (2014). Implicit training involved reading in which each word was targeted in a storybook, shown in a picture and used in a sentence in which the word was defined through its characteristics. Explicit training involved the explanation of the targeted word through its defining characteristics, three sentences with the word used three times, and a picture of the word used. In their study, 48 children ages 5 to 7, were divided into four groups: two intervention groups and two control groups. One of the intervention groups initially received explicit training and the other initially received implicit training, a post-test was then conducted and then the explicit training group received implicit training and the implicit training group received explicit training. Intervention groups consisted of three to four children, and the intervention was conducted over four consecutive days per week for 10 to 15 min per intervention. The intervention lasted two weeks and a pre- and post-test was given. Two weeks following the post-test, a retention evaluation was conducted. For short-term effect, both the explicit and the implicit interventions significantly improved the depth of children´s vocabulary, in comparison with the control group (Damhuis et al., 2014). For the long-term effects, there were no significant differences between the control and experiment groups.

Later, in an effort to study the effect of two specific explicit methods of vocabulary instruction, Henderson et al. (Henderson, Weighall, & Gaskell, 2013), studied the effect of vocabulary learning on 97 typically developed 5–9 year olds. In this study, Tier 3 scientific words were paired with a picture and a definition. Two groups were created for this study: the first group learned new words with semantic information, i.e., *"A gadfly is a fly that annoys a cow"* (Henderson et al., 2013, p. 590), the other with orthographic information *"Gadfly begins with the letter G"* (Henderson et al., 2013, p. 590). Children were tested immediately after the training, 24 hours later and 1 week later. There was no difference in

the recall effect between the two groups of children 24 hours after training; however, the semantic group recalled more words one week after training. Furthermore, the semantic group showed improvement in defining the words 24 hours later and even more so 1 week later. This study showed the importance of providing semantic information about a word when it is presented to the students. The effects of the program were not tested in the long-term.

A study by St. John et al. (2014) of 18 children, 5 to 6 years old, with English as an additional language or weak vocabulary, investigated the effect of a teacher implemented intervention program for the improvement of vocabulary. The intervention lasted 3–4 weeks and was implemented in small groups of six. The intervention involved various oral activities in which the teacher encouraged the students to talk about a specific word through various activities (rolling dice, question cards, prompt cards)—teaching word learning strategies. The study indicated significant differences between pre-intervention and post-intervention in words that were actively taught and words that were not taught, directly through the program with large effect sizes (St. John & Vance, 2014). These results indicate that even after a short, teacher led intervention, transfer effects of teaching via metacognitive techniques, could be effective in learning new words.

Since words can have ambiguous meanings, children also need to be taught tools to examine the different definitions a word might have. The studies described above employed teacher directed metalinguistic methods to learn or remember vocabulary (Table 5). Significant training effects were gained when explicit teaching and active learning took place. Although the studies showed short-term training effects, no long-term training effects were observed.

Since German is a transparent language, reading is phonological and dialect students should not have any specific difficulties acquiring fluen-

cy. However, as discussed in section one, Swiss German vocabulary is often different to standard German, especially on Tier 1 and 2 words (Appendix B).

**Table 5.** Vocabulary and Fluency Intervention Tasks

| Vocabulary | Fluency |
|---|---|
| Identifying root words | Repetitive reading |
| Definitions (semantic information) | |
| Metacognitive activities (questioning, inferring) | |

### Stage Three: Reading to Learn

There is usually a shift during the early years of schooling from decoding and word recognition to text comprehension. "Comprehension refers to the ability to go beyond words, to understand the ideas and the relationships between ideas conveyed in the text" (McNamara, 2007, preface xi) (and also within the sentence). Stronger students improve their vocabulary through reading in a much more substantial manner than weaker ones due to a quicker and more frequent exposure to new words (Duff, Tomblin, & Catts, 2015). However, reciprocally, it can also be difficult to comprehend the meaning of a sentence without understanding a key word that is used in it.

There are three common models in reading research: Bottom-up models begin on the letter level and eventually develop to the sentence and finally to the text level. The more automatic the reading is, the more cognitive resources can be directed to comprehension (Samuels, 1994/ 2004). The top-down view states that the reader automatically brings their own experiences to the reading, trying to make sense and interpret as they read (Smith, 2004). The third reading model is the interactive view. According to this model, the reader provides input and uses information from the text for comprehension. In this model, the reader "interacts" with the text (Rumelhart, 1994/ 2004).

In 1974, LaBerge and Samuels showed that a lack of decoding frequency resulted in weak comprehension skills, as it always requires active attention (LaBerge & Samuels, 1974; Lyon, 1995; Torgeson, Rashotte, & Alexander, 2001). If too much attention is devoted to decoding, they argued, not enough attention will be devoted to comprehension (LaBerge & Samuels, 1974). Reading comprehension programs typically involve training learning strategies such as reflecting, predicting, using prior knowledge and pictorial clues, inferential thinking and summarizing (Suggate, 2010). These, however, should not be confused with metacognitive strategies which are more concerned with the *whys* of reading comprehension—why a strategy has been chosen (Varga, 2017).

As a child progresses from single words reading to short sentence reading and finally to longer sentences and texts, there are some texts which are easier to understand, and others which are more difficult. This might be due to the complexity of ideas presented, vocabulary used and/or the sentence and text structure. Phonologically overlapping sentences are more difficult to comprehend and take more time to read than those that do not overlap (Acheson & MacDonald, 2011; Frisson, Koole, Hughes, Olson, & Wheeldon, 2014). For example: "She sells seashells by the sea-shore" is more difficult to understand than "She bought shellfish at the store" (Samoff, 2014). While testing comprehension skills, the influence of silently reading phonologically similar words in a sentence affects the rate and accuracy of processing the sentence. In fact, when reading tongue twisters silently, both WM and internal articulatory system twist the tongue and brain, especially the Broca region (Keller, Carpenter, & Just, 2003).

In an attempt to use peer metalinguistic teaching techniques to improve reading comprehension skills, Yuill paired children ages 7 to 9 with weak reading comprehension skills, with children with stronger reading comprehension skills of the same age group. During the paired session, the students discussed in three 20-minute sessions riddles based on ambiguous meanings, i.e., *"How do you make a sausage roll? Push it*

*down a hill"* (Yuill, 2009, p. 78). Results showed that children who participated in the metalinguistic sessions, reflecting on the content, performed significantly better than those who did not.

Zipke et al. (Zipke, Ehri, & Cairns, 2009; Zipke 2011) studied the effect of teaching explicit metalinguistic skills, through an instructor, to first to third graders (8–9 year olds) and then to first graders (6–7 year olds) through the use of homonyms and riddles. In each of these programs, children were encouraged to use top-down strategies to understand the multiple meanings of words, such as *"One way to determine if a word is a homonym is to ask yourself, 'Is it something I can do?' and 'Is it a thing?' For example, you can* ***watch*** *television, and a* ***watch*** *is a thing you wear on your wrist. So watch has two meanings"* (Zipke, 2011, p. 358). In the first grade group (Zipke, 2011), individual students had two sessions, each of 30 minutes. In the third grade study (Zipke et al., 2009), students had four sessions, over a four-week period, and each session lasted 30 to 45 minutes. Immediate post-tests for both age groups showed a significant difference between the treatment and the control group´s sensitivity in identifying ambiguous sentences, for the 8–9 year old age group, and in the 6–7 year old age group a significant difference in metalinguistic awareness (Zipke, 2011). The studys´ findings indicate that metalinguistics skills can be taught successfully, in a short intensive program and with short-term improvements.

In summary, the importance of individual meanings of words within a sentence is paramount in understanding the ideas intended by the author. Short, intensive metalinguistic training programs have shown significant improvements on students´ performance, immediately after intervention.

#### 2.4.2.2 Writing Competencies

Orthographic knowledge consists of information that is stored in the memory that tells us how to represent spoken language in written form.

This can be a conscious or unconscious awareness to the form of the word. In languages that exhibit consistent orthographies, such as Finnish, German, Dutch, and Norwegian, phonological awareness is more important at an earlier age when children are learning to read than in languages that are not as transparent such as English, Korean, and Hungarian, because reading skills improve faster in transparent languages (Torppa et al., 2016).

There is a strong correlation between word-reading and writing performances, as they develop together and they require knowledge of the same source. However, writing is a more complex process, as it requires that the writer produce multiple letter combinations and sequences (Ehri, 2000). In a further publication, she elaborates:

> *Orthographic mapping occurs when, in the course of reading specific words, readers form connections between written units, either single graphemes or larger spelling patterns, and spoken units, either phonemes, syllables or morphemes. These connections are retained in memory along with meanings and enable readers to recognize the words by sight. An important consequence of orthographic mapping is that the spellings of words enter memory and influence vocabulary learning, the processing of phonological constituents in words, and phonological memory* (Ehri, 2013, p. 5).

The Dual Route Model of spelling (DRM) predicts that speech and sound production are associated with spelling. This system proposes that spelling occurs through two distinct but interactive loops: the phonological loop and the orthographic (or visual) loop (Ellis, 1993). As early as 6 years 9 months, inaccurate speech output is predictive of spelling difficulties (Nathan, Stackhouse, Goulandris, & Snowling, 2004). Overby et al. (2015) studied and analyzed the relationship between the types of speech sound errors of 250 children in kindergarten with their spelling accuracy in 3rd grade. Findings indicated, on the one hand, that children with the weakest speech accuracy also produced spelling with less lin-

guistic knowledge than other levels. These "weaker" students made more orthographic errors than phonological spelling errors. On the other hand, children at the top 98-percentile articulation accuracy outperformed all the other children in spelling accuracy and in the number of correct and legal spelling patterns (Overby, Masterson, & Preston, 2015).

To test the effect of speaking dialect on the type of spelling error, Treiman and Bowman (2015) compared the spelling of first grade dialect speakers and standard American English speakers. In the one experiment, they investigated the use of the final /d/ in a word as it is devoiced in spoken African American dialect. When comparing the spelling of words that ended in /d/, standard speakers were significantly more likely to spell the /d/ in words than children who spoke dialect. In another experiment, Treiman and Bowman (2015) investigated with the same group of first graders the spelling of words whose final consonant was pronounced the same in way in standard language and dialect. In this experiment they did not find more errors in the dialect speakers than in the standard speakers. Therefore, devoicing of the letter /d/, created linguistic interference in spelling (Treiman & Bowman, 2015).

Pre-school children with better literacy skills use inner speech to help them during the spelling process, a form of internal scaffolding (Aram, Abiri, & Elad, 2014; Vygotski & Cole, 1978). In their study, Aram et al. (2014), videotaped preschool children, ages 4 to 6 years old, while writing a series of words in Hebrew. The recordings showed that most children had a tendency to use phonological units while using private speech (syllable/sub-syllable/phoneme). Data indicated that internal regulations such as private speech predict children´s early spelling level. In fact, their results show that most of the variance in spelling can be predicted by internal measures: phonological awareness, early literacy, private speech and behavior regulations.

Inner speech uses a similar mechanism as overt speech and errors occur from planning of speech rather than its articulatory implementation.

However, inner slips are less sensitive to phonemic similarity when there is no mouthing (Dell & Oppenheim, 2015). Therefore, a mouthing component might be beneficial in a language program which intends to increase the sensitivity to differences between dialect that a child is accustomed to thinking in, and the high form of the language used to write.

In a study of 59 Dutch speaking children, mean age of 10 years 4 months, processing an average spelling delay of two years, while using scaffolding, or artificial pronunciation (for example, the German word, Bahn (rail) pronounced as /bahan/ rather than standard pronunciation /ba:n/) in a computer training program, did not retain spelling patterns more effectively than children who only memorized the spelling of the words (Hilte, Bos, & Reitsma, 2005). In this study, the computer program, and not the child, generated the artificial pronunciation. Rather, the child indicated through a press of a button when he or she was ready to reproduce the spelling word that was pronounced by the computer.

German, however, is phonemic and a highly transparent language. Spelling is mostly straightforward. For example, hearing if a vowel length is short or long is an indication of the word´s spelling: Vowels of short duration are followed by two consonants. Instead of doubling the graphemes z and k, tz and ck are followed by short vowels; long vowels are either followed by doubled vowel or a "silent h" is followed by the grapheme (Thaler, Landerl, & Reitma, 2008). Hence, it makes sense that dyslexia is less common in German than it is in less phonologically consistent languages, such as English (Wimmer, 1996; Wimmer & Goswami, 1994). Therefore, sensitizing students to the correct pronunciations of German, might improve spelling.

In German-speaking primary school children with developmental dyslexia, phonological and auditory discrimination of vowel length is impaired (Steinbrink, Klatte, & Lachmann, 2014). In their study, Steinbrink, Klatt and Lachmann used a vowel length discrimination task to

determine the phonological, temporal (length of vowel) and spectral quality of processing in 19- 8 to 10 year old dyslexic children. Half of the children in this study showed deficits in three aspects of vowel length processing. Being able to discriminate vowel length is important in German as it helps determine the spelling of a word: single consonant follows a long vowel, vowels are usually long if they are written as a double letter, a vowel is long if it is followed by a silent ´h´; letters ´ie´ represent a long ´ i´ and ´ei´ represent a long ´e´ sound; an unstressed vowel at the end of a word is usually long, unless it´s an ´e´(Table 6).

**Table 6.** German Vowels

| Rule[1] | Example |
|---|---|
| Vowel followed by a single consonant is long | Rad (wheel), rot (red) |
| Vowel followed by a double consonant, or two different consonants, is short | Bett (bed), Rest (rest) |
| Double letter vowels are long | Meer (sea), Boot (boat) |
| Vowels followed by a silent ´h´ are long | Lehrer (teacher), Fahrer (driver) |
| Letters ´ie´ represent long ´i´ sound | Spiel (game), vier (four) |
| Letters ´ei´ represent long ´e´ sound | Leib (body), Scheidung (divorce) |
| Unstressed vowel at the end of a word is long | Lotto (lottery), Lama (lama) |

[1]There are exceptions to these rules

To assist children in deciphering between long and short vowel sounds, Michele (2013) developed a "syllable training" program for the German language (Michele, 2013). This training helps students spell words phonologically by identifying types of syllable combinations within a word. Although this training technique is very popular, its effects are controversial (Brinkmann & Brügelmann, 2014). A study of 256 typically developed children in Grade 4 concluded that syllable training was not more effective than another program (not syllable based) in improving children´s spelling. However, children who had this type of training were

more aware of double consonants in words than those who were not taught using the syllable method (Weinhold, 2010).

Less controversial are visual spelling patterns. These should be used to assist in spelling as they have been consistently shown to be helpful for all children (Gillon, 2000; Hilte et al., 2005). Gillon (2000, p. 34) recommends that during spelling activities in the classroom students should learn to be aware of the structure and sounds of the word, by:

1. Articulating the word.
2. Listening to the sounds in the word
3. Identifying the initial and final sounds in the word
4. Observing the visual aspects of the world, integrating phonological and orthographic information

Based on empirical evidence, these four concrete suggestions were given for learning and teaching spelling in a German context. Brinkmann and Brügelmann (Brinkmann & Brügelmann, 2014, p. 7, translated from the original) have argued:

1. When writing an unknown word, explicit rules provide only exceptionally reliable decision-making aids. Knowledge of rules of thumb can, however, keep error probability low.
2. To a large extent, orthographic competence is based on implicit pattern formation. Spelling conventions are suitable for children through an independent rule formation, which can be stimulated and supported by appropriate instruction.
3. Select and concentrate on exercises with particularly frequent words that are supplemented by a class vocabulary. This is particularly important for strengthening the knowledge of words and the readability of the spelling in a core area, offering models for work focusing on spelling (for the writing of an unknown word, give explicit exceptions and secure decision-making aids).

However, the knowledge of rules of thumb can keep the error probability low.

4. Observation of the syllable structure helps in the initial phase of learning to focus attention on the loudness of words. Syllabic analytical approaches can make teachers focus on more sporadic spelling particularities such as stretching and sharpening vowel sounds, but can be complicated for many children. To a large extent, orthographic competence is based on implicit pattern formulation.

Overby et al. (2015), recommends that classroom activities should focus on teaching spelling patterns to assist in preventing orthographically plausible error patterns on a word-specific treatment level.

> *Activities, such as backward spelling or describing the number of vowel letters, consonant letters, and so on, that direct the child's attention to the specific ways individual words are spelled are beneficial to address this skill. It is important to note that such techniques are used only after ensuring that the requisite phonological, orthographic, and morphological knowledge are in place"* (Overby et al., 2015, p. 1665).

These activities help students become more aware of the letter patterns and develop techniques to spell correctly and create stronger connections to correct long-term phonological memories.

In an extensive meta-analysis of the effect of teaching English spelling, 53 studies were evaluated in their significance at improving spelling skills in students. This comparison, in line with Hattie (2009), indicated that programs that are long-term and employ explicit instructions for spelling and/or direct feedback of misspelled words were most likely to improve the spelling abilities of children regardless of age, level or literacy skills (Graham & Santangelo, 2014).

**Grammar**

Although the use of correct grammatical forms in standard language are important in both written and oral competencies, in dialect-speaking children standard grammar has a more significant role in writing than in oral language.

There are three main approaches in treating children with grammatical deficiencies: implicit, explicit, and a combination of explicit and implicit approaches (Ebbels, 2014). These address *"[the] amount of grammar knowledge the pupil brings to school or develops from classroom activities or their own intuitive knowledge about language"* (Milian, 2015, p. 45).

Implicit approaches are mostly used in early primary education for children with expressive language difficulties. The most common implicit language teaching methods are imitation, modeling or focused stimulation and recasting. Reflecting and using grammar—a metalinguistic competence, is a *"key point"* in grammar education (Milian, 2015, p. 48). Explicit approaches, on the other hand, involve explicit teaching of grammar rules, often with visual cues, textbooks and worksheets. Milian, referring to Catalonia, states:

> *[...] one cannot refer to implicit knowledge of the first language as one can in a more monolingual context, but must take into account that in the learner´s implicit grammar one can find a certain amount of knowledge referring to the first language but also an implicit rudimentary knowledge concerning the second language, and also an implicit knowledge built out of the relationship the speaker establishes between both languages in use* (Milian, 2015, p. 51).

Similarly, one can also argue the case of dialect speakers learning standard language: When the spoken language does not correspond to the written language, it is useful to discuss the differences between the spoken and written form of the language, and *"encourage mutual interac-*

*tion between grammatical and discursive knowledge and learning to use the language(s)"* (Milian, 2015, p. 53). But grammar lessons on their own include not only learning rules but also how to manipulate features of a word within a group of words that combine to make a meaningful sentence. In German, words are declined or conjugated depending on their meaning and grammatical position within the sentence.

Actual intervention programs employing both explicit and implicit grammar learning, through the use of a metalinguistic approach have not been empirically studied in Swiss German Switzerland in the past 20 years. Most grammar intervention programs in school-aged children are with children with primary language impairments or children learning a second language (e.g. Francey & Cain, 2015; Green, & Klecan-Aker, 2012; Van Lommel, Laenen, & d'Ydewalle, 2006; Wiechmann, Richardson, & Jones, 2014). These programs emphasize predominately explicit language methods, but they employ implicit language instruction too and indicate the importance of morphological awareness in reading comprehension, reading vocabulary and spelling (Ebbels, 2014; Nagy, Berninger, & Abbott, 2006).

For example, in a study by Motsch and Riehemann (2008), the effects of an intervention program within a classroom setting in Germany were studied. The program implemented was called "Context Optimization" and it focused on grammatical cases by grammar facilitation, metalinguistic approaches and writing. Four hundred seventy eight 8 to 10 year old students participated in this 12- hour intervention study: average of 17 minutes, 4 times a week. Results indicated positive effects for the intervention group and it highlighted the fact that the accusative case in German was easier to learn than the dative case. Comments by teachers, video analysis and written documentations indicated sound factor, distractions in the class, incorrect usage of cases by heard and imputed by students and confusion between content changing subject as obstacles to this program (Motsch & Riehemann, 2008). The sustainable effect of the program was not investigated.

Sentence focused treatment is important in treating children with difficulties acquiring tense and agreement properties in sentence structure (Oetting & Hadley, 2009) among children with migration backgrounds (Kotzerke, Ebert, & Weinert, 2014), as teachers tend to use similar grammatical schemes in their communication during class time and students become accustomed to them. Hadley et al. (2014) proposed a sentence-focused framework, which emphasizes that the sentence is the basic unit of grammar, since tense and grammatical agreement are properties of sentences and not words (Hadley, Nippold, & Hoffman, 2014). They continue to argue that *"intervention activities that focus on sentence diversity will simultaneously create more diverse opportunities for use of T/A [tense and agreement] morphemes across different verbs and grammatical subjects"* (Hadley et al., 2014, p. 111), enabling students to build upon different types of grammatical schemes.

In summary, studies in both the English- and German- speaking world, suggest that the active use of the language by the students and an increasing confrontation with demanding formulations in written texts and spoken language of instruction will promote an understanding of grammatical structures (e.g. Hadley et al., 2014; Kotzerke et al., 2014).

## 2.5 Sprachspezifisches Hirnfunktionstraining

Among the plethora of individualized and small group intervention programs, *Sprachspezifisches Hirnfunktionstraining (SH-* Language Specific Cognitive Functions Training; Gruner & Kirchhofer, 1997), is unique in the way it is administered and its widespread effects. SH was first developed by Gruner in 1975 for the University of Zurich Language Pathology department to improve reading and writing performance of otherwise healthy children and adults with severe reading and writing disabilities (i.e. dyslexia, dysgraphia). Most of these patients were referred to the hospital for more specific and intense treatment than could be provided by local speech therapists.

An important—perhaps the most important—aspect of an intervention program, is its accessibility. Since the speech and language pathology department at the university clinic is located in Zurich and is well-known for its speech and language pathology department, some children with learning difficulties used to have to endure a long waiting time for an appointment or a potential three hour trip to the clinic (Gruner Interview, 2013).

SH was developed as an "export" product enabling children to get treatment immediately and without the inconvenience of traveling far. The treatment is conducted in a one-to-one setting without a specialist's help. (Although the program can be also administered to adults, it was mainly aimed at improving children´s oral and written language competencies, as a parent or guardian is required to support the implementation of the program.) After beginning the program, an evaluation of the patient´s progress was periodically done at the university.

The program consists of nine steps which are applied to a sentence from a text appropriate to the child´s age and ability and consists of a predetermined number of words based on the child´s ability:

**Sprachspezifisches Hirnfunktionstraining (Gruner & Kirchhofer, 1997)**

1. The sentence should be very clearly articulated and the meaning and structure discussed.
2. The child should repeat the sentence from memory until s/he can do so perfectly from memory, unassisted.
3. The child should use overt inner speech to say the memorized sentence.
4. The child should use inner speech to repeat the sentence while showing a finger for each word heard in inner speech.
5. The child should repeat the sentence loudly.

6. The child should write the memorized sentence while using overt speech.
7. The child should correct the written sentence, word for word. Incorrectly spelled words should be rewritten correctly.
8. The child should discuss individual misspelled words with the parent or guardian.
9. The child should rewrite the sentence, repeating steps six to eight until the sentence is written without any mistakes.

Numerous studies have demonstrated that most deficits in written and oral language among healthy children occur due to the inability to retain and recall memories from verbal WM and LTM, produce and perceive speech and access lexical representations (e.g. Ehri, 2000; Gathercole, 2006; Gruner & Kirchhofer, 2005). SH attempts to restructure and strengthen neural pathways in the brain. These short meaningful sentences are thus anchored into lexical memory through non-vocal inner speech, overt inner speech and vocal speech, strengthening the phonological loop and orthographic loop, improving language acquisition aptitude (Gruner & Kirchhofer, 2005). Through specific and goal oriented discussions of the six components of language, students should become more aware of the specific use of different aspects of language. Sometimes, 2–4 months of this program sufficed to correct the child´s problems enough so that no intensive intervention programs at the speech and language pathology department at the hospital was required (Gruner Interview, 2013).

**Summary**

Dialect-speaking Switzerland is a diglossia since two forms of the same language are used by the same community of speakers. During all informal situations, and even during some formal situations, such as town halls, parent-teacher meetings and interviews, Swiss German people speak dialect. However, in formal written situations (school, work, emails, etc.) Swiss German speakers use standard German. In the use of standard German, reading and writing have shown to have overlapping

areas of activity in the brain (e.g. Pugh et al., 2006), yet they require different types of abilities: Reading, especially in a transparent language, such as German, is phonologically based and is directly correlated to the ability to recognize the sound-letter representation. Writing, on the other hand, requires subvocal production and repetition of linguistic units that are stored in the memory. Therefore, in a diglossia linguistic information stored in memory cannot simply be transcribed from long-term memory; rather, it needs to be held in memory and translated into new linguistic units that are used in the written language.

A large and growing body of literature has investigated working memory and its importance in language aptitude. Based on the research, working memory is a complex system in which the phonological store (responsible for sound and phonological association) is linked to the central executive of the working memory (Baddeley, 2003). The phonological loop and the visuospatial loop of the working memory deal with sound, phonological association and visual information, and are overseen by the central executive. The central executive is responsible for selecting and monitoring behavior, also through a set of cognitive process that include attention and concentration. To date, however, research has not been successful in showing a direct transfer of ability on academic performance through working memory training; therefore, questions have been raised whether the central executive of the working memory can be improved and whether this improvement can be transferred into academic performance. Consequently, it has been suggested that an additional cognitive, self-regulatory, component needs to be identified.

This cognitive, self-regulatory component could be an ability to analyze and manipulate linguistic code independent of its meaning—a metalinguistic ability to shift easily between formal (standard) language and informal language (dialect), what is hypothesized in linguistic studies as the linguistic awareness/ flexibility hypothesis (Roth & Speece, 1996; Terry, 2014; Terry & Connor, 2010). To date, research has shown that students can be taught metalinguistic skills. Results have also indicated correlations between metalinguistic skills and academic achievement,

especially among non-typically developed children and second language learners.

Based on the research above, and by comparing both oral and written language-oriented interventions, programs that mostly involved individuals or small groups and combined explicit active learning techniques were most effective. These interventions involved actively cueing working and long-term memory and were more effective than passive interventions, especially immediately after intervention. Effective oral and written language intervention programs engaged students in the learning process through i.e., questioning methods, manipulation of words on a phonemic level, generation of sounds, and thus indicate that there exists a metalinguistic component when acquiring either oral language and/or written language (Table 7).

In Switzerland, an integrated training approach to language learning that simultaneously addresses the effects of a metalinguistic training on the seven components of literacy (prosody/ rhythmic prosodic component, phonology, morphology, syntax, lexicon/vocabulary, semantics and pragmatics) may be a promising method of improving the writing of diglossic children in a diglossia and add experimental data to experimental and theoretical hypotheses. In German-speaking Switzerland this self-regulatory component can be disentangled from attention and concentration and written linguistic abilities can be tested by examining its effects on written language which requires a shift from dialect to standard language. Since studies on the effects of working memory training on academic work are inconclusive at best, could an intervention program that focuses on cognitive awareness bridge the gap between the central executive and the phonological loop?

**Table 7.** Implicit v. Explicit Learning

| Implicit Learning | Explicit Learning |
|---|---|
| Intuitive | Learned |
| Unconscious | Conscious |
| Passively learned | Actively learned |
| Non reflective | Metacognitive |
| Less effort | More effort |

## 3 Research Questions and Hypotheses

Based on the state of the research described above, there was general agreement that individual reading and writing components can be improved through explicit and implicit methods, in both individuals and small groups. Likewise it has also been suggested that the central executive is important to academic achievement. Baddeley (Baddeley, 2003), suggested that attention and concentration are parts of the central executive of working memory and are responsible for regulating and coordinating information that will then pass to the phonological loop, which is linked to sound and phonological association. However, less is known about the relationship between the central executive and academic achievement. It has been suggested that this relationship might be facilitated through an additional cognitive component (Peng & Miller, 2016). In this thesis, this cognitive component is explored experimentally through a language acquisition training program.

To investigate the effect of this component, students were evaluated on their ability to place additional demands on executive functions—specifically attention and concentration—through a linguistic training program that links spoken language (inner and outer) with written language. This training program functioned similarly to the working memory non-computerized programs in which students were instructed to consciously hold information and manipulate it (Kyttälä et al., 2015; Röthlisberger et al., 2012). Dialect-speaking children were ideal candidates for this investigation since dialect-speaking children think in dialect (e.g. Ashby et al., 2013; Filik & Barber, 2011; Gatlin & Wanzek, 2015; Kohler et al., 2007; Patton-Terry & Connor, 2010; Treiman & Barry, 2000) and although their ability to switch from dialect to standard language can be made, it is a much more subtle switch than that in second/ or in additional-language learners. Consequently, if the assumptions that working memory and academic performance are linked through a cognitive component, (Peng & Miller, 2016) is true, then a language program which focuses on print-speech mismatch

through a metalinguistic component could link academic performance and the attention and concentration aspect of the central executive. Therefore, the aim of this thesis was to examine the effect of a metalinguistic language program on both linguistic markers associated with print-speech mismatch and on the central executive (specifically attention and concentration), in 3rd grade students in Swiss public school. In specific:

1. How would a metalinguistic training program impact linguistic markers related to print-speech mismatch in dialect-speaking 3rd grade children?

    a. Would the program impact vocabulary depth differently than vocabulary breadth? (morphological awareness/ lexical awareness)
    b. What impact would the program have on rhyme sensitivity? (prosody/ phonology)
    c. What impact would the program have on grammatical awareness? (morphology/ syntax)
    d. What impact would the program have on spelling? (phonology/ morphology)

2. How would a metalinguistic training program impact attention and concentration in dialect-speaking 3rd grade children?

Based on the empirical and theoretical findings described in the research section (see section 2.0), the following hypotheses were tested:

**Hypothesis One: Metalinguistic training will improve linguistic abilities involving print-speech mismatch.**

**Impact on Vocabulary**

*If dialect-speaking students are required to represent, retrieve and process, the different lexical meanings used in H. German words, the ex-*

*pectation is that a linguistic cognitive training will allow them to compensate for the disconnect between what they hear (dialect) and what they are required to speak (H. German). A prime example would be the ability to use their explicit knowledge of stems, prefixes and suffixes to change the meaning of words. However, if dialect-speaking students are required to select the meaning of a word from a set of words, a task involving only retrieving information, the expectation is that a linguistic cognitive training will not require that they compensate what they hear (dialect) and what they are required to speak (H. German).*

Anderson and Freebody (1981) made the distinction between vocabulary breadth and depth. According to them, vocabulary breadth refers to *"the number of words for which the person knows at least some of the significant aspects of meaning"* (Anderson & Freebody, 1981, p. 93), while vocabulary depth is *"the quality or depth of understanding"* (Anderson & Freebody, 1981, p. 93). Based on the research, through focused discussions with the teacher on the nature and meaning of commonly used words in standard language—Tier 1 and Tier 2 words—which are pronounced differently in dialect than in standard language and/or might have a different meaning or substituted with words in Swiss German dialect within a sentence structure (Appendix B), and through discussions of linguistic characteristics, such as prefixes, suffixes and roots, students would focus on the meaning of vocabulary through a heightened semantic and morphological awareness (Hammond, 2012; Henderson et al., 2013; Roulstone et al., 2011). Several studies have also indicated that through explicitly defining words, children improve vocabulary knowledge and can transfer it to unknown words, inducing deeper processing of meaning (Damhuis et al., 2014; Henderson et al., 2013; St. John & Vance, 2014). Additionally, vocabulary research has shown that the more words a child knows, the easier it would be for the child to acquire new words. In fact, vocabulary interventions have shown significant effects of moderate effect size on vocabulary acquisition of new words both in the short and longer term

(e.g. Damhuis et al., 2014; Hattie, 2009; Nation, 2001; Stahl, 2003; St. John & Vance, 2014).

Since dialect-speaking children have aural access to language but less active use, we expected non significant improvements in breadth of vocabulary on Tier 1 and Tier 2 words, but significant improvements in vocabulary depth in the intervention group in comparison to the control group due to a metalinguistic training program. Based on metalinguistic models, we expected vocabulary depth, the ability to represent, retrieve and process information, to increase as the students build upon their existing knowledge of Tier 1 and Tier 2 words. We expected that the ability to process and retrieve words would continuously improve also after the program ends, at a follow-up evaluation stage, since students in these grades read to know in standard German and this would reinforce the knowledge and awareness to language that was gained through the intervention.

**Impact on Rhyme Sensitivity**

*If dialect-speaking students are required to carefully articulate each sound of H. German individual syllables, focusing on intonation and rhythmic structure of the language both in their inner and outer language, the expectation is that this will allow them to compensate for the disconnect between what they normally hear (dialect) and what they are required to write (H. German). A prime example would be the careful articulation during inner-language would help dialect speakers distinguish and segment the different syllable sounds within a word.*

In dialect-speaking individuals, previous studies have indicated that there can exist a mismatch between inner language and orthographic representation of the printed word (e.g. Filik & Barber, 2011; Treiman and Bowman, 2015). Since standard German is a transparent language, if students are encouraged to read a sentence carefully out loud by articulating each sound in each word very precisely, reflecting on their linguistic knowledge through classroom discussions and by identifying

specific aspects of words (i.e., long and short vowel sounds; letter combinations; syllables), they would need to apply and reflect upon their phonological knowledge of standard German. By repeating the sentence correctly in overt and private inner language, students would become more aware of the use of their inner voice and its relationship to spoken standard German (Aro et al., 2015). Several studies have shown significant short-term effects in reading by increasing students´ awareness to the sounds that make up a word (e.g. Fuchs et al., 2002; McIntosh et al., 2007), but these promising results were not maintained in follow-up evaluations (e.g. Henning et al., 2010; Justice et al., 2010).

In studying the effects of a metalinguistic language intervention program, we expected that the group which was made aware of the differences between inner language and written language to perform significantly better on rhyme sensitivity tasks than a control group. Contrary to Shapiro and Solity (2008) study with preschool children, in our study we expected that improvement rates would not improve as much *after* the program, as *during* the program since students might neglect to recognize the differences between their inner reading language and written reading language after the program is completed (as it is not a topic that is normally discussed in class).

**Impact on Grammatical Awareness**

*If dialect-speaking students are required to carefully articulate each sound of H. German and are made aware of the different grammatical structures in H. German, the expectation is that this will allow them to compensate for the disconnect between what they normally hear (dialect) and what they are required to write (H. German). A prime example would be that the careful articulation would help dialect speakers distinguish the different grammatical cases in H. German, which they normally swallow in their speech.*

Students who speak Swiss dialect use different grammatical structures than those who speak standard German. In the German language one

needs to decide which word in a sentence needs to be inflected to represent grammatical categories—tense, case, person, gender, and articles, and these inflections change the spelling and pronunciation of a word. In Swiss German, the final letters of a word are often devoiced, the genitive case does not exist, and there is no simple past tense or past perfect. Also important to note is that grammar "rules" differ from those in German and the order of words within a sentence in Swiss German is more forgiving than in standard German. For example in the following comparison (See Appendix A, Daily Sentence, set 3):

| | |
|---|---|
| High German: | Klitzekleine Kinder können keinen Kirschkern knacken. |
| *Swiss German dialect:* | *Chlitzechlini Kinder chönnd kei kirschkern knacke.* |

If one neglects the changes in the spelling of the root word, one can also see that most of the endings of the words have changed, and these changes are seemingly random and grammatically highly complex.

Based on the literature review, the combination of written grammar exercises and use of correct oral grammar were part of a successful grammar intervention program (e.g. Hadley et al., 2014; Motsch and Riehemann, 2008; Oetting & Hadley, 2009;). Since teachers tend to use the same grammatical structures during instruction, repetition of preselected sentences for both oral and written use could be beneficial in developing an awareness to different sentence structures than are normally used in a classroom setting (Hadley et al., 2014). The clear articulation required in repeating a sentence carefully and then memorizing and repeating it in overt inner language, private inner language and in vocal language, and then discussing the sentence´s grammatical features while focusing on both the letter and word level, were hypothesised to strengthen the awareness of grammatical structures in standard oral language, and help speakers become aware of

the differences between inner dialect language and standard language, (e.g. Filik & Barber, 2011; Treiman and Bowman, 2015). Additionally, by writing sentences, correcting them, and paying attention to the individual syllables in each word, students were expected to monitor and reflect on their knowledge of standard language (Hadley et al., 2014; Kotzerke et al., 2014). Due to the short-term effects of most grammar-based interventions, we expected a stronger effect of the program directly after the training. However, since the required educational curriculum in both Swiss cantons (Bern Lehrplan, 1995; Lehrplan 21, n.d.; Solothurn Lehrplan, 2007), required the teaching of grammatical declinations and conjugations in the 4$^{th}$ grade, we predicted that the students´ linguistic awareness of grammatical forms in standard language would continuously grow after a metalinguistic intervention more so in an intervention group than in a control group due to the sensitization of grammatical forms of the language.

**Impact on Spelling**

*If dialect-speaking students are required to articulate and discuss the individual syllables of H. German, the expectation is that this will allow them to compensate for the disconnect between what they normally hear (dialect) and what they are required to write (H. German). A prime example would be the ability to distinguish between long and short vowel sounds in H. German, which in dialect is often rounded (i.e., lips are relaxed).*

Several studies have shown that during the early school years, children use their inner voice to spell words (Mann & Foy, 2003; Overby et al., 2015; Treiman & Bowman, 2015). Although some words are similar in dialect and standard, they are usually not pronounced in the same way. For example, take the word for Wednesday: ´Mittwuch´ in dialect and ´Mittwoch´ in standard (Table 8). These two words are only slightly different in pronunciation but one has to be aware that what is said is different than what is written.

**Table 8.** Days of the Week
A comparison between dialect and standard language

| English | Dialect | Standard German |
|---|---|---|
| Monday | Määntig | Montag |
| Tuesday | Ziischtig | Dienstag |
| Wednesday | Mittwuch | Mittwoch |
| Thursday | Dunschtig | Donnerstag |
| Friday | Friitig | Freitag |
| Saturday | Samschtig | Samstag |
| Sunday | Sunntig | Sonntag |

Spelling in a transparent language is mostly phonological. Research indicates that through correct articulation, careful listening, the identification of specific linguistic structures, observation of letter combinations and finally writing the word, students should become consciously aware of phonological and orthographic aspects that do not match in dialect and standard speech by developing a deeper understanding of the structure of the word. For example, through these recommendations students would be able to distinguish long and short vowel sounds within a word which clue the students to its correct spelling (e.g. Brinkmann & Brügelmann, 2014; Gillon, 2000; Hattie, 2009; Overby et al., 2015). In addition students who use mouthing are more likely to prevent inner slips (Dell & Oppenheim, 2015). A successful metalinguistic training intervention program would implement all the spelling recommendations in its spelling training within a classroom setting. We therefore expected the students who participated in metalinguistic intervention would improve their written spelling more significantly than a control group on words that are phonologically spelled as the students become more aware of the possible mismatch between their inner speech and the written language. After the intervention was completed, at a follow-up evaluation, we expected students to be more likely to make inner slips in pronunciation

of long and short vowels as they became less aware of inner speech articulation while working independently.

**Hypothesis Two: Metalinguistic training will improve attention and concentration.**

*If dialect-speaking students are required to actively hold, manipulate and evaluate linguistic information in the working memory, the expectation is that their ability to perform tasks that place additional demands on central executive will also improve attention and concentration.*

In multiple studies of the effects of computerized and non-computerized programs which place additional demands on the central executive, there were none that evaluated the effects of a language acquisition program on the central executive (Melby-Lervåg et al., 2013/ 2016; Peng & Miller, 2016; Randall & Tydesley, 2016). A language acquisition program could place additional demands on the central executive through linguistic activities and at the same time, affect processes in the phonological loop. The hope was that diglossic children´s phonological working memory would function in much the same way as bilingual children´s. Bilingual children outperformed monolinguals on tasks that require suppression, phonological working memory and cognitive judgment (Bialystok, 1986; Ebert & Weinert, 2013). However, unlike in bilingual children in which two distinct languages need to be distinguished, in dialect-speaking children, the two languages are similar and the difference between the two is more vague. Therefore, students in a diglossia would have to self-regulate their thinking process in order to determine if one needed to change a word/ sentence or keep the dialectic word/ sentence as is. If there existed a reciprocal relationship between attention and concentration, phonological working memory and cognitive judgment, we could reasonably expect that the children´s attention and concentration would also improve through a cognitive language-training program.

To sum up, children who speak a dialect at home and in their environment are less likely to hear and rehearse idiomatic phrases, correct pronunciation, complex grammar and the orally spoken vocabulary that a non-dialect speaker is exposed to daily, both in the community and at home. The reinforcement of correct language skills by the awareness of the seven components of literacy (Weinert, 2010) is important for developing a rich and powerful language base, especially in children who do not have the ingrained aptitude to acquire language. Through a targeted linguistic intervention, we expected children to self-regulate cognitive processes which place additional demands on working memory and help store linguistic information needed to establish the grounds for compatible print and speech schemes (Jalil & Liow, 2008; Mann & Foy, 2007; Liow & Lau, 2006).

# 4 Method

As described in Chapter 1, the purpose of this work was to evaluate the effects of a self-regulatory component on linguistic components affected by print-speech mismatch and the central executive through a language intervention training program in a classroom setting.

For the purpose of this study, third graders were chosen as developmental theory proposes that there is a developmental shift from "learning to read" to "reading to know" around the 4th school year (Chall, 1983). Based on the research in Chapter 2, a lexical and sentence based intervention program using a variety of metalinguistic activities would increase students´ awareness of the difference between dialect and standard language.

This chapter will explain how the participants were selected, the evolution of the classroom intervention program from the individual program, and how the impact of the program was assessed.

## 4.1 Design and Sample

The hypotheses were tested in two cantons from Northwestern Switzerland, Bern and Solothurn, due to their similar curricula, vacation plans, infrastructures, and dialects (Husy, 2009). A classroom design was then selected because the research was intended to add experimental everyday classroom data opposed to that drawn from a theoretical and controlled clinical setting.

To draw the sample, an article requesting teacher participants was placed in a teachers´ education magazine and letters were sent to schools in Canton Bern and Solothurn if: (1) they had two parallel 3rd grade classes which belonged to the same school and had one school principal, (2) the class teachers had met between once a week to once a

month to discuss work done in class, allowing us to assume the two teachers had similar learning programs and educational expectations, and (3) the teachers spoke standard German within the classroom and dialect outside the classroom. Since larger schools with parallel classes are mostly found in larger cities or suburbs, we assumed that there are no significant differences between the socio-demographic features between the classes of the groups.

Due to the difficulties encountered in recruiting teachers based on the three criteria given above, teachers were not randomly selected to the control or intervention group but were allowed to choose either to participate in the intervention program or in the control group. There were three situations which resulted in teacher recruitment: (1) individual teachers applied independently, (2) teachers were asked to apply by their school´s principal, or (3) the schoolhouse agreed to participate and teachers were randomly chosen to be part of the intervention or the control group. Both the intervention and the control group were told that this program aimed at improving children´s written language abilities and the attention and concentration of the students. In addition, teachers in the control group were requested to continue with their `usual´ literacy program. At the completion of the program, control teachers could request the materials that were given to the intervention group.

This quasi-experimental design included, N = 279 children from grade 3, in school year 2013/2014 from 8 schoolhouses and 16 school classes from two cantons. The sample consisted of two groups: (1) students who participated in the intervention program (referred to as "intervention group") and (2) students who did not participate in the intervention and continued with their ´usual´ lessons (referred to as the "control group"). The 140 students in the intervention group made up 50% of the children while the 139 students in the control group comprised the other 50%. At the start of the study, the average age of the children was 9.06 ($SD$ = .53); 137 (49%) of the children were female and 142 (51%) of the

children were male; 166 (60%) of the children spoke either Swiss German or German at home (a total of 4 or 1.4% of the students spoke German at home) and 113 (41%) spoke additional languages at home; 205 (73%) of the children were typical learners, 55 (20%) required additional academic assistance. In addition, 19 (7%) were attending additional German language classes during school time because they were new to Switzerland and did not speak Swiss German with their classmates.

Based on the literature review, there were two types of language intervention treatment time frames: short and long. Short intervention programs ranged from a day up to a few months and in general, tended to be less effective than long-term training programs (Damhuis et al., 2014; Henning et al., 2010; Justice et al., 2010), which lasted approximately one school year. However, since SH was administered between two and four months, we decided to implement the language program for three months, or approximately one academic term, to see how it affected the students´ performance.

Since SH took approximately 15 minutes to administer in a private setting, after several tries within a trial classroom, we determined that the program would take approximately 20 minutes within a classroom setting. Therefore, we decided to evaluate the children´s written abilities before beginning the program (pre-intervention) and after three months of intervention. The long-term effects of the program were then evaluated four months after the completion of the program, in October 2014, after the students´ summer vacation and promotion to 4$^{th}$ grade (Figure 6). This was done in order to explore whether the students´ heightened awareness of the mismatch between written and spoken language could last four months after the intervention concluded, and whether the students would continue independently using the metalinguistic tools that they were trained in during the intervention, without reminders from the teacher.

The program was therefore conducted using a pre/ post, follow-up design for the two non-randomized groups (control/ intervention). All the students in the intervention and control groups were evaluated with the same instrument tools at these times: pre-intervention (T1), one week before the program began; post-intervention (T2), 12 school weeks after the initial administration of the program; and follow-up evaluation (T3), 16 weeks after the program was completed, once the students were in the 4th grade. The children who could not attend an evaluation session were, if possible, given the evaluation up to one week later. All the testing took place in the students´ classroom.

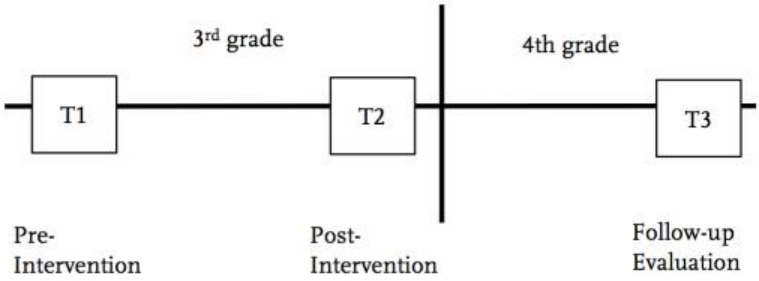


**Figure 6.** Timeline

To implement the program, at the end of February 2014, teachers in the intervention group received a PowerPoint presentation concerning the background of the program and a detailed explanation of how to administer the program. The presentation, without interruptions, lasted approximately 45 minutes. However, the teachers were encouraged to ask questions and accordingly workshops lasted between 1 hour and 15 minutes and two hours.

After each workshop, the intervention teacher participating in the intervention program received a Daily Sentence Calendar both in paper format and as a PDF file which contained: 60 daily tongue twisters, with an illustration for each sentence (Figure 7; Appendix A); A lined

notebook in which to write the daily sentence (Table 13); popsicle sticks with each student´s name written on it and placed in a cup so that the teacher could then randomly choose students for steps 2–4 (Wong & Wong, 1998; Table 13); and a package of colorful round stickers to place in the student´s notebook when s/he answered a task from the training correctly.

### 4.2 Intervention

This intervention aimed at improving both the written language skills and attention and concentration in third grade students in Swiss German speaking public schools. Initially, each step of *Sprachspezifisches Hirnfunktionstraining* (Gruner & Kirchhofer, 1997) was analyzed to determine: (1) which language components could it specifically improve; (2) if it would involve a metalinguistic aspect; and (3) if it could be transferred "as is" into a classroom setting (Table 9).

**Table 9.** Sprachspezifisches Hirnfunktionstraining (Gruner & Kirchhofer, 1997)

| Sprachspezifisches Hirnfunktionstraining Steps | Language Component Focused Upon in Dialect Speakers | Fit into Classroom Setting |
|---|---|---|
| *Pre-Intervention*<br>*Parent chooses a sentence out of a book the child is reading. The sentence for a 9 year old should include approximately 8–12 words.* | | |
| Step 1<br>The sentence should be very clearly articulated and the meaning and structure discussed. | **Prosody:** stress and intonation of words<br>**Phonology:** rules for structuring of sound<br>**Morphology:** structure of words (i.e., prefixes, | + |

| | | |
|---|---|---|
| | suffixes, base words)<br>**Lexicon/vocabulary:** unknown words<br>**Semantics:** meaning of the sentence<br>**Pragmatics:** context of sentence in text | |
| **Step 2**<br>The child should repeat the sentence from memory until s/he can do so perfectly from memory, unassisted, three times. | **Prosody:** stress and intonation of words<br>**Syntax:** arrangement of words in the sentence | + |
| **Step 3**<br>The child should use overt inner speech to say the memorized sentence. | **Syntax:** arrangement of words in the sentence | + |
| **Step 4**<br>The child should use inner speech to repeat the sentence while showing a finger for each word heard in inner speech. | **Syntax:** arrangement of words in the sentence | + |
| **Step 5**<br>The child should repeat the sentence loudly. | **Prosody:** stress and intonation of words<br>**Syntax:** arrangement of words in the sentence | + |
| **Step 6**<br>The child should write the memorized sentence while using overt speech. | **Phonology:** rules for structuring of sound<br>**Morphology:** structure | + |

| | | |
|---|---|---|
| | of words (i.e., prefixes, suffixes, base words)<br>**Syntax:** arrangement of words in the sentence | |
| **Step 7**<br>The child should correct the written sentence, word for word. Incorrectly spelled words should be rewritten correctly. | **Phonology:** rules for structuring of sound<br>**Morphology:** structure of words (i.e., prefixes, suffixes, base words)<br>**Syntax:** arrangement of words in the sentence | + |
| **Step 8**<br>The child should discuss individual misspelled words with the parent or guardian. | **Phonology:** rules for structuring of sound<br>**Morphology:** structure of words (i.e., prefixes, suffixes, base words)<br>**Syntax:** arrangement of words in the sentence | — |
| **Step 9**<br>The child should rewrite the sentence, repeating steps six to eight until the sentence is written without any mistakes. | **Phonology:** rules for structuring of sound<br>**Morphology:** structure of words (i.e., prefixes, suffixes, base words)<br>**Syntax:** arrangement of words in the sentence | + |

Based on the evaluation (Table 9), the following "problems" could be identified: (1) At pre-intervention, the sentence was chosen from a book read by the child. Random sentences, we suspected, would create variances among the expectations of the teachers. (2) Step 8, an individual-

ized discussion concerning orthographic and grammatical mistakes is not feasible within a classroom setting due to time restraints and disciplinary concerns.

To address issue 1, we first determined objective criteria for the sentences which we would use: (1) Focus on "confusing" letter sounds that are more difficult to distinguish through lip reading or sound (Table 10). (2) Consist mostly of Tier 1 and Tier 2 German words which have a dialect substitution (phonologically or lexical). (3) Composed of 5–20 syllables, as recommended in SH. As a result, we adapted the program in the following ways:

To create our weekly focus sounds, initially, in conjunction with a speech therapist we determined "confusing" letter sounds (Table 10):

**Table 10.** Weekly Focus Sound

| | | | |
|---|---|---|---|
| Week 1 | B and P | Week 7 | Ä, Ö and Ü |
| Week 2 | D and T | Week 8 | Au, Ei and Eu |
| Week 3 | G and K | Week 9 | R and L |
| Week 4 | F and V | Week 10 | Ch and Sch |
| Week 5 | S and Sch | Week 11 | Sp and St |
| Week 6 | Z and X | Week 12 | M and N |

We then chose 60 tongue twisters (which emphasized these confusing sounds) for four main reasons (Table 11): (1) Tongue twisters are amusing. (2) The silent reading of tongue twisters influences both speed of comprehension and accuracy of repeating the tongue twister. (This reading has been shown to affect the frontal speech motor, premotor areas and inferior parietal areas—a more widespread network of areas than when "simple" sentences are read. Tongue twisters *"twist not only the tongue but the brain"* (Keller et al., 2003, p. 200)). (3) Students are ex-

pected to be more motivated to use correct pronunciation while being listened to by their classmates. (4) Students are expected to be more motivated to listen carefully when monitoring a classmate (Table 11).

**Table 11.** Sample Week (Focus sounds D and T)

| | |
|---|---|
| Monday | Der Mond scheint schon schön. |
| Tuesday | Drei dünne Damen danken dich. |
| Wednesday | Tante Trudi tanzt mit Theo Tango und Twist. |
| Thursday | Teigwaren heissen Teigwaren, weil Teigwaren Teig waren. |
| Friday | Drei dicke dumme Damen donnern durch das dicke doofe Dorf. |

The use of the tongue twister, however, posed an additional problem; the repetition and similarity of words in the tongue twister may cause the *"tongue twister paradigm"* in which after an error in the first repetition of the sentence creates a negative ingrained effect (Wilshire, 1999, p. 57). To address this problem, during the introduction of the sentence, we decided that the teacher would reveal the daily tongue twister syllable-by-syllable, similar to the syllable method (see: Weinhold, 2010). By adding this element to the program, the organization of the sounds in the words (phonology) and the manner in which the words were formed (morphology), could be emphasized and improved.

For example:

The sentence: *Fischers Fritz fischt frische Fische* is written on one line, as a sentence. The sentence is initially covered and slowly revealed by the teacher in thirteen small steps, from left to right, to the students:

| | |
|---|---|
| Step 1: | *Fi* |
| Step 2: | *schers* |
| Step 3: | |
| Step 4: | *Fritz* |
| Step 5: | |
| Step 6: | *fischt* |
| Step 7: | |
| Step 8: | *fri* |
| Step 9: | *sche* |
| Step 10: | |
| Step 11: | *Fi* |
| Step 12: | *sche* |
| Step 13: | . |

Another hindrance to the original program was step 8 (Table 9) as it was difficult to transport into a classroom setting because it requires specific attention by the caregiver to each error a student made *(Step 8: The child should discuss individual misspelled words with the parent or guardian).* To address this issue we added a working memory step that helped focus attention onto various aspects on the letter to meaning level of the sentence (e.g. Kyttälä et al., 2015; Röthlisberger et al., 2012). This activity required students to manipulate linguistic information and put additional demands on working memory (Table 12).

**Table 12.** Working Memory Activity

| |
|---|
| Teacher calls on three individuals—one individual at a time, to answer one of the following questions (or independently generated question based on specific needs of the child):<br>1. Spell a certain word in the sentence backwards.<br>2. Name the vowels in the X word (i.e., 3rd word).<br>3. Name the consonants in the X word (i.e., 3rd word).<br>4. How many syllables are in the X word (i.e., 3rd word)?<br>5. How many syllables are in the sentence?<br>6. List the nouns (verbs, adjectives, or adverbs) in the sentence.<br>7. Which words are compound words?<br>8. Name an antonym/synonym for the X word (i.e., 3rd word). |

Next, we added an illustration to the tongue twister (Figure 7). We expected that this would assist and create additional discussion about the sentence within the classroom, giving students a clearer understanding of the meaning of the sentence, and enabling them to understand the sentence within and out of its context.


**Figure 7.** Sample Tongue Twister Calendar Page
Picture alliance/AP Images / Manuel Valdes

This program that evolved from SH was now referred to as Cognitive Language Acquisition Training, CLAT, as it can be transferred into a classroom setting. It encourages children to articulate words correctly. In doing so we expected it to create an awareness of nuances in language in all seven components of language: prosody/ rhythmic prosodic component, phonology, morphology, syntax, lexicon/vocabulary, semantics and pragmatics. In order to simplify the nine-step process of SH, we re-clustered the steps into six, larger, more encompassing activities, which were to be done sequentially in the classroom (Table 13).

**Table 13.** CLAT Method of Implementation

| Process | Monitoring |
|---|---|
| **Step 1**<br>Daily sentence presented syllable syllable to the students, read to the students and grammatical features and vocabulary discussed [SH step 1]. | Discussion between teacher and student. |
| **Step 2**<br>Students repeat memorized sentence to their classmates, carefully three times [SH steps 2]. | Student repeats the tongue twister three times from memory, correctly to their classmate. Classmate monitors correct articulation and intonation. |
| **Step 3**<br>Students repeat the sentence using lips only [SH step 3]. | Teacher monitors the mouth movements of the students, or students, working in pairs, monitor mouth movements. |
| **Step 4**<br>Teacher asks students to count the number of words in the sentence without using any mouth movements [SH step 4]. Students repeat sentence out loud [SH step 5]. | Teacher observes students, making sure that there are no mouth movements. Then the teacher randomly calls upon a student using the "popsicle stick"[1] method (Wong & Wong, 1998) asking: "How many words are in the sentence?" |

| | |
|---|---|
| **Step 5**<br>Teacher calls upon three students to answer a "working memory" question [SH step 8] (Table 12). | Teacher randomly calls upon three students using the "popsicle stick" method and then gives children who answer the question correctly a sticker. This sticker is then place in the student´s notebook. |
| **Step 6**<br>Teacher asks the students to write the sentence correctly in their notebooks using lip movements. Students correct their work independently, using check-correct method. Students write the sentence (up to three consecutive times) until the sentence is correctly written [SH steps 6, 7 & 9]. | Initially, students correct their work using check-correct method. Then students exchange notebooks and make sure that final version of sentence is correct. Once the sentence is correctly written, student monitoring corrections signs his/her name beside the completely correct sentence. |

[1] Each student´s name is written on a "popsicle" stick and placed in a cup. The teacher randomly pulls out a "popsicle stick" with a student´s name to choose the student who will participate in the activity.

**Students´ Motivation**

Motivation, difficult though it may be to measure, is a critical component of any program. There are two kinds of motivation and it was our hope that this training program would draw upon both.

Intrinsic motivation stems from enjoying or gaining pleasure from the task at hand without any external reward other than the interest in the task. Strong intrinsic motivations are related to self-efficacy, the belief in one's personal capabilities. *"People with high self-efficacy are more likely to have high aspirations, take long views, think soundly, set themselves difficult challenges, and commit themselves firmly to meeting those challenges"* and *"their motivation will be stronger if they believe they can attain their goals and adjust them based on their*

*progress"* (Bandura, 1997, para. 9). Larson and Rusk (2011), propose that intrinsically motivated experiences offer *"conditions for effective, efficient, and self-sustained learning within an activity. IM [intrinsic motivation] is associated with the experience of control over the challenges of the activity, focused attention, and feelings of enjoyment and effortlessness in taking on these challenges"* (Larson & Rusk, 2011, p. 96).

On the other hand, extrinsic motivations are gained by separable rewards and are more likely to lead to short-term changes in behavior. Students who do well in an academic subjects (math, social studies, English and science) have typically displayed intrinsic motivation or high self-efficacy while students who do not perform well in an academic subject typically might only display extrinsic motivation in that subject. Between the ages of 8 (3rd grade) and 14 ($8^{th}$ grade), intrinsic motivation in academic subjects seems to decline (Harter & Jackson, 1992). Non-self determined extrinsic motivation (i.e., winning a medal, receiving praise, force) also has been shown to decrease among this group of students until the age of 12, however, not as rapidly as intrinsic motivation (Gillet, Vallerand, & Lafrenière, 2012). The CLAT intervention program uses verbal praise and stickers to also extrinsically motivate its participants but there are no grades given for correct or incorrect work.

Tongue twisters are fun and allow students to try to meet the difficult challenge of pronouncing the combination of words and letters correctly. Also, they have a social, "game-like" component because they need to be repeated to others and the "others" need to be consciously aware of what is said and how it is said. As argued by Larson and Rusk (2011), this type of engagement is intrinsically motivated. As the program progresses, we expected that the students would improve their performance on the different tasks by using newly acquired metalinguistic techniques, enforcing motivation *"[b]ecause their attention and motivation (their "hearts and minds") are more fully engaged, their mental work is thought to be more efficient and effective"* (Larson & Rusk, 2011, p. 91).

Also, since students monitor their own written work, we hoped that they would not have external pressure to succeed in the writing task, rather would take their time to assess and process their corrections.

Given that struggling students often have negative attitudes towards school and do not gain intrinsic pleasure from learning (Park, 2011; Zisimopoulos & Galanaki, 2009), we suggested that teachers require a maximum of three re-writes, in order to avoid frustration. *"Beyond solid teaching methods, improving students´ motivation is the key for academic and behavioral success"* (Wery & Thomson, 2013, p. 103).

### 4.3 Instrument

After the workshop was completed, the teachers received an electronic form to complete in regards to the students´ first initials and family name initials, date of birth, gender, language(s) spoken at home and special needs. Each student was then given a number that indicated his/her canton, school, and student number within that school. Details provided by the teachers were placed on an Excel form and then transferred to an IBM SPSS, (23.0) data sheet. The number given to each student with his/her name was then given to the teachers. From this point on, students could only be identified by this number-code.

This intervention was built upon a two by three group design: two groups (control and intervention) in a pre-, post-, follow-up design, to assess the effectiveness of CLAT on both linguistic markers affected by dialect, and attention and concentration (AC). The evaluation was composed of two main sections: the first section consisted of five written language tasks, given at two sitting sessions, and the other of an AC section.

The written language evaluation subtasks were adapted from the *Allgemeiner deutscher Sprachtest* (Steinert, 2011) and consisted of four tasks related to the linguistic markers that are possibly affected by print-

speech mismatch: vocabulary depth, rhyme, grammar and spelling (Table 16), and one section that has not been expected to be affected by print-speech mismatch, vocabulary breadth. Sections used for the evaluation were adapted to the needs of Swiss German students: German sharp `S` (ß) changed to Swiss German´s `ss` and the informal capital ´Du´ to lowercase ´du`. In the vocabulary breadth (synonym task), vocabulary depth (antonym task), rhyme and grammar and spelling sections, there were 10 questions. Each question had to be completely correct, i.e., no partial points were given. Raw scores are calculated based on the number of correct responses obtained. The students had a total of 40 minutes to complete the synonym, antonym, rhyme and grammar tasks. Additional time was given to the spelling task in the same week. Internal consistency of the sub items is given as Cronbach`s α (Steinert, 2011, p. 64).

**Vocabulary Breadth Subtask**

In this evaluation subtask, we presented students with a sentence. Beneath each sentence were three words. Students needed to comprehend the sentence and identify a single word with a meaning similar to a particular word in the sentence. This task included 10 exercises. For each correct answer, students received 10 points. This task evaluated students' ability to retrieve information from long-term memory but did not require students to process this information. Therefore, we predicted no differences between the intervention and the control group on this task. According to the publisher´s manual, the reliability coefficient of the task vocabulary breadth task was good (Cronbach´s α = .86).

**Vocabulary Depth Subtask**

In this evaluation subtask, we presented students with a sentence. In the sentence one word was written in bold letters, a lexeme. Students needed to produce a single word that had the opposite meaning of the word in bold. This task included 10 exercises. For each correct word, students received 10 points. Words that were phonologically written but incorrectly spelled were considered correct. This task involved the ability to reflect

on (1) the way words are formed (morphological awareness) as both stem words, prefixes and suffixes were used; (2) the meaning and structure of the lexicon, and (3) the meaning of the sentence (semantics). According to the publisher´s manual, the reliability coefficient of the vocabulary depth task was good (Cronbach´s α = .82).

### Rhyme Sensitivity Subtask

Students were evaluated in their ability to discriminate between graphemes-similar written words. In this subtask, a rhyme identification task was presented in a written form. Students were asked to identify two pairs of rhyming words among six words. There were 10 exercises in this task. To receive points, all three pairs of rhyming words had to be identified. In this task, students needed to switch from dialect inner language, to standard language in written form (Ashby et al., 2013; Filik & Barber, 2011). On this exercise we evaluated the phonological awareness and prosodic awareness abilities of the students. According to the publisher´s manual, the reliability coefficient of rhyme identification task was good (Cronbach´s α = .94).

### Grammar Subtask

The grammar subtask consisted of 10 sentences, each with seven to ten words. In each sentence three bracketed words were either not conjugated or not declined. In this exercise, students´ ability to transform basic forms into the conjugated or declined version of the word is tested. Students needed either to conjugate the verbs with regard to the matching subject and tense, or declinate the word to one of the four cases in the German language they represent (dative, accusative, nominative, genitive). There were no partial points given for each sentence: To receive points, all three bracketed words must be conjugated or declined correctly. On this test students´ phonological, morphological, and syntax awareness was evaluated. According to the publisher´s manual, the reliability coefficient of the grammar task was good (Cronbach´s α = .90).

**Spelling Subtask**

In order to assess students´spelling abilities, 20 short sentences were read aloud. After reading each sentence, the teacher would repeat two key words of which the children had to write the verb only (dictation style evaluation). The verbs contained vowel sounds that if pronounced in dialect, could be either long or short vowels. This exercise evaluated the ability to orally discriminate sounds, phonological awareness and prosodic awareness (as intonation in dialect varies to that in standard language).

For exploratory reasons, after the spelling task was assessed, each incorrectly spelled word was analyzed to determine the type of spelling mistake made. Four categories were created for this evaluation: omission, addition, substitution and transposition (Gruner, Fleck, & Zeller, 2013). Addition and omission are quantitative spelling mistakes and substitution and transposition are qualitative spelling mistakes (Table 14). For each two words correctly spelled, 10 points were given. According to the publisher´s manual, the reliability coefficient of the spelling task was good (Cronbach´s $\alpha = .88$).

**Table 14.** Spelling Analysis Criteria

| | Original word: YAWN |
|---|---|
| Omission of letter | YAN |
| Addition of letter | YAWEN |
| Substitution of letter | YAUN |
| Transposition of letter | YWAN |

On this evaluation, each student could have more than one mistake per word. For example, if a child spelled the target word ´yawn´ as ´jawem´ then (Table 15) the child would have one addition mistake, one

substitution mistake, one transposition mistake and no omission mistake (Appendix D).

**Table 15.** Type of Spelling Error Measurement Sample (Yawn)

| | Omission | Addition | Substitution | Transposition | O | A | S | T |
|---|---|---|---|---|---|---|---|---|
| jwaem | – | e | j | a & e | 0 | 1 | 1 | 1 |

**Table 16.** Sample Exercises from Allgemeiner deutscher Sprachtest (Steinert, 2011)

| | Exercise | Answer | Score Range |
|---|---|---|---|
| Vocabulary Breadth | *Er hat immer gute **Laune.*** | | 1–100 |
| | __ *Gesundheit* | __ *Gesundheit* | |
| | __ *Stimmung* | **X** *Stimmung* | |
| | __ *Form* | __ *Form* | |
| Vocabulary Depth | Fritz: Wie war die Prüfung: Hast du **bestanden?** | *Durchgefallen* | 1–100 |
| | *Franz: Im Gegenteil: Ich bin* _____ | *Franz: Im Gegenteil: Ich bin Durchgefallen* | |
| Rhyme Sensitivity | knebeln beten betten betteln Kletten kneten | knebeln **beten** betten betteln Kletten **kneten** | 1–100 |
| Grammatic Awareness | (Unser) Katze (liegen) gern auf (der) Sofa. | Unsere Katze liegt gern auf dem Sofa | 1–100 |

| | | | |
|---|---|---|---|
| Spelling Ability | Woher kennst du ihn eigentlich? Du kennst. | kennst | 1–100 |
| | Wenn gähnst, bist du sicher müde. Du gähnst. | gähnst | |

**Attention and Concentration**

The third part of the booklet, attention and concentration, was evaluated through a 12-minute administration of *The Star Counting Test* (SCT) (de Jong & Das-Smaal, 1990). This test is based on Baddeley and Hitch´s model of WM (Baddeley, 1986) and aimed at tapping the executive center of the central executive by placing additional demands on the attention capacity and the ability to activate and inhibit processes in WM (de Jong, 1995). The SCT task consisted of 12 exercises. In this activity, the effect of metalinguistic training on the executive functions of WM was examined through a task in which an initial number was given and then a group of stars to the right side of the number. Between the number and the stars was either an addition or subtraction sign. In between each small cluster of stars was an addition or subtraction sign or a space. Students were required to begin each exercise with the number. Once they saw an addition sign, they needed to count backwards and each time there was a subtraction sign, they needed to count forward (counter intuitive) (Figure 8). Only results from the backwards-counting SCT were reported.

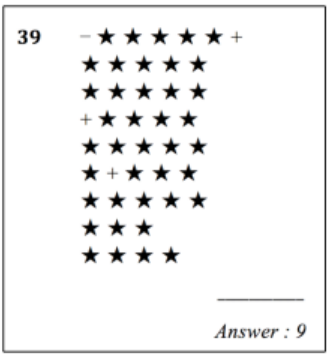


**Figure 8.** Star Counting Test Sample Exercise

All testing materials were collated into a small booklet. The students required three days to complete the entire test: Initially, the children were given 40 minutes to complete section one of the test; on another day, the students were given the spelling test (approximately 10 minutes). Finally, on the third day, the SCT test was allotted 12 minutes.

### 4.4 Data Analysis

The statistical analysis was conducted using SPSS version 23.0. Initially, we analyzed the data during each time period using a *t* test to compare the interaction of time from pre-intervention to post-intervention (T2–T1); follow-up evaluation to post-intervention (T3–T2); and follow-up evaluation to pre-intervention (T3–T1) on means between the two groups (Appendix C).

To check for the properties of a Gaussian distribution, we reviewed the following: (1) difference in improvement in each linguistic marker affected by print-speech mismatch, and AC. (2) violation of symmetry (skewness not greater than 1 or smaller than -1). (3) shape, and (4) means of distribution.

Although the data deviated from the normal distribution based on Shapiro-Wilk´s normality test, an ANOVA was robust against the normal distribution assumption (Schmider, Ziegler, Danay, Beyer, & Bühner, 2010). The null hypothesis H0 in this study, therefore, was that the difference between the intervention group and control group times was not significant. The alternative hypothesis was that the intervention and control group were statistically significantly different between the three times.

We then determined significant improvements, based on the significance level $\alpha < .05$, which is equal to the probability of rejecting the null hypothesis due to random fluctuations at 95% probability. We then used the General Linear Model (GLM), repeated measures, within subjects´ contrasts to measure the interaction between time (the repeated-measurement factor) and the group (control/intervention). To correct for inequalities between the control and intervention groups, we then added the covariates gender, languages spoken at home, and type of learner (Tabachnick & Fidell, 2013). Control variables/independent were either categorical—gender, language spoken at home, additional learning needs—or numeric: age, reported as an F-statistics Pillai Bartlett trace test as it is the most robust among the MANOVA tests against nonnormality (Olson, 1974). Results between T1–T2, T2–T3, and T1–T3, were reported as a ratio *(F)* of the mean square between (MSbetween) the groups and the mean square within (MSwithin) groups. Dependent-variables outcomes (pre-intervention to posttest, posttest to follow-up test, and pre-intervention to follow-up test) were statistically analyzed for all vocabulary breadth, vocabulary depth, rhyme, grammar, spelling, attention, and concentration.

## 5 Results

In this chapter, section 5.1 contains details of the composition of the control and intervention groups. Section 5.2 presents the results of the investigation of group results at each time period and examination of

students´ responses on the linguistic markers affected through print-speech mismatch, attention, and concentration. Finally, in section 5.3, we analyze the rate of improvement for the various measures using repeated measures, General Linear Model.

## 5.1 Independent/ Descriptive Variables

In this study 279 students and 16 teachers participated in this pretest, posttest, and follow-up quasi-experimental design. Eight classrooms participated in the intervention program and eight in the control group. Each intervention and control group was in one schoolhouse. We collected student information on age, gender, languages spoken at home, and type of learner (i.e., "typical," "non typical" learner, or German as a second language) through a form given to teachers. We compared data collected using independent samples *t* test on numeric variables (age) and a chi square test on categorical variables (gender, languages spoken at home, and type of learner; Table 17).

### Age and Gender

The average age of the participants at the beginning of the study was 9.5 years old ($SD = .53$). Participants consisted of 142 male and 137 females aged 8 to 11 years (male: $M = 9.5$ years, $SD = .51$; female: $M = 9.5$, $SD = .46$). An independent samples *t* test between the control ($M = 9.07$, $SD = .56$) and intervention group ($M = 9.05$, $SD = .50$) indicated no significant differences in age between the two groups, $t = .35$, $p > .05$.

Initially, the distribution of gender and age was approximately normal. Between the male and female participation, control—64 (46%) males and 75 (54%) females—and the intervention group—78 (56%) males and 64 (46%) females. A chi square test indicated no significant difference in gender distribution between the control and intervention groups, $\chi^2$ (1, $N = 279$) = 2.82, $p > .05$.

### Languages Spoken at Home

Of the children in the intervention, 62% in the intervention group and 57% of the control group spoke Swiss German/German at home (of which 1.4% spoke standard German at home); 38% of the intervention and 43% of the control group were either bilingual or multilingual. A chi square test tested the distribution of Swiss/German speaking children and bilingual/multilingual children and indicated no significant difference between the two groups. $\chi^2$ (1, $N$ = 279) = .816, $p$ > .05.

### Type of Learner

In total, 205 out of 279 (73%), children were typical learners and did not receive educational support in or outside the classroom setting; 55 (19.71%) children were atypical and received additional educational support due to a linguistic weakness; and 19 (6.81%) children received extra German lessons because they were new to the country (German as a second language). A chi-square test assessed the distribution of typical learners who did not receive additional language support (German as a Second Language, GSL) in the control group (105 children) to the number of typical learners who did not receive GSL; the difference in the number of children receiving educational support due to a learning weakness between the two groups, control ($n$ = 23) and the intervention groups ($n$ = 32); and between the number of children receiving additional German lessons in the control ($n$ = 11) and intervention groups ($n$ = 8); none were significant, $\chi^2$ (2, $N$ = 279) = 2.07, $p$ > .05.

**Table 17.** Descriptive Variables

| | Intervention n = 140 | Control n = 139 |
|---|---|---|
| **Age** | | |
| Minimum (months) | 102 | 103 |
| Maximum (months) | 129 | 135 |
| M/ SD (years) | 9.05/ 0.50 | 9.07/ 0.56 |
| **Gender** | | |
| Male | 78 (55.71%) | 64 (46.04%) |
| Female | 62 (44.29%) | 75 (53.96%) |
| **Language Spoken at Home** | | |
| Monolingual | 87 (62.21%) | 79 (56.83%) |
| Bi/ Multilingual | 53 (37.86%) | 60 (43.17%) |
| **Type of Learner** | | |
| Typical Learner (no additional assistance) | 100 (71.14%) | 105 (75.53%) |
| Learning Problem & Receiving Assistance | 32 (22.86%) | 23 (16.55%) |
| German as a Second Language | 8 (5.70%) | 11 (7.91%) |

### Socio-Demographic Features

In Switzerland, children attend school in their municipality. Because the schools in this study have two classes per schoolhouse, children attending each school were from the same region and assumed to be pooled from similar sociodemographic regions.

In summary, according to baseline testing, no significant differences emerged between children in the control and children in the intervention group on measures of age, gender, home language, type of learner and sociodemographic features.

## 5.2 Dependent Variables

We conducted a two-tailed Pearson correlation to determine the relationship between the linguistic markers affected through print-speech mismatch and AC, pre-intervention. As expected, a positive correlation emerged for all the subtests (Table 18).

**Table 18.** Intercorrelation Between Dependent Variables at Pre-intervention (N = 279)

| | Voc. Breadth | Voc. Depth | Rhyme | Gram. | Spell. | Atten. & Concen. |
|---|---|---|---|---|---|---|
| Voc. Breadth | 1 | .492** | .250** | .332** | .310** | -.124* |
| Voc. Depth | .492** | 1 | .434** | .380** | .266** | -.205** |
| Rhyme | .250** | .434** | 1 | .425** | .373** | -.232** |
| Gram. | .332** | .380** | .425** | 1 | .493** | -.252** |
| Spell. | .310** | .266** | .373** | .493** | 1 | -.234** |
| Atten. & Concen | -.124* | -.205** | -.232** | -.252** | -.234** | 1 |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

## 5.3 Initial Observations between T1, T2 and T3

The improvement measures in each evaluation were then given as the difference between the improvements of the intervention versus the control group to measure the relative performance (observed interaction effect) between the groups, the significance, and the width of the distribution (95% confidence interval) of the data (Appendix C). These initial results, which did not consider the covariates of the data (gender, languages spoken at home, and type of learners), indicated that the observed difference in means between the intervention group and the control group lay well within 95% confidence levels.

To examine the independence among students in a school, school-level intraclass cluster correlation (ICC) estimates were calculated for within-subject correlation over time, to the 95% confidence interval, using SPSS statistical package 23 (SPSS Inc., Chicago IL). Based on absolute agreement, we calculated a two-way mixed-effect model with values reported based on Koo and Li (2016) as less than .5 being of poor reliability (weak cluster effect), between .5 and .75 as moderate reliability, and values between .75 and .9 as excellent reliability (strong cluster effect; Table 19).

**Table 19.** Intra Cluster Correlation—School Level at T1, T2 and T3

| Variable | ICC |
|---|---|
| Voc. BreadthT1 | 0.01 |
| Voc. BreadthT2 | 0.01 |
| Voc.BreadthT3 | 0.00 |
| Voc. DepthT1 | 0.09 |
| Voc. DepthT2 | 0.11 |
| Voc. DepthT3 | 0.10 |
| RhymT1 | 0.06 |
| RhymT2 | 0.03 |
| RhymT3 | 0.03 |
| GrammarT1 | 0.12 |
| GrammarT2 | 0.06 |
| GrammarT3 | 0.08 |
| SpellingT1 | 0.03 |
| SpellingT2 | 0.03 |
| SpellingT3 | 0.02 |
| Conc.T1 | 0.03 |
| Conc.T2 | 0.09 |
| Conc.T3 | 0.05 |

Due to a more significant cluster effect in vocabulary depth post-intervention (T2) and grammar at pre-intervention (T1), we will be cautious in interpreting these results.

## 5.4 Inferential Data

We then used GLM, repeated measures, within-subject contrasts to measure the interaction between time (the repeated-measurement factor) and the group (control/ intervention). To correct for inequalities between the control and intervention groups, we then added the covariates: gender, languages spoken at home, and type of learner. In the analysis with covariances, pure mean results are given.

If the results were significant ($\alpha < .05$), we rejected the null hypothesis and reported the effect size. The effect size used a partial eta squared ($\eta_p^2$) rather than eta squared, as can be used in designs using covariates (Richardson, 2011). We then identified effect sizes as small (.01– .05), moderate (.06– .13) or large ( ≥ .14; Cohen, 1969, pp. 278–280).

### 5.4.1 Impact on Vocabulary Acquisition

Using IBM SPSS (23.0), we conducted a GLM repeated measures to assess the impact of CLAT on participants' scores on vocabulary breadth and depth between three time periods (pre-intervention to post-intervention, post to follow-up evaluation, and pre-intervention to post-intervention). Within the design with repeated measurements on the factor time, controlling for gender, languages spoken at home, and type of learner, no significant interaction emerged between the program and time in respect to vocabulary breadth, Pillai´s Trace = .001, $F(2,249)$ = .18, $p > .01$, with an insignificant effect size, ($\eta_p^2$) > .01. A substantial effect for time emerged, Pillai´s Trace = .09, $F(2,249)$ = 12.89, with a moderate effect size ($\eta_p^2$) = .09. In contrast, within the repeated measures design, controlling for gender, languages spoken at home, and type of learner, a significant interaction arose between the program and time in respect to vocabulary depth, Pillai´s Trace = .085, $F(2,249)$ = 11.55, $p < .01$, with a moderate effect size, ($\eta_p^2$) = .09, and a substantial

effect for time, Pillai´s Trace = .09, $F(2,249) = 12.89$, $p < .01$, with a moderate effect size, $(\eta_p^2) = .09$. Therefore, as predicted, an overall interaction effect of time and program on vocabulary depth but not on vocabulary breadth emerged, however, this result needs to be read with some caution as the ICC for vocabulary breadth at pre-intervention (T1), post-intervention (T2) and follow-up evaluation (T3) were .9, .11, and .10, respectively (Table 23).

### Vocabulary Breadth

The main effect comparing the control group ($n = 134$, $M = 6.04$, $SD = 22.81$) and the intervention group ($n = 130$, $M = 5.84$, $SD = 16.37$) between pre-intervention (T1) and post-intervention (T2), was not statistically significant $F(1,250) = .036$, $p > .05$, with an insignificant effect size, $(\eta_p^2) < .01$. The main effect comparing the control group ($n = 131$, $M = 6.03$, $SD = 15.33$) and the intervention group ($n = 130$, $M = 4.00$, $SD = 14.97$), between post-intervention (T2) and follow-up evaluation (T3) was not statistically significant $F(1,250) = .29$, $p > .05$, with an insignificant effect size, $(\eta_p^2) < .01$. The main effect comparing the control group ($n = 132$, $M = 10.30$, $SD = 17.56$) and the intervention group ($n = 130$, $M = 9.69$, $SD = 16.84$) between pre-intervention (T1) and follow-up evaluation (T3), was not statistically significant $F(1,250) = .09$, $p > .05$, with an insignificant effect size, $(\eta_p^2) < .01$ (Table 20).

**Table 20.** Vocabulary Breadth Between Evaluation Times

| | Intervention | | | Control | | |
|---|---|---|---|---|---|---|
| Time Period | *n* | *M* | *SD* | *n* | *M* | *SD* |
| T1–T2 | 130 | 5.84 | 16.37 | 134 | 6.04 | 22.81 |
| T2–T3 | 130 | 4.00 | 14.97 | 131 | 6.03 | 15.33 |
| T1–T3 | 130 | 9.69 | 16.84 | 132 | 10.30 | 17.56 |

Based on the mean scores at pre-intervention (T1), post-intervention (T2) and follow-up evaluation (T3), 4-months after the completion of the program, the intervention and control groups improved at a similar rate

during the 9-months of observation, indicating no significant improvement in vocabulary breadth due to the intervention program (Figure 9).

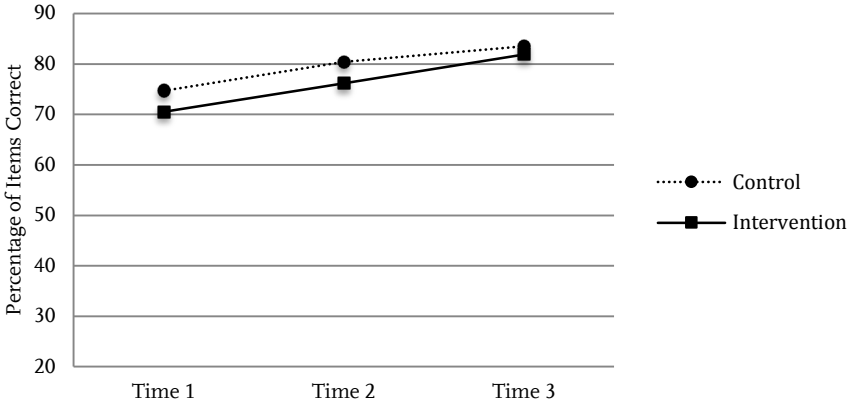


**Figure 9.** Vocabulary Breadth Between Evaluation Time
Covariates: Gender, Languages spoken at home, Type of learner
Pillai´s Trace = .001, $F(2,249) = .18$, $p = .84$, with an insignificant effect size, $(\eta_p^2) > .01$

### Vocabulary Depth

The main effect comparing the control group ($n = 135$, $M = 6.14$, $SD = 18.65$) and the intervention group ($n = 130$, $M = 17.15$, $SD = 17.53$), between pre-intervention (T1) and post-intervention (T2), was statistically significant $F(1,250) = 22.18$, $p < .01$, with a moderate effect size $(\eta_p^2) = .08$. The main effect comparing the control group ($n = 131$, $M = 6.56$, $SD = 16.16$) and the intervention group ($n = 130$, $M = 1.15$, $SD = 18.70$), between post-intervention (T2) and follow-up evaluation (T3) was statistically insignificant $F(1,250) = .15$, $p > .05$, with an insignificant effect size $(\eta_p^2) < .01$. The main effect comparing the control group ($n = 132$, $M = 12.58$, $SD = 20.10$) and the intervention group ($n = 130$, $M = 18.46$, $SD = 18.78$), between pre-intervention (T1) and follow-up evaluation (T3) was statistically insignificant $F(1,250) = 3.61$, $p > .05$, with an insignificant effect size $(\eta_p^2) < .01$ (Table 21).

**Table 21.** Vocabulary Depth Between EvalutationTimes

| | Intervention | | | Control | | |
|---|---|---|---|---|---|---|
| Time Period | *n* | *M* | *SD* | *n* | *M* | *SD* |
| T1–T2 | 130 | 17.15 | 17.53 | 135 | 6.14 | 18.65 |
| T2–T3 | 130 | 1.15 | 18.70 | 131 | 6.56 | 16.16 |
| T1–T3 | 130 | 18.46 | 18.78 | 132 | 12.58 | 20.10 |

Based on the mean scores at pre-intervention (T1), post-intervention (T2), and follow-up evaluation (T3), 4-months after completion of the intervention, the intervention group was more able to reflect on the morphology of the words, the meaning and structure of the lexicon, and the meaning of the sentence to produce antonyms than the control group between pre-intervention and post-intervention (T1–T2). Although the intervention group did not improve as rapidly as the control group between the post-intervention and the follow-up evaluation (T2–T3), they did perform at follow-up (T3) slightly better than the control group (Figure 10).

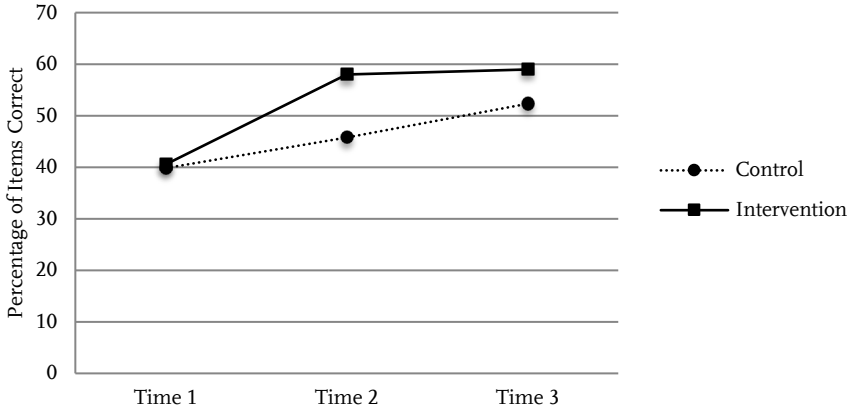


**Figure 10.** Vocabulary Depth Between Evaluation Times
Covariates: Gender, Languages spoken at home, Type of learner
Pillai´s Trace = .085, F(2,249) = 11.55, p < .01, $\eta_p^2 = .09$

### 5.4.2 Impact on the Identification of Rhyme Pairs

Using IBM SPSS (23.0), we conducted a GLM repeated measures to assess the impact of CLAT on participants´ scores on the identification of rhyme pairs between three time periods (pre-intervention to post-intervention, post-intervention to follow-up evaluation, and pre-intervention to follow-up evaluation). Within the design with repeated measurements on the factor time, controlling for gender, languages spoken at home and type of learner, on the identification of written rhyme pairs, a significant interaction emerged between the program and time Pillai´s Trace = .042, $F(2,248) = 5.45$, $p < .01$, with a small effect size $\eta_p^2 = .04$. A substantial effect for time emerged, Pillai´s Trace = .10, $F(2,248) = 14.40$, $p < .01$, with a moderate effect size $\eta_p^2 = .10$. We can conclude that children who participated in the program were more able to transfer and apply their knowledge to the rhyme pair identification than the control group.

The main effect comparing the control group ($n$ = 135, $M$ = 4.74, $SD$ = 24.10) and the intervention group ($n$ = 129, $M$ = 14.11, $SD$ = 22.35), between pre-intervention (T1) and post-intervention (T2), was statistically significant $F(1,249) = 10.87$, $p < .01$, with a small effect size $\eta_p^2 = .04$. The main effect comparing the control group ($n$ = 132, $M$ = 6.82, $SD$ = 23.68) and the intervention group ($n$ = 129, $M$ = 0.78, $SD$ =22.14), between post-intervention (T3) and follow-up evaluation (T3) was not statistically significant $F(1,249) = .09$, $p > .05$, with an insignificant effect size $\eta_p^2 = .01$. The main effect comparing the control group ($n$ = 131, $M$ = 11.14, $SD$ = 22.69) and the intervention group ($n$ = 130, $M$ = 15.00, $SD$ = 22.04), between pre-intervention (T1) and follow-up evaluation (T3) was statistically significant $F(1,249) = 2.04$, $p > .05$, with an insignificant effect size $\eta_p^2 = .01$ (Table 22).

**Table 22.** Rhyme Sensitivity Task Between Evaluation Times

| | Intervention | | | Control | | |
|---|---|---|---|---|---|---|
| Time Period | *n* | *M* | *SD* | *n* | *M* | *SD* |
| T1–T2 | 129 | 14.11 | 22.35 | 135 | 4.74 | 24.10 |
| T2–T3 | 129 | 0.78 | 22.14 | 132 | 6.82 | 23.68 |
| T1–T3 | 130 | 15.00 | 22.04 | 131 | 11.14 | 22.69 |

Based on the mean scores pre-intervention (T1), post-intervention (T2), and follow-up evaluation (T3), 4-months after completion of the intervention, the intervention group was more able to switch from dialect (inner language) to written language, than the control group between pre-intervention and post-intervention (T1–T2). However, from post-intervention to follow-up evaluation (T2–T3), the intervention´s group improved less than that of the control group (Figure 11). Therefore, the positive effect of the intervention was not sustained.

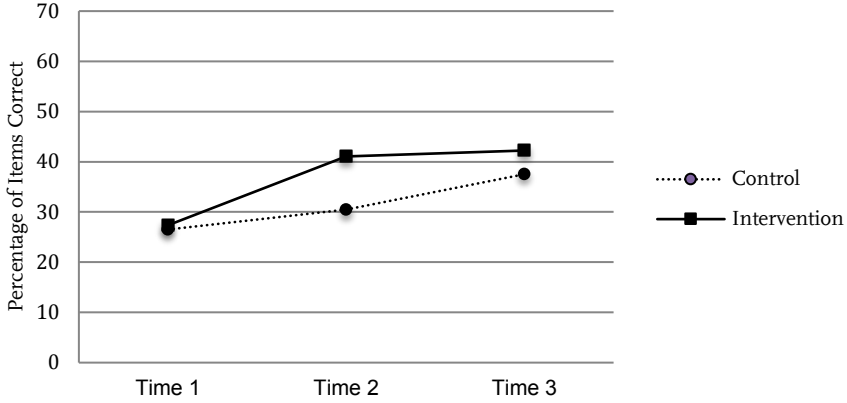


**Figure 11.** Rhyme Sensitivity Task Between Evaluation Time
Covariates: Gender, Languages spoken at home, Type of learner
Pillai´s Trace = .042, $F(2,248) = 5.45$, $p < .01$, $\eta_p^2 = .04$

### 5.4.3 Impact on Grammatical Awareness

Using IBM SPSS (23.0), we conducted a GLM repeated measures to assess the impact of CLAT on participants´ scores on the ability to transform basic forms into the conjugated or declined version of the word between three time periods (pre-intervention to post-intervention, post-intervention to follow-up evaluation, and pre-intervention to follow-up evaluation). Within the design with repeated measurements on the factor time, controlling for gender, languages spoken at home, and type of learner, on this grammar subtask, a significant interaction between the program and time emerged, Pillai´s Trace = .093, $F(2,249) = 12.84$, $p < .01$, with a moderate effect size, $\eta_p^2 = .09$. A significant effect for time emerged, Pillai´s Trace = .22, $F(2,249) = 34.16$, $p < .01$, with a large effect size, $\eta_p^2 = .22$. However, since ICC was at T1 was at .12, the effect size must be read with some caution.

The main effect comparing the control group ($n = 135$, $M = 6.52$, $SD = 18.50$) and the intervention group ($n = 130$, $M = 17.62$, $SD = 22.34$), between pre-intervention (T1) and post-intervention (T2), was statistically

significant $F(1,250) = 20.48$ , $p < .01$, with a moderate effect size $\eta_p^2 = .08$. The main effect comparing the control group ($n = 131$, $M = 5.65$, $SD = 19.89$) and the intervention group ($n = 130$, $M = 4.77$, $SD = 21.18$), between post-intervention (T2) and follow-up evaluation (T3) was statistically significant $F(1,250) = 5.41$, $p < .05$, with a small effect size $\eta_p^2 = .02$. The main effect comparing the control group ($n = 132$, $M = 11.97$, $SD = 20.21$) and the intervention group ($n = 130$, $M = 21.23$, $SD = 23.92$), between pre-intervention (T1) and follow-up evaluation (T3) was statistically significant $F(1,250) = 18.03$, $p < .01$, with a moderate effect size $\eta_p^2 = .07$ (Table 23).

**Table 23.** Grammatical Awareness Task Between Evaluation Times

| | Intervention | | | Control | | |
|---|---|---|---|---|---|---|
| Time Period | *n* | *M* | *SD* | *n* | *M* | *SD* |
| T1–T2 | 130 | 17.62 | 22.34 | 135 | 6.52 | 18.5 |
| T2–T3 | 130 | 4.77 | 21.18 | 131 | 5.65 | 19.89 |
| T1–T3 | 130 | 21.23 | 23.92 | 132 | 11.97 | 20.21 |

Based on the mean scores at pre-intervention (T1), post-intervention (T2), and follow-up evaluation (T3), 4-months after completion of the intervention, the intervention group were better able to conjugate and declinate between pre-intervention and post-intervention (T1–T2) than the control group. From post-intervention to follow-up evaluation (T2–T3), the intervention group maintained their improvement and continued to improve at a similar rate as the control group (Figure 12). Therefore, the positive effect of the intervention was only slightly sustained.

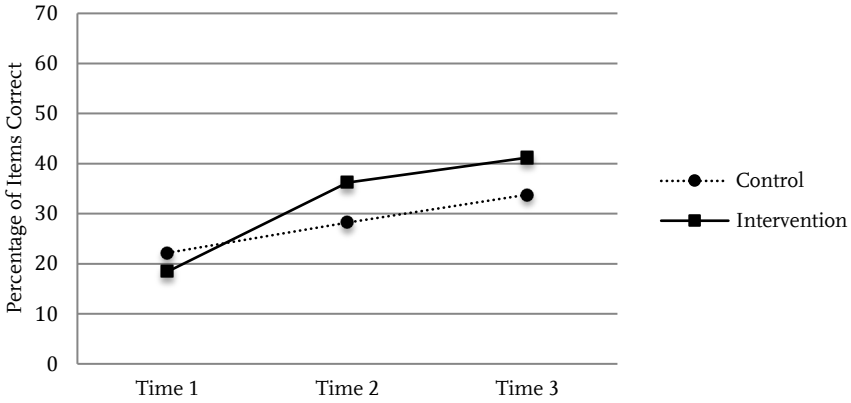


**Figure 12.** Grammatical Awareness Task Between Evaluation Times
Covariates: Gender, Languages spoken at home, Type of learner
Pillai´s Trace = .093, F(2,249) = 12.84, p < .01, $\eta_p^2 = .09$

### 5.4.4 Impact on Spelling Ability

Using IBM SPSS (23.0), we conducted a GLM repeated measures to assess the impact of CLAT on participants´ scores on the correct spelling of words that differed in their vowel sounds between three time periods (pre-intervention to post-intervention, post-intervention to follow-up evaluation, and pre-intervention to follow-up evaluation). Within the design with repeated measurements on the factor time, controlling for gender, languages spoken at home, and type of learner, on the ability to spell words correctly, a significant interaction emerged between the program and time, Pillai´s Trace = .06, $F(2,248) = 7.83$, $p < .01$, with a moderate effect size $\eta_p^2 = .06$. A substantial effect for time emerged, Pillai´s Trace = .29, $F(2,248) = 50.26$, $p < .01$, with a large effect size $\eta_p^2 = .29$. We can conclude that children who participated in the program were more able to transfer and apply their knowledge to the spelling task than those children in the control group.

The main effect comparing the control group ($n$ = 131, $M$ = 6.34, $SD$ = 16.88) and the intervention group ($n$ = 131, $M$ = 12.37, $SD$ = 13.52), between pre-intervention (T1) and post-intervention (T2), was statistically significant $F(1,249) = 13.63$, $p < .01$, with a small effect size, $\eta_p^2 = .05$. The main effect comparing the control group ($n$ = 132, $M$ = 3.41, $SD$ = 16.66) and the intervention group ($n$ = 132, $M$ = 2.72, $SD$ = 14.52), between post-intervention (T2) and follow-up evaluation (T3) was not statistically significant $F(1,249) = 1.39$, $p > .05$, with an insignificant effect size $\eta_p^2 < .01$. The main effect comparing the control group ($n$ = 131, $M$ = 9.70, $SD$ = 15.49) and the intervention group ($n$ = 128, $M$ = 15.70, $SD$ = 14.18), post-intervention to follow-up evaluation (T2–T3) was statistically significant $F(1,249) = 8.50$, $p < .01$, with a small effect size, $\eta_p^2 = .03$ (Table 24).

**Table 24.** Spelling Task Between Evaluation Times

| | Intervention | | | Control | | |
|---|---|---|---|---|---|---|
| Time Period | *n* | *M* | *SD* | *n* | *M* | *SD* |
| T1–T2 | 131 | 12.37 | 13.52 | 131 | 6.34 | 16.88 |
| T2–T3 | 132 | 2.72 | 14.52 | 132 | 3.41 | 16.66 |
| T1–T3 | 128 | 15.70 | 14.18 | 131 | 9.70 | 15.49 |

Based on the mean scores pre-intervention (T1), post-intervention (T2), and follow-up evaluation (T3), 4-months after completion of the intervention, the intervention group was more able to distinguish between long and short vowel sounds between pre-intervention and post-intervention (T1–T2) than the control group. However, from post-intervention to follow-up evaluation (T2–T3), the intervention group maintained their improvement but grew at a slightly slower rate as the control group (Figure 13).

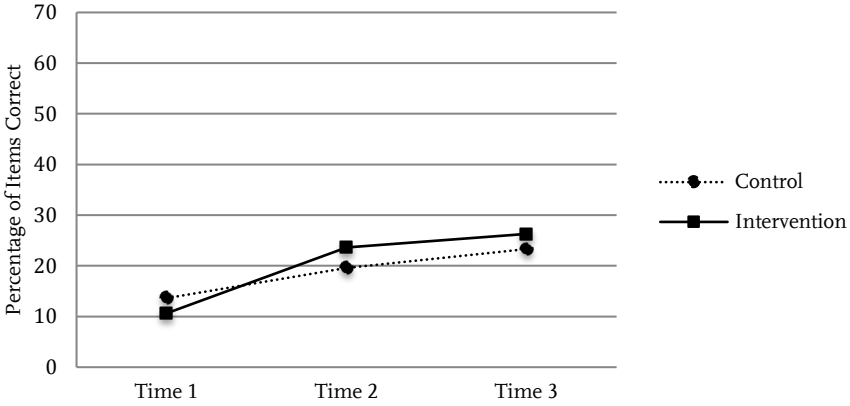


**Figure 13.** Spelling Task Between Evaluation Times
Covariates: Gender, Languages spoken at home, Type of learner
Pillai´s Trace = .06, $F(2,248) = 7.83$, $p < .01$, $\eta_p^2 = .06$

### 5.4.5 Impact on Attention and Concentration

Using IBM SPSS (23.0), we conducted a GLM repeated measures to assess the impact of CLAT on participants scores on AC between three time periods (pre-intervention to post-intervention, post-intervention to follow-up evaluation, and pre-intervention to follow-up evaluation). Within the design with repeated measurements on the factor time, controlling for gender, languages spoken at home, and type of learner, on the ability activate and inhibit processes in WM, no significant interaction between the program and time emerged, Pillai´s Trace = .02, $F(2,248) = 2.01$, $p > .05$, with a small effect size $\eta_p^2 = .02$. A significant effect for time emerged, Pillai´s Trace = .07, $F(2,248) = 9.24$, $p < .01$, with a moderate effect size $\eta_p^2 = .07$. We can conclude that children who participated in the program were not more effective on the AC task than those in the control group.

The main effect comparing the control group ($n = 132$, $M = -.78$, $SD = 2.97$) and the intervention group ($n = 131$, $M = -.37$, $SD = 3.09$), between pre-intervention (T1) and post-intervention (T2), was not statistically significant $F(1,249) = 1.41$, $p = .27$ with an insignificant effect size, $\eta_p^2 < .01$. The main effect comparing the control group ($n = 132$, $M = -1.24$,

*SD* = 5.32) and the intervention group (*n* = 130, *M* = - .64, *SD* = 2.78), between post-intervention (T2) and follow-up evaluation (T3) was not statistically significant $F(1,249) = 2.57$, $p = .11$ with an insignificant effect size $\eta_p^2 < .01$. The main effect comparing the control group (*n* = 133, *M* = 1.98, *SD* = 5.41) and the intervention group (n = 128, M = .89, SD = 2.67), between pre-intervention (T1) and follow-up evaluation (T3) was not statistically significant $F(1,249) = 3.71$, $p = .06$ with small effect size, $\eta_p^2 = .01$ (Table 25).

**Table 25.** Attention and Concentration Between Evaluation Times

| | Intervention | | | Control | | |
|---|---|---|---|---|---|---|
| Time Period | *n* | *M* | *SD* | *n* | *M* | *SD* |
| T1–T2 | 131 | -0.37 | 3.09 | 132 | -0.78 | 2.97 |
| T2–T3 | 130 | -0.64 | 2.78 | 132 | -1.24 | 5.32 |
| T1–T3 | 128 | 0.89 | 2.67 | 133 | 1.98 | 5.41 |

Based on the mean scores pre-intervention (T1), post-intervention (T2), and follow-up evaluation (T3), 4-months after the completion of the intervention, the intervention group did not improve significantly more rapidly between the three time periods (pre-intervention to post-intervention, post-intervention to follow-up evaluation, and pre-intervention to follow-up evaluation) than the control group due to the intervention (Figure 14).

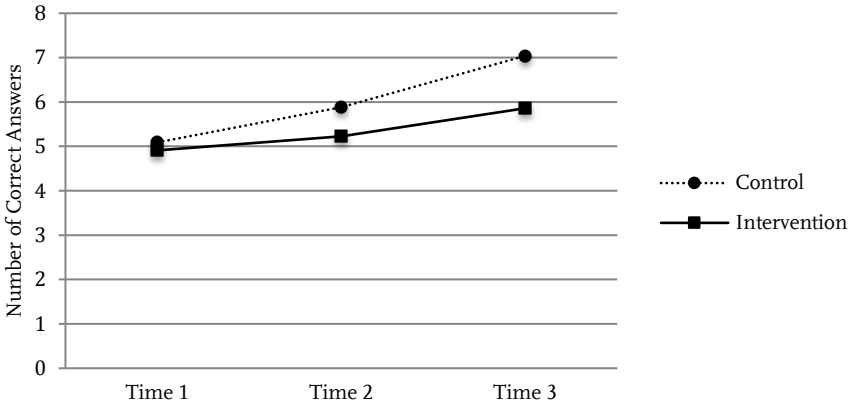


**Figure 14.** Attention and Concentration Between Evaluation Times
Covariates: Gender, Languages spoken at home, Type of learner
Pillai´s Trace = .02, $F(2,248) = 2.01$, $p = .14$, $\eta_p = .02$

## 6 Discussion

Within this chapter, the results of the present study will be discussed in relationship to previous research, both generally and specifically to CLAT. Limitations, implications and directions for further research will also be discussed.

The overall purpose of this study was to identify, highlight and analyze the effect of a relationship between the central executive (Baddeley, 2003) and academic achievement. Since many studies in the past twenty years have been unsuccessful in their attempt to show a transfer effect of working memory training on academic performance (e.g. Melby-Lervåg, Redick, & Hulme, 2016; Colmar et al., 2016), it has been suggested that an unexplored self-regulatory component might link the two (Peng & Miller, 2016). Related to this effort, it became necessary to determine how to explore this paradigm in a nonclinical setting to avoid a direct transfer effect. In written language acquisition, metalinguistic awareness assumed a high degree of importance in the literature review. Developing metalinguistic awareness as a self-regulatory component is, however, difficult as it is mostly an internal process. Swiss German school children were the ideal candidates for such a study as there is a subtle mismatch between their spoken and written language and more attention and concentration would be needed to control and select some stimuli and ignore others. Therefore, if the central executive and academic performance are linked through a self-regulatory component, after a cognitive training intervention, (based on the linguistic awareness/flexibility hypothesis,) there would be an improvement in both academics, and attention and concentration. However, if there was an improvement in either language performance, or attention and concentration, this study would not show that metalinguistic awareness as a self-regulatory component is the "missing link" between the two. Therefore the purpose of this thesis was to find out if the rate of improvement in language learn-

ing, and/or attention and concentration, would differ between children who received metalinguistic language training and those who did not.

Initially, a new classroom version of a language-training program based on an ambulant, cognitive language program created for children with more severe written language problems (*Sprachspezifisches Hirnfunktionstraining zur Verbesserung der Lese- und Schreibleistungen,* Gruner & Kirchhofer, 1997) was created. Although there was no data available due to patient-doctor confidentiality, Gruner, who co-created the program and managed the language therapy team at the University of Zurich pathology department, assured us that the results of SH on children that visited her were often very positive after only three months of home-based intervention (Gruner, interview). Based on the literature review, this program was adjusted for a classroom setting to include the seven components of language and a more explicit metalinguistic task based on other non-computerized working memory programs studied in this research (e.g. Kyttälä et al., 2015; Röthlisberger et al., 2012). This new, classroom version of SH, Cognitive Language Acquisition Training, is unique as it focused not only on the seven components of language (Berendes et al., 2013; Weinert, 2010) but also on the relationship between written language and inner language, non-vocal overt language and overt language. Furthermore, it could be adapted into a classroom setting to include metalinguistic aspects which required students to control and regulate their learning by placing additional demands on the executive functions.

To test the effect of CLAT on written language affected by speech-print mismatch and the executive function (i.e., attention and concentration), we recruited 279 third grade students from 8 schools, each with two parallel classes, i.e., 16 classrooms. We then chose four tasks based on dialect-standard language mismatch that required active and cognitive understanding and use of written language. We adapted these tasks from the *Allgemeiner deutscher Sprachtest* (Steinert, 2011), which required active reflection of word parts (prefix, suffix, base words),

rhyme differentiation between standard language and dialect, differentiating endings of words depending on their conjugation or declination, and the awareness of short and long vowel sounds in written language. A synonym section was added to evaluate how students would perform on a non-reflective written language task. To evaluate the effects of an intervention on attention and concentration, the *Star Counting Test* (de Jong & Das-Smaal, 1990) was administered. This test is unique as it can be administered to a group of students within a classroom setting. The SCT required students to focus attention and to decide how to attend to different, contrasting stimuli—non-linguistic interferences. We administered both tests pre-intervention, post-intervention and 4-months after intervention at follow-up evaluation. On these tasks, we hypothesized students would have to combine the metalinguistic skills they trained during the program, and apply them to written linguistic material, by placing additional demands on the executive function.

We then determined the difference between the improvement rate of the intervention versus the control group. Finally, we measured the interaction between time points (the repeated measurement factor) and the group (control/intervention) using General Linear Model, repeated measures within subjects´ contrasts in a two by three model, taking into account the covariates: gender, languages spoken at home and type of learner. Through the use of these two instruments, we collected data which addressed the research questions and hypotheses posed in Chapter Three.

Significant result differences between testing times in the intervention group and the control group on linguistic skills would indicate that metalinguistic techniques enabled the children to shift from dialect to standard language. Significant result differences between testing times in the intervention group and the control group on attention and concentration, would indicate that there exists a relationship between a self-regulatory component and the executive functions. Finally,

significant result differences between testing times in the intervention group and the control group on both linguistic skills and attention and concentration would further the argument that the self-regulatory component helps mediate attention and concentration (working memory) and academic performance.

## Conclusion

The pre-intervention scores on linguistic markers affected by the mismatch of dialect to standard language were compared between the control group and the intervention group and were not significantly different. After applying the General Linear Model, repeated measures within subjects' contrasts, three covariates were added: gender, languages spoken at home and type of learner, and the interaction between time and group was determined.

After reviewing the data, it became obvious that children in the intervention group improved significantly during the intervention from pre-intervention to post-intervention on all subtest items that involved metalinguistic awareness, compared to the students in the control group. CLAT groups maintained improvements 4-months after intervention at the follow-up evaluation, but at a slower rate, achieving similar results to the control group. The only significant lasting effect size reflected in the study was the interaction of time and subtests. These results were mirrored and continued to be more pronounced numerically than statistically also when reviewing the mean differences based on monolingual and bi/multi- lingual children, typical learners, non-typical learners, females, and males (Appendix E).

Based on the results of this study, attention and concentration scores among the intervention group was not significantly different to that in the control group at any of the three evaluation times. Therefore, this study has not been able to demonstrate that metalinguistic awareness training could increase the central executive component of working memory.

## Hypothesis One: Metalinguistic training will improve linguistic abilities involving print-speech mismatch.

### Vocabulary Acquisition

There were two tests used to compare the effects of CLAT on vocabulary acquisition. We hypothesized that the ability to complete tasks which involve explicit understanding of vocabulary (process and retrieve vocabulary through the training of control and regulation strategies) would improve more so than those which involve incidental word knowledge (the ability to represent vocabulary). We tested this assumption on two vocabulary tasks: Incidental word knowledge was evaluated through a vocabulary breadth subtask in which students were asked to identify a word that had a similar meaning as a word in bold within a sentence (a multiple choice synonym task). Explicit word knowledge was evaluated through a vocabulary depth task in which students needed to write an antonym to a word in bold within a sentence. On this task, students were not given possible options for the answers (multiple choice); rather, the students needed to understand the word and process its lexical characteristics by evaluating its similarities with the equivalent word in dialect and then intentionally produce a word that had the opposite meaning of the word written in bold.

Based on the literature review, we expected students to become more aware and reflect on the meanings of words as an independent unity and as a word within the sentence through two CLAT activities (12 & 13): (1) Step 1: Daily sentence presented syllable-syllable to the students, read to the students and grammatical features and vocabulary discussed (2) Step 5: Teacher calls upon three students to answer a "working memory" question. These two CLAT steps mirrored activities that were done in kindergarten classes, on 5–9 year olds, and in additional language (Damhuis et al., 2014; Henderson et al., 2013; St. John et al., 2014). In these studies, short-term effects of the three programs were significant but long-term effects were mixed. In the current study, between pre-intervention to post-intervention, significant differences emerged be-

tween the ability of the students in the intervention group and the control group on the antonym task (vocabulary depth) but not on the synonym task (vocabulary breadth), with a more significant improvement rate in the intervention group than the control. The improvement of intervention group in comparison to that of the control between pre-intervention and post-intervention aligned with prior research results on the effects of explicit instruction of vocabulary during classroom time (Damhuis et al., 2014; Henderson et al., 2013; St. John et al., 2014). Therefore, the results immediately after the intervention at post-intervention indicate that the transfer effects of teaching metalinguistic techniques could assist students in learning new words.

In order to test for sustainable effects from the CLAT intervention on vocabulary depth and breadth, the vocabulary tasks were re-administered 4-months after the intervention was completed. However, between these two measurements, from post-intervention to follow-up evaluation, the intervention group did not improve significantly more than the control group, but continued to grow on a higher level on the vocabulary depth subtasks. These final results at follow-up evaluation indicated that the intervention students´ lexical and morphological awareness was not sustained. Similarly, in a two-week study, Damhuis et al. (2014) found significant differences in vocabulary depth after implicit and explicit language methods were implemented in small groups, but there were no lasting effects of the intervention in the long-term. Damhuis et al. (2014) and this result contradict research indicating vocabulary learning becomes easier the more a child acquires vocabulary (e.g. Nation, 2001; St. John & Vance, 2014; Stahl, 2003). Taken together, these results do suggest that self-regulatory strategies are more effective tools for learning vocabulary than for transporting new vocabulary information into long-term memory (Table 26). One should, however, be cautious in analyzing vocabulary breadth results as there was a one in three chance of correctly choosing a synonym for the word and there were only 10 questions to answer which resulted in a slight ceiling effect.

### Rhyme Sensitivity

To evaluate the effects of CLAT on inner language, phonological awareness and prosodic speech, a rhyme identification subtask was given to both the intervention and control group. Recent evidence suggests that inner speech is used while reading and that dialect-speakers think in dialect while reading (e.g. Filik & Barber, 2011; Treiman and Bowman, 2015). We hypothesized that through correct inner and outer speech repetitions of tongue twisters using standard German, dialect-speaking students would be made aware of the individual sounds of spoken words (Gillon, 2000; Mann & Foy, 2007) through four CLAT activities (Table 13): (1) Step two: Students discuss the sentence with the teacher and repeat memorized sentence to their classmates three times (2) Step 3: Students repeat the sentence using lips only (3) Step 4: Teacher asks students to count the number of words in the sentence without using any mouth movements. Students repeat the tongue twister out loud. (4) Step 6: Teacher asks the students to write the sentence correctly, using lip movement, in their notebooks.

Based on the research on intrinsic motivation, we expected that due to the entertaining effect of the tongue twister and the intrinsic motivation to repeat the short sentence correctly to a classmate, students would not only repeat or retrieve the sentences but also reflect on the structure of the sentence and process the independently read standard language that they are to repeat (initially as they retrieve linguistic rules taught in order to read the sentence correctly and then by repeating the memorized sentence to a classmate in a more relaxed manner using the standard language, then to lip sync the sentence by paying attention to all the sounds of the words, and finally through processing standard spoken language—both inner and overt, into written standard language). Therefore the rhyme subtask would evaluate if the students could make a conscious switch between the sounds in spoken language (dialect) and those sounds in written language (standard language). This subtask consisted of ten exercises, each with six words and three rhyme pairs (no partial points were given). The pairs required students to specifically

reflect on knowledge related to the vowel length of individual words which are pronounced differently in dialect than in standard language (Brooks & Macwhinney, 2000; MacLean et al., 1987).

As hypothesized between pre-intervention and post-intervention, the intervention group improved significantly more than the control group due to CLAT, but with only a small effect size. After the intervention program ended there were no significant differences between the results of the intervention group and the control group; rather, based on the mean results, the intervention group grew at a slighter slower rate than the control group, reaching similar mean results 4-months at follow-up evaluation. These results strengthen previous research indicating that inner speech can be explicitly taught (Aleman et al., 2005; Farias et al., 2014); however, three months of intervention were not sufficient to create lasting effects 4-months after intervention at the follow-up evaluation. This result concurs with other studies on the small effect size of linguistic training on phonological awareness at post-intervention but not at the follow-up evaluation (Fuchs et al., 2002; Justice et al., 2010; Table 26).

**Grammatical Awareness**

To evaluate the effects of CLAT on morphological awareness, a grammar subtask was given to both the intervention and control group in which students needed to decide how to conjugate or declinate three words in parentheses in each of ten sentences—the endings of words which are often swallowed when speaking dialect. Based on the research, instruction on morphology awareness has been shown to assist children in the understanding of words and reading comprehension (e.g. Nagy et al., 2006; Zipke, Ehri, & Cairns, 2009). Since students in early primary school are not taught the cases through direct instruction in the 3$^{rd}$ and 4$^{th}$ grades (Bern Lehrplan 1995; Lehrplan 21, n.d.; SO Lehrplan, 1992), the differences in word endings could not have been learned through direct explicit teaching of grammar rules. Instead, we hypothesized that through CLAT students became more sensitized to the differences be-

tween dialect and standard language by a sentence focused treatment, as was proposed by Hadley et al. (2014) and which showed significant positive effects in 8–10 year olds by Motsch and Riehemann (2008) after a short 12 hour intervention. In accord to the previous studies (e.g. Motsch & Riehemann, 2008; Oetting & Hadley, 2009) the intervention group was hypothesized to improve their awareness to the different grammatical cases more so than the control group due to the metamorphologcial activities of the CLAT training between pre-intervention and post-intervention (Table 13): (1) Step 1: Daily sentence presented syllable-syllable to the students, read to the students and grammatical features and vocabulary discussed (2) Step 5: Teacher calls upon three students to answer a "working memory" question. In this evaluation task, we expected that due to the entertaining effect of the tongue twister and the intrinsic motivation to repeat the short sentence correctly to a classmate, students would not only repeat or retrieve the sentences but also reflect and process the endings of the words, paying attention especially to the swallowed sounds in dialect language. (6) Finally, through step 6: Teacher asks the students to write the sentence correctly in their notebooks using lip movements—students will use the oral phonological knowledge gained through correct repetition and apply it to written standard language.

As hypothesized, between pre-intervention and post-intervention, the intervention group performed significantly better than the control group due to the intervention with a moderate effect size. Four months after the intervention, at follow-up evaluation, the intervention group maintained the higher level but improved at a slightly slower rate than the control group. These results confirm the immediate benefits of metamorphological awareness on the students´ ability to declinate and conjugate words (Motsch & Riehemann, 2008; Table 26).

### Spelling Ability

To evaluate the effects of CLAT on orthographic ability, a spelling subtask consisting of 20 words in which each two consecutive words

differed in the short and long vowel usage, was given to the intervention and control groups. Initially, at pre-intervention, the type of spelling mistake(s) in each word was analyzed. As hypothesized, in both groups of Swiss dialect-speaking children, there were more quantitative spelling errors than qualitative errors: omitting of a letter and substitution of a letter (Appendix D). This present finding seems to be consistent with other research that found that accuracy in speech is reflected in spelling accuracy (Overby et al., 2015; Treiman & Bowman, 2015) rather than phonological awareness skills.

Based on the research, the correct pronunciation and mouthing of the words would sensitize the students to correct spelling of a transparent language like German (e.g. Dell & Oppenheim, 2015; Thaler et al., 2008; Weinhold, 2010; Wimmer, 1996; Wimmer & Goswami, 1994). We hypothesized that CLAT would improve the ability of the students to apply spelling rules due to training activities which focus on carefully articulating standard speech and observing the differences between what is spoken in dialect and what is spoken in standard language: (1) Step 1: Daily sentence presented syllable-syllable to the students, read to the students and grammatical features and vocabulary discussed (e.g. Michele, 2013; Weinhold, 2010) (2) Step 2: Students discuss the sentence with the teacher and repeat the memorized sentence to their classmates, carefully three times (e.g. Gillon, 2000) (3) Step 3: Students repeat the sentence using lips only (4) Step 5: Teacher calls upon three students to answer a "working memory" question (5) Step 6: Teacher asks the students to write the sentence correctly in their notebooks using lip movements. We hypothesized that the varied activities using the sentence would not only encourage the students to repeat the sentences correctly, but also process (initially, consciously and then sub-consciously) the difference in the pronunciation of short and long vowels in dialect and standard language.

As hypothesized, findings on the spelling task mirrored the trend observed in all the findings of this study related to linguistic markers af-

fected by the mismatch of dialect to standard language—students in the intervention group improved in spelling more than students in the control group between pre-intervention and post-intervention with a moderate effect size. But, 4-months after the intervention, there were no significant differences between the two groups. The intervention group maintained the higher level but continued to grow at a slower rate than the control group (Table 26).

**Table 26.** CLAT on Linguistic Markers

| | Pre-intervention to Post-intervention | Post-intervention to Follow-up evaluation |
|---|---|---|
| Vocabulary Breadth (receptive vocabulary) | — | — |
| Vocabulary Depth (processing and retrieving vocabulary) | + | — |
| Rhyme Sensitivity | + | — |
| Grammatical Awareness | + | ≈ |
| Spelling Ability | + | — |

**Hypothesis Two: Metalinguistic training will improve attention and concentration.**

To investigate the effect of CLAT on mental processes needed to concentrate and pay attention, we assigned subtasks that tapped the central executive by placing additional demands on the attention capacity and the ability to activate and inhibit processes in WM. Based on the research, it has been suggested that to improve long-term memory, chunking of information could be beneficial (e.g. Bonhage et al., 2014; Guida et al., 2012; Mathy & Feldman, 2012). In non-computerized classroom settings, it has been shown that training could improve cognitive flexibility through a variety of exercises designed to encourage interference

control and cognitive control (e.g. Röthtlisberger et al., 2012). We therefore hypothesized that by combining linguistic tasks which required interference control and cognitive control, the attention and concentration aspect of the central executive (based on Baddeley, 2013) would improve. The CLAT program uses a variety of activities that are intended to place additional demands on the executive functions of working memory and simultaneously serve to improve the awareness of the differences between oral and spoken language: (1) Step 4: Teacher asks students to count the number of words in the sentence without using any mouth movements. (2) Step 5: Teacher calls upon three students to answer a "working memory" question (i.e., Spell a certain work in the sentence backwards; Name the vowels in the X word; How many syllables are in the X word?).

In addition, since dialect-speakers must self-regulate their thinking while writing—as there is no direct pathway of correspondence between speech and print—the assumption was that there were more demands placed on the central executive in the intervention group than in the control group due to the program. The CLAT program would simulate bilinguals´ ability to control which language they speak and their flexibility of switching between languages (e.g. Morales, Calvo, & Bialystok, 2013; Wiseheart, Viswanathan, & Bialystok, 2016).

Contrary to what was hypothesized, between pre-intervention to post-intervention, and between post-intervention and follow-up evaluation, there was no significant difference in attention and concentration between the two groups. These results concur with the bulk of evidence against transfer effects of training WM (e.g. Melby-Lervåg, Redick, & Hulme, 2012/2013/2016; Randall & Tyldesley, 2016; Redick, Shipstead, Wiemers, Melby-Lervåg, & Hulme, 2016).

In sum, in order to tease out the role of a self-cognitive component in the relationship between academic performance and attention and concentration, it was necessary to determine if a metalinguistic awareness

would affect both academic performance and attention and concentration. The combination of results provides some support for the conceptual premises that metalinguistic training can be implemented in a classroom setting by a teacher and can improve linguistic abilities affected by print-speech mismatch of students more rapidly than a "normal" lesson. In particular, the CLAT program improved participating students' ability to reflect on the differences between inner language (dialect) and written language (standard German) in respect to phonological, morphological, lexical, prosodic, and syntactic awareness. However, the results failed to show that metalinguistic training (as a self-regulatory component) links the executive functions and academic performance. Therefore, this study indicates that there exists a link between academic abilities and metalinguistic awareness but not a link between metalinguistic awareness and attention and concentration. Thus, the findings of this study do not provide evidence that academic achievement is linked to the central executive through a self-regulatory component.

**Limitations**

The main limitation of this study concerns the training protocol. Due to the setting of the program, we could not determine the amount of time, attention and knowledge each teacher allocated for the intervention. Step one of CLAT involves an active discussion between the teacher and the students about the tongue twister. The other five activities were less subject to interpretation. Furthermore, the number of sentences each teacher did with the class was difficult to measure. Some teachers began to use class notebooks and it was difficult to determine how consistently teachers were implementing the program.

An obvious limitation that arises from this thesis is that it is impossible to determine which specific steps, or which combination of steps, in CLAT (or SH) were effective in improving the transfer between private languages to written language. However, in this didactic study, the intention was to add experimental data from a classroom setting based on theoretical knowledge that has been collected through many research

projects. The specific mechanism is rather secondary in this study. Indeed, a specific mechanism is necessarily secondary in any study conducted in a classroom, as opposed to a laboratory situation, since a classroom provides a holistic total learning environment. The hope remains that interdisciplinary training programs, such as this one, will give insight to effective educational practices especially when embedded in a broader context.

Another limitation could stem from classroom teachers (both intervention and control group) administering the evaluation tool at pre-intervention and post-intervention, but at follow-up evaluation a new teacher administered the test. These follow-up evaluation teachers had not invested any time or effort in the program and had to administer the test on the students because the agreement to participate in the program was made by the previous teachers. As a result, teachers might have not taken the test as seriously. Students at post-intervention were also aware that the test results were not personally important for them, and might have not performed to their best ability. However, since both the control and intervention groups performed similarly at follow-up evaluation, the results indicate no significant difference between the control and the intervention group´s performance on the evaluation tasks at this time.

Similarly, due to the tendency for people to change their behavior in the short-term when they know that they are being observed, referred to as the Hawthorne effect, it could be that some teachers taught more carefully than they traditionally did in class, paying more attention to the work of the students. However, due to the length and intensity of the program, and that the teachers were not observed during their lessons, we assume this to be unlikely.

An additional limitation was the number of students in the evaluation. A larger sample size would be more representative of the population. Furthermore, it is important to realize that this study was conducted on dialect-speaking children within a classroom setting and the effect of the

program on academic performance could differ in classrooms in smaller settings or among children with learning disabilities.

Finally, the SCT has not been widely used in classrooms. However, it is the only tool available for classroom use. A more sensitive and complex measuring tool might have detected more variety in specific executive functions aspects (i.e., inhibition, planning, switching, control, cognitive flexibility) among the students.

**Implications**

It is obvious a richer understanding of how spoken language is transferred into written spelling would be useful, as demographic movement is shifting the needs of language learners. In a classroom setting, each individual´s academic requirements cannot be catered to individually. Therefore meaningful research is needed to understand the mechanisms involved in learning and how they are related.

Theoretically the findings from this study suggest that there is a significant short-term effect in learning language through metalinguistic awareness training in dialect-speaking Switzerland. However, improvement rates among the intervention group stagnated after the program ended, a tendency that was observed in several other written and oral language intervention studies (e.g. Damhuis et al., 2014; Henning et al., 2010; Justice et al., 2010). Since the evaluation tasks differed from the training tasks, they required more than just transferring learned information. Students who participated in the CLAT were able to apply the metalinguistic skills they were taught to tasks that were different than those in the intervention program.

This research also indicates that inner speech needs to be addressed more explicitly during lesson time as it has a direct influence on the academic performance of students. We also argue that although some children might have a natural ability to reflect on their language use, not all children do. Metalinguistic awareness tasks need to be regularly im-

plemented during class time and teacher-training programs should include practical knowledge on how to teach children metalinguistic skills, such as those used in CLAT.

Finally, our study indicates that a three-month metalinguistic awareness training program was not enough for a long-term improvement effect. This can be addressed in several ways; for example, either through a longer program or through short, refresher intervention programs.

While these limitations may have influenced the results of this study, the data collected suggests that students made linguistic gains through the intervention. Results indicate that it is probable that the CLAT intervention did have a positive effect on vocabulary depth, rhyme sensitivity, grammatical awareness and spelling abilities. However, this study questions the assumption that the central executive is linked to academic achievement through a self-regulatory component.

### Further Research

Although the post-intervention results were encouraging, there are several questions and issues that can be addressed through future research addressing CLAT in a classroom setting.

First, since it was difficult to determine the amount of time and expertise each teacher allocated for the program, further research could control the discussion through predetermined questions and discussion points given to the teachers.

Second, further research should attempt to study the direct effect of print-speech mismatch on academic performance in transparent languages.

Thirdly, results from the study pose implications for further research in language teaching. The CLAT program was beneficial in improving all linguistic markers that were identified in speech-language mismatch.

However, the program´s effects were mostly short lived. Further research on the effect of implementation time on metalinguistic training needs to be conducted.

Another possibility for future research could involve different groups of children: younger children, who are not yet "reading to learn" but "learning to read", children with special needs or children who are bi/multilingual.

Finally, investigating methods that enable students to self-regulate their learning and think flexibly to adapt to new learning situations is critical in an ever-changing world. Swiss children are lagging behind in their linguistic skills compared to international averages, but are excelling in mathematics (OECD, 2016). This academic discrepancy may indicate that diglossia has long-term linguistic disadvantages if the final performance of diglossic children is measured not in dialect but in the target standard language. More research needs to be conducted in the area of print-speech mismatch in order to create programs which are adapted to countries´ social and cultural needs.

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## Appendix A. Daily Sentence Calendar

**Set 1: B P**
Paul packt pausenlos prima Picknickpakete.
Gibst du Opi Opium, bringt Opium Opi um.
Weisse Borsten bürsten besser als schwarze Borsten bürsten.
Der Potsdamer Postkutscher putzt den Potsdamer Postkutschenwagen.
Bäcker Braun backt braune Bretzeln, braune Bretzeln bäckt Bäcker Braun.

**Set 2: D T**
Drei dünne Damen danken dir.
Der Mondschein schien schon schön.
Tante Trudi tanzt mit Theo Tango und Twist.
Teigwaren heissen Teigwaren, weil Teigwaren Teig waren.
Drei dicke dumme Damen donnern durch das dicke doofe Dorf.

**Set 3: G K**
Grosse Krebse krabbeln im Korbe.
Lang schwang der Klang am Hang entlang.
Ein krummer Krebs kroch über eine krumme Schraube.
Klitzekleine Kinder können keinen Kirschkern knacken.
Die Katze tritt die Treppe krumm. Der Kater tritt sie gerade.

**Set 4: F S**
Fischers Fritz fischt frische Fische.
Fünf Ferkel fressen frisches Futter.
Fritz fastet fast vierzig Feste lang.
Früh fressen freche Frösche Früchte.
Flössers Vroni flog frohlockend vom frostigen Floss.

**Set 5: S Sch**
Sechs sächsische Säufer zahlen zehn tschechische Zechen.
Selten ess ich Essig; ess ich Essig, ess ich Essig im Salat.
Sieben Schneeschaufler schaufeln sieben Schaufeln Schnee.
Schneiders Schere schneidet scharf, scharf schneidet Schneiders Schere.
Zwischen zwei Zwetschgenbaum Zweigen sitzen zwei zwitschernden Schwalben.

**Set 6: Z X**
Zehn zahme Ziegen zogen zehn Zentner Zucker zum Zoo.
Xaver liest im Lexikon, Felix spielt auf dem Xylophone.
Der Zahnarzt zieht Zähne mit der Zahnarztzange im Zahnarztzimmer.
Zwei zischende Schlangen sitzen zwischen zwei spitzen Steinen.
Zwanzig Zwerge zeigen Handstand, zehn im Wandschrank, zehn am Sandstrand.

**Set 7: Ä Ö Ü**
Häschen Hoppel hoppelt hinterm Hühnchen her.
Plötzlich plapperte Papas Papagei putzige Sätze.
Müller Lümmer frühstückt schüsselweise grünes Gemüse.
Hans hackt Holz hinterm Hühnerhaus. Hinterm Hühnerhaus hackt Hans Holz.
Ich wünsch Dir soviel gute Tage im Jahr, wie der Fuchs am Schwanz hat Haar.

**Set 8: AU EL EU**
Neulich heulten neue treue Freunde.
Er sang leider lauter laute Lieder zur Leute.
Acht alte Ameisen assen am Abend Ananas.
Auf den sieben Robbenklippen sitzen sieben Robbensippen.
Zwei Astronauten kauten während sie blaugrüne Mondsteine klaubten.

**Set 9: R L**
Runde Räder rollen rasch, rasch rollen runde Räder.
Ludwig Leckermann aus Neck am Leck leckt leckere Lollies.
Auf dem Rasen rasen Hasen, atmen rasselnd durch die Nasen.
Russische Russen rutschen russische Rutschen russisch runter.
Weil lustige Leute laufend lachen, lachen lustige Leute auch beim Laufen.

**Set 10: CH SCH**
Echte Dichter dichten leichter bei Licht.
Ein schwarzes Schwein hat einen schwarzen Schwanz.
Er spritzt Schaum und fischt am Riff.
Schnecken erschrecken, wenn Schnecken an Schnecken schlecken.
Wenn hinter Griechen Griechen kriechen, kriechen Griechen Griechen nach.

**Set 11: SP ST**

Mein Spitzer spitzt Stifte spielend spitz.
Violett steht ihr recht nett, recht nett steht ihr violett.
Spinnende spanische Spanner spannen spannende spanische Spinner.
Der Staubsaugerschlauch saugt auch Hausstaub in den Staubsaugerbauch.
Ein sehr schwer sehr schnell zu sprechender Spruch ist ein Schnellsprechspruch.

**Set 12: M N**

Der Stand stand am grossen Strand.
Ameisen, die Adelheid heissen, beissen meist beim Reisen.
Ein Soldat mit stumpfen Stiefeln sass auf einem spitzen Stein.
Zungen gezwungen im Becher sind gesungene Zungenbrecher.
In einem Schokoladenladen laden Ladenmädchen Schokolade aus.

**Appendix B. Sample Dialect-Standard Language Mismatch Words/Phrases**

| English | Dialect | German |
|---|---|---|
| Hello | Grüezi | Guten Tag |
| Good Evening | Gueten Abig | Guten Abend |
| See You Later | Bis spöter | Bis später |
| Carrots | Rüebli | Möhre(n)/Karotte(n) |
| Breakfast | Z'Morge/Morgenässe | Frühstück |
| Walk | Laufe | Gehen |
| Run | Ränne | Laufen/rennen |
| Walk Downhill | Uälaufe | Aufwärts gehen |
| Walk Uphill | Ufälaufe | Aufwärts gehen |
| Move To A New House | Zügle | Umziehen |
| Shall We Leave? | Gömmer? | Gehen wir? |
| Tram | Tram | Strassenbahn |
| Motorbike | Töff | Motorrad |
| Bike | Velo | Fahrrad |
| Work | Schaffe | Arbeiten |
| Work Hard | Chrampfe | Hart arbeiten |

| | | |
|---|---|---|
| Go Shopping | Poschte | Einkaufen |
| Look | Luege | Sehen |
| Call | Aalüte | Anrufen |
| I Call You | Ich lüte dir aa | Ich rufe dich an |
| You Know | Weisch | Weisst du |
| Are You Coming? | Chuntsch? | Kommst du? |
| Do We Have? | Hämmer...? | Haben wir...? |
| Approximately | Öppe | Etwa |
| Someone | Öpper | Jemand |
| Something | Öppis | Etwas |
| ... Right? | ..gäll? | ...nicht wahr? |
| Well, yes | Mol | doch |
| Pig | Sau | schwein |
| Butterfly | Summervogel | Schmetterling |
| Money | Schtutz (informal) | Franken |
| Church | Chile | Kirche |
| Market/Fun Fair | Chilbi | Dorffest/Kirmes |

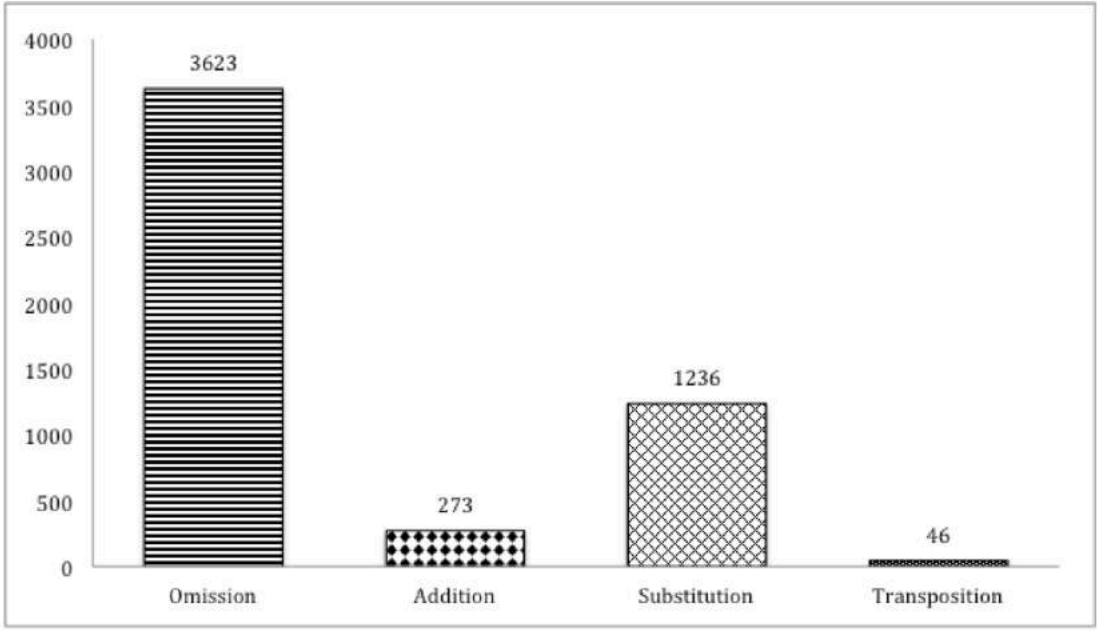
(Adapted from: A quick guide to the Swiss German language, n.d)

## Appendix C. Observed Interaction Effect Between Times

| | Significance | Effect Size | Intervention | Control | Observed Interaction Effect | 95% Confidence Interval |
|---|---|---|---|---|---|---|
| Vocabulary Breadth | | | | | | |
| ΔT2-T1 | $p = 0.94$ | 0 | 6.04 | 5.84 | -0.20 | (-4.63) – 5.02 |
| ΔT3-T2 | $p = 0.30$ | 0 | 6.03 | 4.00 | -2.03 | (-1.66) – (5.72) |
| ΔT3-T1 | $p = 0.02$ | 0 | 10.3 | 9.69 | -0.61 | (-3.58) – 4.79 |
| Vocabulary Depth | | | | | | |
| ΔT2-T1 | $p < 0.01$ | 0.09 | 17.15 | 6.14 | 11.01 | 6.62 – 15.39 |
| ΔT3-T2 | $p = 0.01$ | 0.02 | 1.15 | 6.56 | -5.41 | (-9.67) – (-1.15) |
| ΔT3-T1 | $p = 0.02$ | 0.02 | 18.46 | 12.58 | 5.88 | 1.15 – 10.62 |
| Rhyme | | | | | | |
| ΔT2-T1 | $p < 0.01$ | 0.04 | 14.11 | 4.74 | 9.37 | 3.73 – 15.00 |
| ΔT3-T2 | $p = 0.03$ | 0.03 | 0.78 | 6.82 | -6.04 | (-11.62) – (0.46) |
| ΔT3-T1 | $p = 0.17$ | 0.01 | 15 | 11.15 | 3.85 | (-1.6) – 9.31 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Grammar | | | | | | |
| ΔT2-T1 | $p < 0.01$ | 0.07 | 17.62 | 6.52 | 11.10 | 6.14 – 16.07 |
| ΔT3-T2 | $p = 0.73$ | 0.01 | 4.77 | 5.65 | -0.88 | (-5.89) – 4.13 |
| ΔT3-T1 | $p < 0.01$ | 0.06 | 21.23 | 11.97 | 9.26 | 3.87 – 14.65 |
| Spelling | | | | | | |
| ΔT2-T1 | $p < 0.01$ | 0.04 | 12.37 | 6.34 | 6.03 | 2.31 – 9.75 |
| ΔT3-T2 | $p = 0.72$ | 0.01 | 2.72 | 3.41 | -0.70 | (-3.10) – 4.48 |
| ΔT3-T1 | $p < 0.01$ | 0.04 | 15.7 | 9.69 | 6.01 | 2.34 – 9.64 |
| Concentration & Attention | | | | | | |
| ΔT2-T1 | $p = 0.27$ | -0.04 | -0.37 | -0.78 | 0.41 | (-0.32) – 1.15 |
| ΔT3-T2 | $p = 0.25$ | -0.06 | -0.64 | -1.24 | 0.60 | (-0.43) – 1.64 |
| ΔT3-T1 | $p = 0.04$ | 1.09 | 0.89 | 1.98 | -1.09 | (-2.13) – 0.04 |

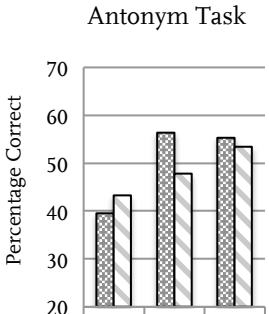
## Appendix D. Pre-intervention Spelling Analysis



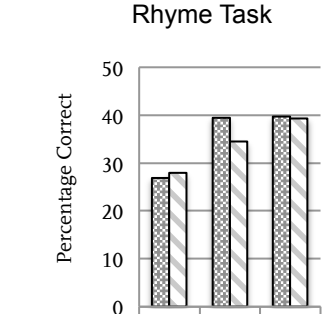
## Appendix E. Subgroup Performances on Descriptive Criteria

### Appendix E.1 Gender

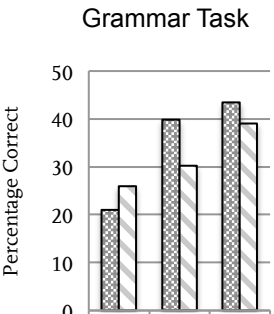
#### Females



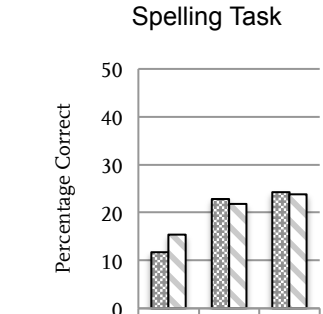

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 39.48 | 56.38 | 55.33 |
| Control | 43.29 | 47.84 | 53.42 |




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 26.90 | 39.47 | 39.67 |
| Control | 27.95 | 34.46 | 39.32 |

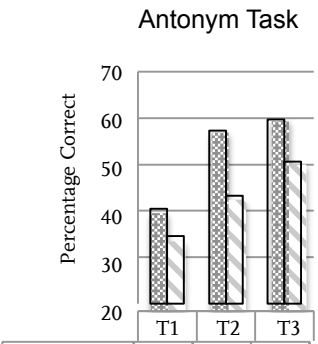



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 21.03 | 39.83 | 43.50 |
| Control | 25.89 | 30.27 | 39.04 |

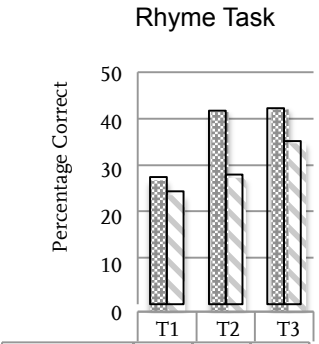



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 11.72 | 22.83 | 24.26 |
| Control | 15.42 | 21.76 | 23.78 |

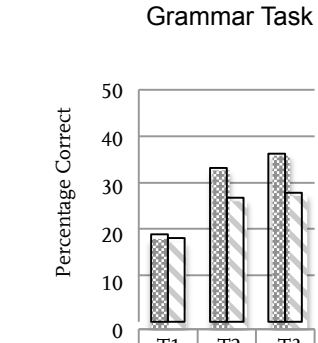
## Males



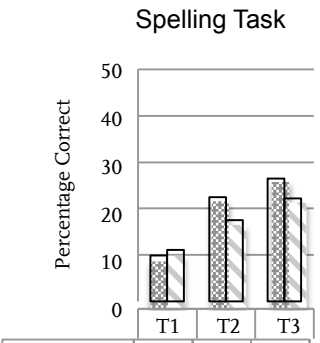

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 40.39 | 57.24 | 59.74 |
| Control | 34.60 | 43.23 | 50.67 |




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 27.37 | 41.71 | 42.24 |
| Control | 24.29 | 27.90 | 35.17 |



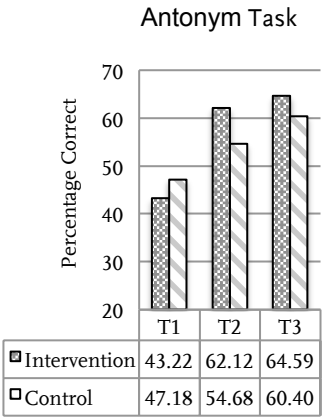

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 18.82 | 33.16 | 36.18 |
| Control | 18.10 | 26.77 | 27.83 |



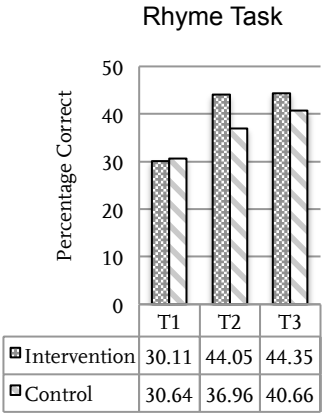

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 9.86 | 22.50 | 26.53 |
| Control | 11.15 | 17.54 | 22.13 |

## Appendix E.2. Number of Languages Spoken

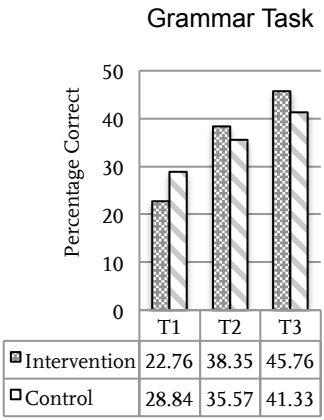
### Monolingual Students



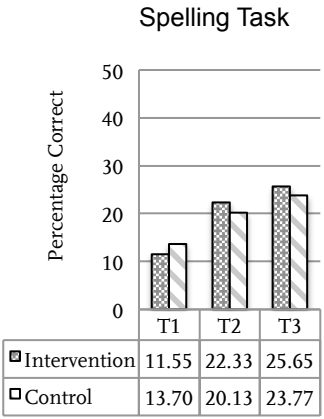

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 43.22 | 62.12 | 64.59 |
| Control | 47.18 | 54.68 | 60.40 |




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 30.11 | 44.05 | 44.35 |
| Control | 30.64 | 36.96 | 40.66 |

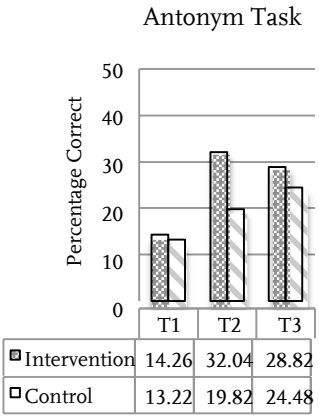



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 22.76 | 38.35 | 45.76 |
| Control | 28.84 | 35.57 | 41.33 |

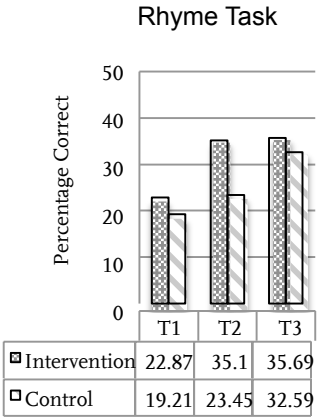



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 11.55 | 22.33 | 25.65 |
| Control | 13.70 | 20.13 | 23.77 |

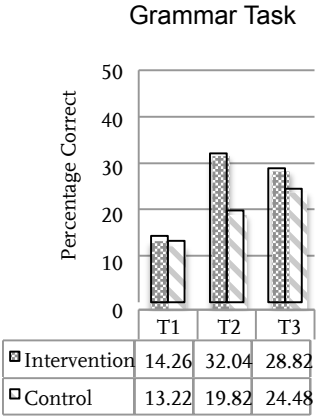
## Bilingual/ Multilingual



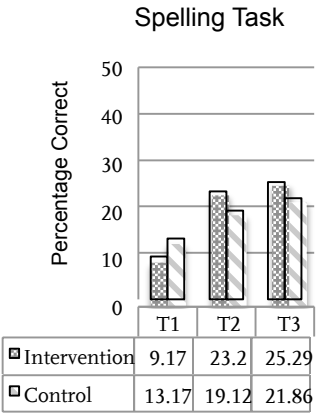

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 14.26 | 32.04 | 28.82 |
| Control | 13.22 | 19.82 | 24.48 |




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 22.87 | 35.1 | 35.69 |
| Control | 19.21 | 23.45 | 32.59 |



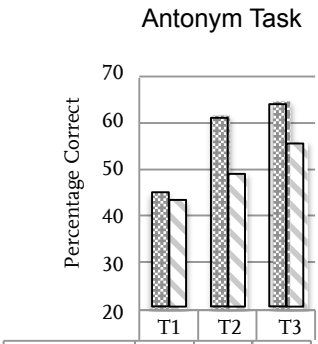

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 14.26 | 32.04 | 28.82 |
| Control | 13.22 | 19.82 | 24.48 |



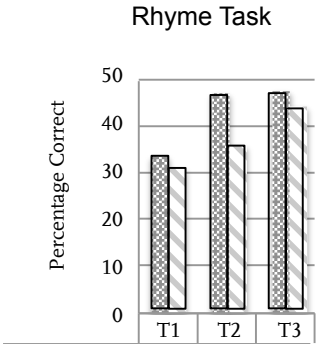

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 9.17 | 23.2 | 25.29 |
| Control | 13.17 | 19.12 | 21.86 |

## Appendix E.3: Type of Learner

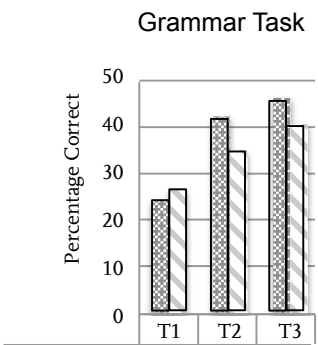
### Typical Learner



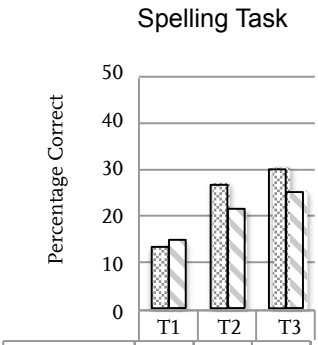

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 44.64 | 60.62 | 63.57 |
| Control | 43.00 | 48.65 | 55.20 |




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 32.89 | 45.94 | 46.43 |
| Control | 30.39 | 35.10 | 43.17 |

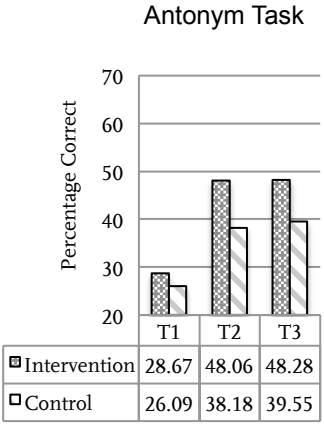



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 23.81 | 41.34 | 45.20 |
| Control | 26.12 | 34.23 | 39.70 |

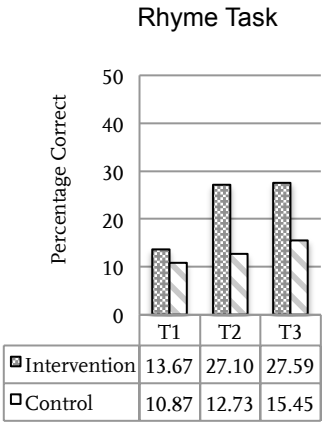



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 13.23 | 26.63 | 29.90 |
| Control | 14.65 | 21.36 | 25.00 |

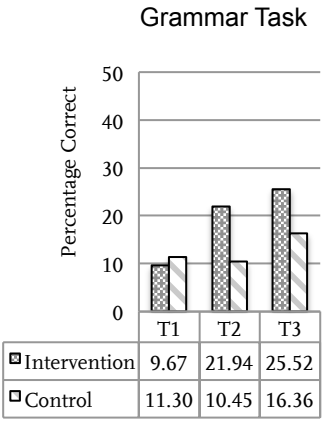
## Non-Typical Learners



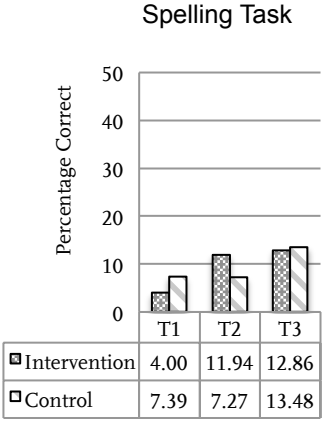

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 28.67 | 48.06 | 48.28 |
| Control | 26.09 | 38.18 | 39.55 |




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 13.67 | 27.10 | 27.59 |
| Control | 10.87 | 12.73 | 15.45 |

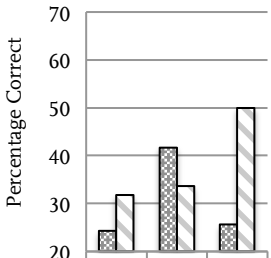



| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 9.67 | 21.94 | 25.52 |
| Control | 11.30 | 10.45 | 16.36 |



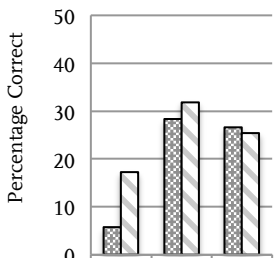

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 4.00 | 11.94 | 12.86 |
| Control | 7.39 | 7.27 | 13.48 |

Antonym Task



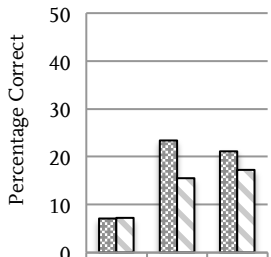

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 24.29 | 41.67 | 25.56 |
| Control | 31.82 | 33.64 | 50.00 |

Rhyme Task



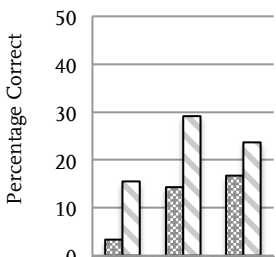

| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 5.71 | 28.33 | 26.67 |
| Control | 17.27 | 31.82 | 25.45 |

Grammar Task




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 7.14 | 23.33 | 21.11 |
| Control | 7.27 | 15.45 | 17.27 |

Spelling Task




| | T1 | T2 | T3 |
|---|---|---|---|
| Intervention | 3.33 | 14.29 | 16.67 |
| Control | 15.45 | 29.09 | 23.64 |

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This study examines the indirect correspondence between the spoken and written word confronting dialect speakers in northwestern Switzerland and the cognitive self-regulation required to function in such a diglossia. To interpret the effect of such self-regulation, a language acquisition program, designed to improve the rate of language acquisition as well as working memory, was implemented in sixteen classrooms within eight schoolhouses on two hundred and seventy-nine 3rd grade students divided into a control group and an intervention group. An evaluation was then conducted in three stages: pre-intervention, post-intervention and four months later at a follow-up. The results were assessed based on four parts related to printspeech mismatch (vocabulary, rhyme, grammar and spelling) and also on a working memory task based on attention and concentration. Significant differences in the two groups' results would indicate that a self-regulatory component could help mediate between working memory and language learning.


ISBN 978-3-86309-610-6
9 783863 096106
www.uni-bamberg.de/ubp/