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The person born
with a
talent
they are meant to use
will find
their greatest happiness
in using it.
(Johann Wolfgang von Goethe)

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List of Abbreviations

AoA	Age of Acquisition
CANAL_F	Cognitive Ability for Novelty in Acquisition of Language as applied to Foreign language
CEFR	Common European Framework of Reference for Languages
CLIL	Content and Language Integrated Learning
CPH	Critical Period Hypothesis
FL	Foreign Language
Hi-LAB	High-Level Language Aptitude Battery
ID	Individual Differences
IMMA	Intermediate Measures of Music Audiation
LCDH	Linguistic Coding Differences Hypothesis
LTM	Long Term Memory
L1	First Language
L2	Second Language
MLAT	Modern Language Aptitude Test
MLR	Multiple Regression
PLAB	Pimsleur Language Aptitude Battery
PM	Phonological Memory
SI	Speech Imitation
SLA	Second Language Acquisition
STM	Short Term Memory
WM	Working Memory

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Theoretical Part

1 Introduction

Every man is in certain respects:
a. like all other men,
b. like some other men,
c. like no other man.
(Kluckhohn & Murray 1948: 35)

Language allows us to communicate to each other, to share and express our personal beliefs, opinions or feelings. It is deeply rooted in our social as well as cultural identity, and after all, the way we use language tremendously affects how we are perceived by others.

No wonder thus "language acquisition is one of the most impressive and fascinating aspects of human development" (Lightbrown and Spada 2013: 5), and even though the origins of human language will always be hidden to us, exploring the ways languages are acquired- whether as a first, second, or foreign language- has been of central interest ever since. Particularly, research in second language acquisition (SLA) has gained utmost attention within the last decades, partly as a result of the demands of our globalized world which yearn for the ability to communicate across the globe.

Language is a shared property of humanity and thus it appears reasonable to view the ability to acquire as well as apply it appropriately as something that makes us similar to each other. Yet, this is only partially true since humans differ from each other, even in such a general principle as language acquisition. Whilst first language acquisition normally does not involve much endeavour of the individual, vast differences can be observed in the acquisition of a second or foreign language (Dörnyei 2006). These Individual differences (IDs) of the language learner have become of tremendous interest among scholars in the field of SLA (e.g. Skehan 2003).

Aside from an individuals' personality or motivation, one factor of the mind's uniqueness that has received special attention over the past years, is language learning aptitude. Beyond any doubt, some people learn a second language more quickly, more

easily, and with greater success than others. They truly seem to be gifted, or more colloquial, they simply have a flair for languages.

Research in this interdisciplinary field of psychology, linguistics, biology, and medicine, to name only a few, consistently tries to establish universal principles regarding the phenomenon of language aptitude (Reiterer 2009: 157). Scholars not only aim to discover the origins of linguistic giftedness, be it nature or nurture, but also try to identify the various components aptitude is composed of (e.g. Carroll 1959; Skehan 2003).

Furthermore, scientific research seeks to detect other factors which might influence and consequently add to reveal the nature of language talent. This aim is reflected in recent research that assumes working memory (e.g. Skehan 1998; Doughty et. a. 2013); and musicality (e.g. Christiner and Reiterer: 2013) as two of these *other factors* crucially affecting language aptitude.

In view of this line of inquiry, the present thesis targets to contribute to previous research and thus seeks to develop a better understanding of the relationship between the cognitive domains of language aptitude, working memory, and musicality. Moreover, it tries to enrich the existing body of research with latest insights from a cross-sectional psycholinguistic study which was conducted among primary school-aged children.

Embracing knowledge from multiple disciplines, this thesis thus unfolds an exciting and fascinating field of research in one particular domain of human ability, that is *giftedness*. Furthermore, it provides a great chance to broaden our mind and understanding on how working memory and musicality may affect foreign language aptitude, and, consequently, success in foreign language learning.

Findings are desired to vitally contribute to the field of foreign language teaching at primary level by proposing ways of teaching which take these cognitive domains into account and thus help young foreign language learners to develop their skills in the most conducive and beneficial way.

2 Second Language Acquisition

The present thesis assumes language learning aptitude as one of the most significant factors among all individual differences (IDs) which affect variation in second language learning outcome. Yet, to understand the ample impact of individual differences, in particular the notion of *language learning aptitude*, it appears inevitable to clarify the general goals and phenomena of second language acquisition (SLA) at first.
This chapter therefore is dedicated to the tremendously wide research field of second language acquisition.

2.1 The goals of SLA

The study of how humans learn a second language (L2) found its beginnings in the second half of the twentieth century. According to Ellis, among others, this special interest in L2 learning was to some extent a result of globalization combined with the rise of electronic communication, which suddenly allowed people to interact across linguistic and geographic boundaries (Ellis 1997: 3). Apparently, the ability to master a foreign language has become indispensable so as to meet the demands of today's globalized world, and thus its study has reached persisting interest across the globe, as well.
Second language acquisition is defined as "the way in which people learn a foreign language other than their mother tongue, inside or outside of a classroom, and 'Second Language Acquisition' as the study of this" (Ellis 1997: 3).
Essentially, SLA pursues two goals: on the one hand, it is concerned with the *description* of L2 acquisitions. This is done by collecting samples of learner language at various points and by describing its development. Another goal is the *explanation* of SLA, which tries to identify factors that contribute to finding out why a learner learns an L2 exactly in the way he or she does (Ellis 1997: 4).
The study of SLA thus tries to identify as well as explain observations in second language learning. These observed phenomena shall be outlined in the following section.

2.2 Observed phenomena of SLA

There exist numerous theories in SLA which all try to unravel foreign language processing. Yet, this thesis aims to investigate only one of the countless aspects related to SLA, thus it seems rather gratuitous to portray them all. Nevertheless, merely for completeness, ten theories which have won broader recognition over time, shall be listed here: *Universal Grammar, Usage-based approaches, Skill Acquisition Theory, Declarative/Procedural Model, Input Processing Theory, Processability Theory, Concept-oriented Approach, Interaction Framework, Vygotskian Sociocultural Theory,* and *Complexity Theory*. (For details see details see VanPatten and Williams 2015: *Theories in second language acquisition*).

All above mentioned theories seek to untangle the mystery of SLA from their particular perspective. Some commonly observed phenomena have been catalogued by M.H. Long (Long 1990: 649ff) and are summarized by VanPatten and Williams (VanPatten and Williams 2015: 9-11) below:

> *Observation 1: Exposure to input is necessary for SLA*. This observation means that acquisition will not happen for learners of a second language unless they are exposed to input. Input is defined as language the learner hears (or reads) and attends to for its meaning. […] Language the learner does not respond to for its meaning (such as language used in mechanical drill) is not input. Although everyone agrees that input is necessary for SLA, not everyone agrees that it is sufficient.
> *Observation 2: A good deal of SLA happens incidentally*. This captures the observation that various aspects of language enter learner´s minds/brains when they are focused on communicative interaction (including reading). In other words, with incidental acquisition, the learner´s *primary* focus of attention is on the message contained in the input, and linguistic features are "picked up" in the process. Incidental acquisition can occur with any aspect of language […]. *Observation 3: Learners come to know more than what they have been exposed to in the input*. Captured here is the idea that learners attain unconscious knowledge about the L2 that could not come from the input alone. […] Another kind of unconscious knowledge that learners attain involves ambiguity. Learners come to know, for example, that the sentence *John told Fred that he was going to sing* can mean that either John will sing or Fred will sing.
> *Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure*. Learners' speech shows evidence of what are called "developmental sequences." […] In addition to developmental sequences, there are such things as "acquisition orders" for various inflections and small words. […] These stages of development also capture the observation that learners may pass through "U-shaped" development. In such as case, the learner starts out

doing something correctly then subsequently does it incorrectly and then "reacquires" the correct form. [...]

Observation 5: Second language learning is variable in its outcome. Here we mean that not all learners achieve the same degree of unconscious knowledge about a second language. They may also vary on speaking ability, comprehension, and a variety of other aspects of language knowledge and use. This may happen even under the same conditions of exposure. Learners under the same conditions may be at different stages of developmental sequences or be further along than others in acquisition orders. What is more, it is a given that most learners do not achieve native-like ability in a second language.

Observation 6: Second language learning is variable across linguistic systems. Language is made up of a number of components that interact in different ways. For example, there is the sound system (including rules on what sound combinations are possible and impossible as well as rules on pronunciation), the lexicon [...], syntax [...], pragmatics [...], and others. Learners may vary in whether the syntax is more developed compared with the sound system, for example.

Observation 7: There are limits on the effects of frequency on SLA. It has long been held that frequency of occurrence of a linguistic feature in the input correlates with whether it is acquired early or late, for example. However, frequency is not an absolute predictor of when a feature is acquired. In some cases, something very frequent takes longer to acquire than something less frequent.

Observation 8: There are limits on the effect of a learner's first language on SLA. Evidence of the effects of the first language on SLA has been around since the beginning of contemporary SLA research (i.e., the early 1970s). It is clear, however, that the first language does not have massive effects on either processes or outcomes, as once thought. [...] Instead, it seems that the influence of the first language is somehow selective and also varies across individual learners.

Observation 9: There are limits on the effects of instruction on SLA. Teachers and learners of languages often believe that what is taught and practiced is what gets learned. The research on instructed SLA says otherwise. First, instruction sometimes has no effect on acquisition. As one example, instruction has not been shown to cause learners to skip developmental sequences or to alter acquisition orders. Second, some research has shown that instruction is detrimental and can slow down acquisition processes by causing stagnation at a given stage. On the other hand, there is also evidence that in the end, instruction may affect how fast learners progress through sequences and acquisition orders and possibly how far they get in those sequences and orders. Thus, there appear to be beneficial effects from instruction, but they are not direct and not what many people think.

Observation 10: There are limits on the effects of output (learner production) on language acquisition. Although it may seem like common sense that "practice makes perfect", this adage is not entirely true when it comes to SLA. There is evidence that having learners produce language has an effect of acquisition, and there is evidence that it does not. What seems to be at issue, then, is that whatever role learner production (i.e., using

> language to speak or write) plays in acquisition, there are constraints on that role, as there on other factors, as noted earlier.

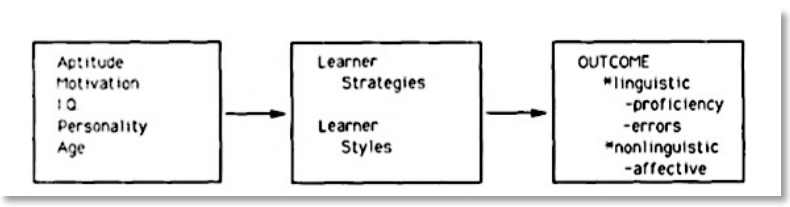
As already stated earlier, theories in SLA try to shed lights on these phenomena from their particular point of view. Some can account for all of them, whilst others can provide explanations only for a few. Essentially, these theories inspired various different and partly incompatible hypotheses, models and approaches towards second language acquisition and teaching (Lightbrown and Spada 2013: 103ff). Still, what all of them seem to have in common, is emphasizing the differences of the individual language learner as a highly relevant factor in learning a second language.
As these individual differences of the language learner constitute one of the central and fundamental pillars of the present thesis, they are examined in the sections below.

2.3 Individual differences affecting SLA

In fact, humans manage to acquire their first language without remarkable complications or difficulties, provided that they had enough time and chance to use it. Interestingly, this is not the case with acquiring second or foreign languages, where people are said to differ in their ease and success truly significantly.
Unfortunately, until today, no common agreement has been reached on why those differences exist, and why it is that some learn a language easily whilst others struggle and eventually do not succeed (Sparks 2006: 546). What is commonly accepted by neuro-linguists, though, is that these individual differences "leave traces in the form of differential brain activation patterns in 'different' bilinguals" (Reiterer 2009: 162). Yet, it is still not clear whether these variables are pre-dispositioned or influenced by environment and experience. This ties in with the current neuroscientific controversy of "'how *hard wired* and bio-chemical is the human mind/psyche?' (e.g. Mohr 2003)" (Reiterer 2009: 162). Further insights into individual differences on brain organisation are described later in this thesis.
So, for the time being, it appears sufficient to notice the existence of individual factors in SLA and their major impact on L2 achievement. While integrating differences in educational settings has largely been neglected, in language science it has received considerable attention.
Dörnyei refers to IDs as "dimensions of enduring personal characteristics that are assumed to apply to everybody and on which people differ by degree" (Dörnyei 2006:

42). IDs thus are seen either as inherent or influenced by external factors, or generated by both internal and external traits. As already touched previously, the distinction between *nature and nurture* is picked up once more in chapter 3.

With regard to Dörnyei, the five most influential ID domains that affect L2 learning, are *personality, motivation, learning style, learning strategies,* and *aptitude* (Dörnyei 2006: 42). Skehan, on the other hand, regards *aptitude, motivation, IQ, personality,* and *age* as the most dominant IDs, and locates *learner strategies* and *learner styles* somewhere in between *aptitude* and *motivation* on the one side, and *learner outcome* on the other side. Figure 1 below illustrates Skehan's model of IDs and their influences of language learning.



| **Figure 1. Influences of language learning** (Skehan 1989: 277)

Figure 1 shows the impact of IDs, shouldered by learner strategies and styles, on learning outcomes.

As IDs are of utmost relevance in this thesis, each is discussed in greater detail below. To begin with, the impact of age on second language learning is addressed.

2.3.1 Age

One factor that is said to play an indispensable role in SLA is the learner's age. At first sight, age appears to be a rather straight forward variable and much more easily to measure than more complex individual differences, such as motivation, personality, or aptitude. However, when looking at the age factor more closely, it might not be as simple as expected.

According to Scovel, one popular assumption is that *younger is better*, that is the younger the learner, the faster and better he or she picks up language (Scovel 2000 in Abello-Contesse 2009: 170). It has fairly often been observed that young language learners show high levels of proficiency in the oral production of a second language, i.e. in pronunciation. Consequently, laypeople generally classify children as more successful language learners than adults. Pinter reports that this belief resulted in the

introduction of English at primary school- and even kindergarten level (Pinter 2006: 29). This claim, though, finds its partial justification in the concept of the Critical Period Hypothesis (CPH).

The CPH was originally introduced by Eric Lenneberg in 1967. According to Lightbrown and Spada (2013: 92), the CPH posits that there is only a special time in human life ending shortly before puberty where a foreign language can be learned to a native-like level. They further summarize that these developmental changes in the brain have an impact on language acquisition, and so language that is learned in or after the critical period "may not be based on the innate biological structures believed to contribute to first language acquisition or second language acquisition in early childhood" (Lightbrown and Spada 2013: 93). This claim of age of acquisition (AoA) affecting brain processing with respect to language learning is supported by several neuro-linguistic studies which partly will be sketched later. Unfortunately, there exists an equal amount of studies against this belief (Reiterer 2009: 169). Abello-Contesse (2009: 171), for instance, reports of various empirical studies that have shown no direct correlations between AoA and L2 development. He continues that some research even suggests that older learners are the more efficient learners as they make use of their world- and metalinguistic knowledge more effectively than children. Additionally, memory strategies and analytical skills appear more advanced in older language learners, thus, they have a clearer picture about why the learn a second language, after all (Lightbrown and Spada 2013: 93). Similarly, Dörnyei (2009: 249) posits that the the *younger-the better hypothesis* is rather problematic since it "only applies optimal naturalistic SLA contexts". In fact, these naturalistic contexts are only given when a child is surrounded by a native-speaking environment. Correspondingly, Dörnyei (2009: 251) assumes the idea of introducing a second language at primary school or even kindergarten level most likely as counterproductive.

Nevertheless, the concept of CPH cannot be rejected at all, and so it remains popular in the field of SLA. Scholars, educators, parents and other parties involved in second language learning thus believe that a successful language learner starts learning when he or she is very young.

In a word, research findings of age and SLA acknowledge pronunciation as the domain of young learners whereas other linguistic features, such as syntax and morphology are regarded as domains of older learners (Lightbrown and Spada 2013: 94).

Aside from these linguistic differences, Dörnyei (2009: 249) confirms another aspect in which older and younger language learners greatly differ. That is the youth's uninhibited attitude and sustainable motivation towards foreign language learning which most likely lies at the bottom of their success.

With respect to language pedagogy, Abello-Contesse (2009: 171) concludes that

* there is no single 'magic' age for L2 learning,
* both older and younger learners are able to achieve advanced levels of proficiency in an L2, and
* the general and specific characteristics of the learning environment are also likely to be variables of equal or greater importance.

As the present thesis examines language learning aptitude in primary school children, special attention to the age-factor in relation to findings in neuro-linguistics as well as language learning aptitude is given later, once more.

The following section deals with another aspect that claims to have a significant effect on SLA, that is motivation.

2.3.2 Motivation

Zoltan Dörnyei remarks that "it is universally accepted that motivation plays a vital role in academic learning in general, and this is particularly true of the sustained process of mastering a second language" (Dörnyei 2006: 50). It is rather obvious why motivation is that important in SLA. It, so Dörnyei (2015: 72),

> provides the primary impetus to initiate L2 learning and later the driving force to sustain the long, often tedious learning process; indeed, all the other factors involved in SLA presuppose motivation to some extent. Without sufficient motivation, even individuals with the most remarkable abilities cannot accomplish long-term goals, and neither are appropriate curricula or good teaching enough on their own to ensure student achievement.

Ellis explains that motivation is concerned with the affective states and attitudes which affect individual L2 learning (Ellis 1997: 75). In other words, it describes the degree of effort a learner puts into his learning. Researching the impact of motivation on SLA started with Robert Gardner and his colleagues in the 1980s, who coined the terms *instrumental motivation* and *integrative motivation*. Instrumental motivation is motivation to learn a second language "for immediate or practical goals", whereas integrative motivation is seen as motivation to learn a second language "for personal

growth and cultural enrichment through contact with speakers of the other language" (Lightbrown and Spada 2013: 87). There have been determined two further types of motivation, that is *resultative* and *intrinsic motivation* (Ellis 1997: 75). Resultative motivation, he continues, is motivation that is due to successful L2 learning, whereas intrinsic motivation refers to situations where the learner neither holds particular reasons nor positive or negative attitudes towards the language he learns. These kind of learners may find particular learning tasks intrinsically motivating in accordance to the extent to which they engage with the task.

Dörnyei points out that there was a renaissance in motivational research in the 1990s. Hence, several new approaches were proposed (Dörnyei 2006: 51). Two of these rather contemporary models of motivation are briefly portrayed at this point.

The first one was developed by Zoltan Dörnyei in 2001 and is referred to as the *process-oriented model of motivation*. It claims that the language learner, over time, passes through different phases while acquiring language and, correspondingly his motivation comes and goes. Thus, motivation is seen as a dynamic system. The first phase is called the *Preactional Stage,* i.e. the stage where the learner gets started and sets his goals; the second phase is called *Actional Stage* and is concerned with the way the learner carries out learning tasks so to stay motivated. Finally, the learner passes through the third phase, that is the *Postactional Stage,* in which he evaluates his performance (Dörnyei 2006: 52; Lightbrown and Spada 2013: 87).

A second model which shall be introduced in this thesis is, after Dörnyei, the *reinterpretation of the integrative motive*. Dörnyei refutes Gardner's concept of *integrative motivation*, which "concerns a positive interpersonal/affective disposition toward the L2 group and the desire to interact with and even become similar to valued members of that community" (Dörnyei 2006: 51-52) since it cannot be applied to all learning contexts. Gardner, apparently, argues that an integrative motivational orientation implies an identification with the L2 community. Yet, particularly in the case of Global English, there does not exist a particular L2 community anymore. This development obviously yearns for a new conceptualization of the integrative motive, i.e. a "virtual or metaphorical identification with the sociocultural loading of a language rather than with the actual L2 community" (Dörnyei 1990), and "in the case of the undisputed world language, English, this identification would be associated with a non-parochial, cosmopolitan, globalized world citizen identity" (Dörnyei 2006: 52-53).

Integrative motivation, thus, can be seen as the desire to identify with an imagined L2 community.

It would, however, go far beyond the scope of this thesis to further examine the countless perspectives towards language learner motivation and its remarkable impact on SLA.

Yet, to summarize an exceptionally complex phenomenon in one sentence, recent research views motivation as highly situated and composed of several diverse components which develop over time (Dörnyei 2015: 104).

The following section introduces another major variable which in all likelihood affects SLA, that is the personality of the second language learner.

2.3.3 Personality

It is commonly agreed that personality traits affect second language learning to some extent. Personality can be defined as one's "whole character and nature" (Collins Cobuild Dictionary). This definition, in fact, is more than broad, and thus numerous contrasting proposals to the study of personality have been developed.

Research, however, suggests that personality characteristics affect SLA in a far less manner than variables such as aptitude and motivation (Dörnyei 2006: 43) since correlations between personality and SLA produce different outcomes. These varying results might be based on its multiple diverse definitions. Dörnyei therefore states that "personality is such a crucial aspect of psychology that every main branch of psychology has attempted to contribute to the existing knowledge in this area and thus the scope of theorising can be as broad as the differences among the various paradigms in psychology" (Dörnyei 2006: 43). Nevertheless, he (2006: 43) continues that nowadays personality psychology has come to an agreement in defining the main domains of human personality. Thus, contemporary personality research proposes three models which even slightly overlap.

The first model of personality is Eysenck's *three-component construct*, the second one is based on Eysenck's and is called the *Big Five Model*. The former contrasts three principal personality dimensions, those are: "(i) extraversion with introversion, (ii) neuroticism and emotionality with emotional stability, and (iii) psychoticism and toughmindedness with tender-mindedness" (Dörnyei 2006: 43). The latter, in contrast, preserves Eysenck's first two but instead of psychoticism proposes three extra dimensions, those are: *conscientiousness, agreeableness* and *openness to experience*

(Dörnyei 2006: 43). For a better understanding, table 1 below illustrates the components of the Big Five Model and their characteristics.

Table 1. Descriptions for the components of the Big Five Model, McCrae and Costa (Dörnyei 2015: 18).

Openness	High scores are imaginative, curious, flexible, creative, moved by art, novelty seeking, original, and untraditional; low scores are conservative, conventional, down-to-earth, unartistic, and practical.
Conscientiousness	High scores are systematic, meticulous, efficient, organized, reliable, responsible, hard-working, persevering, and self-disciplined; low scores are unreliable, aimless, careless, disorganized, late, lazy, negligent, and weak-willed.
Extraversion-Introversion	High scores are sociable, gregarious, active, assertive, passionate, and talkative; low scores are passive, quiet, reserved, withdrawn, sober, aloof, and restrained.
Agreeableness	High scores are friendly, good-natured, likable, kind, forgiving, trusting, cooperative, modest, and generous; low scores are cold, cynical, rude, unpleasant, critical, antagonistic, suspicious, vengeful, irritable, and uncooperative.
Neuroticism-Emotional Stability	High scores are worrying, anxious, insecure, depressed, self-conscious, moody, emotional, and unstable; low scores are calm, relaxed, unemotional, hardy, comfortable, content, even tempered, and self-satisfied.

Empirical studies which all tested the in table 1 above outlined Big Five model can more than less confirm its validity. Yet, it has also been criticized since in some of the scales one end of the continuum is highly obvious much more positive than the other end.

Dörnyei further explains that this construct was used in a study by Verhoeven and Vermeer (2002) to investigate how personality characteristics correlate with *communicative competence*, which was divided into *organisational, strategic,* and *pragmatic* competence, of young teenage language learners. The study showed that only the fifth dimension, that is *openness to experience*, correlated significantly with

the language abilities of the teenagers. According to Dörnyei, "these findings are interesting in themselves and they also indicate that if scholars include in their research paradigm a more elaborate conception of L2 proficiency than a global L2 proficiency measure, stronger and more meaningful relationships can be identified" (Dörnyei 2006: 45).

A more dynamic model of personality was proposed by McAdams and Pals (2006). It is called the *New Big Five,* and attempts to show how personality transpires and develops in different situations within a particular sociocultural context (Dörnyei 2015: 24). For a better understanding, figure 2 below presents the *New Big Five*.

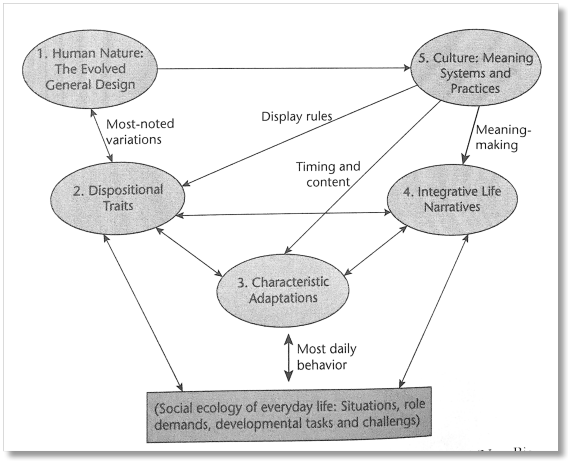


Figure 2. The New Big Five
(McAdams and Pals 2006: 213 in Dörnyei 2015:24)

As figure 2 illustrates, personality consists of multiple dimensions which slightly interrelate: firstly, there exists a general human nature which we all share, that is referred to as *general design*. *Dispositional traits,* then, relate to all the features of personality which seem to be relatively stable throughout an individuals' lifetime- it is fairly similar to the features described in the Big Five model. At the third level, humans employ diverse behavioural strategies as responses to particular situations, this is referred to as *characteristic adaptions*. The next domain is the *integrative life narrative*, which is steadily applied and involves how humans define themselves, how they interact with others, and how they control their behaviour. Lastly, there is the *sociocultural context* that influences all of this accordingly (Dörnyei 2015: 25). Dörnyei sums up that "underpinning all this is the individual's biological inheritance, as well as various sociocultural background influences, thereby offering a gateway to a more integrated theory of personality that attempts to explain the dynamic development of real people in actual contexts" (Dörnyei 2015: 25).

An interesting model of the *narrative identity* within the personality structure of the SL learner which is based on the *New Big Five* present Dörnyei and Ryan (2015). They consider L2 narrative identity as an "integral part of the individual´s overall life narrative, responsible for processing past L2-related experiences and constructing future goals" (Dörnyei and Ryan 2015: 202). Figure 3 below represents this model.

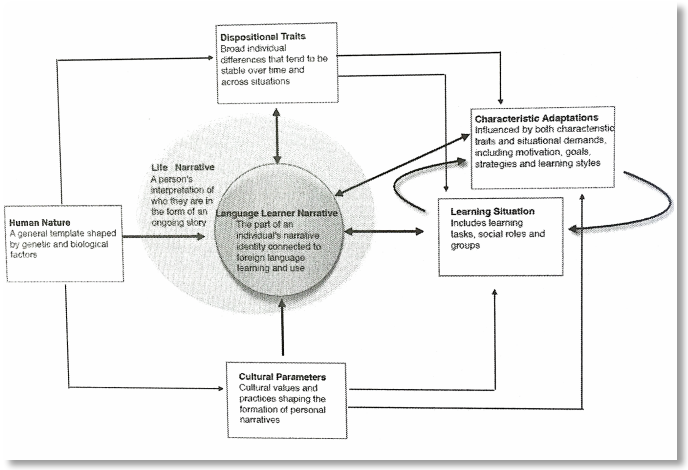


Figure 3. A narrative-based representation of the psychology of the language learner (Dörnyei and Ryan 2015)

In SLA research, fairly understandable, the most studied aspect of personality has been the dimension of *extraversion* and *introversion*. Sadly, research shows mixed or even insignificant results of correlations between L2 learning and these variables (Dörnyei 2015: 30). This lets Dörnyei (2015: 31) conclude, that L2 learning, depending on the particular situation and task, may either accommodate introverts or extroverts, or both.

Other aspects which have been linked to personality are inhibition, learner anxiety, dominance, responsiveness, self-esteem, empathy, and talkativeness, to name a few (Lightbrown and Spada 2013: 85-86).

Although it is commonly agreed that personality plays a rather influential role in L2 learning, research has failed to find significant correlations. This major discrepancy between research findings and perception of personality might be the reason why interest in this field of SLA has decreased and no articles have been published since 2005.

The following section roughly outlines a third ID which is said to affect second language acquisition, that is learning style.

2.3.4 Learning style

Learning style can be defined as "an individual's natural, habitual, and preferred way(s) of absorbing, processing, and retaining new information and skills" (Reid 1995a: viii). Armstrong, Peterson, and Rayner (2012: 451) define learning style as follows:

> Learning styles are individuals' preferred ways of *responding (cognitively and behaviourally)* to learning tasks which change depending on the environment or context. They can affect a person's motivation and attitude to learning, and shape their performance.

Therefore, learners firstly vary perceptually-based: there exist visual learners, auditory learners, kinaesthetic learners as well as learners who have a tactile- group-, or individual preference. Research further differentiates between contrasting cognitive learning styles. Thus, it is distinguished between learners who are *field independent* or *field dependent*. The former relates to learners who separate information, whereas the latter refers to learners who learn in a more holistically manner (Lightbrown and Spada 2013: 83).

With respect to SLA, Dörnyei (2006: 57) summarizes that empirical studies concerning learning style in L2 have produced insignificant outcome, and consequently the interest in learning style research has decreased. Yet, he suggests two learning style constructs which might stimulate new interest in the field, those are Cohen, Oxford and Chi's (2001) *Learning Style Survey* and the *Ehrman and Leaver Style Questionnaire* (Ehrman and Leaver 2003). (Both can be reviewed in: Zoltan Dörnyei; Stephan Ryan. 2015. *The psychology of the language learner. Revisited.* New York: Routledge).

The next factor which most likely affects SLA concerns the technique a learner uses to learn, and is commonly known as learning strategies. It is briefly outlined in the following section.

2.3.5 Learning strategies

Learning strategies refers to "specific actions, behaviours, steps, or techniques that students use to improve their own progress in developing skills in a second or foreign language. These strategies can facilitate the internalisation, storage, retrieval or use of the new language" (Oxford 1999: 518). Learning strategies, thus are paths learners use so as to learn an L2. Ehrman, Leaver, and Oxford (2003: 315) argue that:

> A given learning strategy is neither good nor bad; it is essentially neutral until it is considered in context. A strategy is useful under these conditions: (a) the strategy relates well to the L2 task at hand, (b) the strategy fits the particular student´s learning style preferences to one degree or another, and (c) the student employs the strategy effectively and links it with order relevant strategies.

Ellis states that learners know about the strategy they use and can therefore explain what they did (Ellis 1997: 77). He continues that one can differentiate between cognitive, metacognitive, and social/affective strategies. The first one relates to the way how learners recombine or transform language material in a new way. Metacognitive strategies concern the self-evaluation and monitoring of produced language, and finally social/affective strategies refer to the method a learner picks in order to ask his interlocutor for clarification (1997: 77). Dörnyei (2006: 59) laments that a "theoretical clarification about the nature of the learning strategy concept has not taken place". Nevertheless, a recent definition of the characteristics of language learning strategies was proposed by Griffiths (2013). Her conceptualization is illustrated in table 2 below.

Table 2. Griffiths' (2013) definitional characteristics of language learning strategies (Dörnyei 2015: 148).

Characteristics	Description
Activity	Strategies are active in nature
Consciousness	Strategies are used consciously by learners
Choice	Strategies are chosen with the learner´s active involvement
Goal Orientation	Strategies are goal-oriented and purposeful
Regulation	Strategies are used by learners to regulate learning and make learners active participants in that learning
Learning Focus	Strategies are employed with learning in mind as opposed to communication

Dörnyei regards another concept, developed by Joan Rubin-an expert in the language learning strategy domain-, worth mentioning. That is the concept of *learner self-management* and it "refers to the ability to deploy *metacognitive strategic procedures* and to access relevant *knowledge and beliefs*" (Dörnyei 2006: 59). Metacognitive strategic procedures entail problem-solving, implementation, evaluating, planning,

and monitoring, while knowledge and beliefs relate to strategy knowledge, background knowledge, beliefs, task- and self-knowledge.

As previously stated, no consensus on defining language learning strategies has yet been found. We can however subsume its notion by "thoughts and actions, consciously chosen and operationalized by language learners, to assist them in carrying out a multiplicity of tasks from the very onset of learning to the most advanced levels of target-language performance" (Cohen 2012: 136).

The last examined individual difference in SLA is aptitude. Aside from motivation, it claims to have the greatest influence on SLA. As is also builds the central concern of the present thesis, chapter 3 is fully dedicated to this domain. A little glimpse into language learning aptitude shall though be given now.

2.3.6 Aptitude

Language learning aptitude is considered as one of the most important IDs in second language acquisition (Skehan 2002).

Truly, some people seem to learn a foreign language faster, more easily, and apparently with better results than others. Therefore, innate differences in the ability to learn a second language obviously exist. This observed phenomenon has been referred to by various names, ranging from *foreign/second language aptitude*, *language talent*, or *linguistic giftedness* to *special propensity* or more informal terms, such as *flair* or *knack* for languages (Dörnyei 2006: 46).

As numerous as the names of this phenomenon, are its definitions. Dörnyei admits that not even experts in language, language teaching, and mainstream psychology would dare to ultimately define what exactly language aptitude is (2006:46).

Thus, it appears rather impossible to provide one single definition of aptitude since "such a definition depends largely on both the theoretical and empirical context of a given author" (Nardo and Reiterer 2009: 213). They yet continue that most scholars agree on two features related to aptitude (based on Jorgenson 2008):

* it is regarded as something special, or rather an *exceptional capability* in a given domain;
* it is regarded as a *potential*, e.g. something capable of development.

Apparently, in SLA, different scholars provide distinct definitions of language learning aptitude. These shall be summarized in the following.

"Aptitude", according to Cronbach and Snow (1977), "is any characteristic of a person that forecasts his/her probability of success under a given treatment." (Cronbach & Snow 1977 in Russo 2011: 6). Ellis claims, that foreign language aptitude is a special talent available to a person prior to learning, and best predicts success in foreign language (Ellis 2008 in Olivares 2012: 4). Foreign language aptitude, therefore, presupposes that "there is a specific talent for learning foreign languages which exhibits considerable variation between individual learners" (Dörnyei and Skehan 2003: 560 in Wen and Skehan 2011: 16). Thus, we can say that a "language learner with a high aptitude learns with greater ease and speed but that other learners may also be successful if they preserve" (Lightbrown and Spada 2013: 80). For Robinson (Robinson 2013: 57), aptitude relates to "the ability to successfully adapt to and profit from instructed, or naturalistic exposure to the L2".

To sum up, language aptitude seems to be a special, inherent talent that not all individuals possess. It cannot be learned, however, it may be trained within limits. Additionally, it is characterised by the ability to learn an L2 more quickly and with more ease than the average language learner. Thus, there exists a general agreement that language aptitude is not about the ability to learn a foreign language but rather indicates the rate of progress of the learner under optimal learning conditions (Dörnyei 2015: 38). Nardo and Reiterer (2009: 214) summarize the concept of aptitude as something that is:

- somehow strongly connoted as innate (a gift, thus clearly separated from practice);
- oriented towards something (a propensity or potential);
- exceptional or extraordinary; and
- closely related to a skill (ability, capacity).

As can be drawn from the numerous definitions above, not even experts in the field are ultimately able to identify what language talent involves. Exploring talent in language learning consequently leads to further questions, such as

- is it nature or nurture which generates talent?
- is talent multi-componential or a rather unitary trait?
- if it is multi-dimensional, how many components does it consist of? and finally,
- is talent similar to intelligence?

Dörnyei (2006: 46) relates aptitude to the broader concept of human abilities, and thus concludes that "there is no such thing as 'language aptitude'. Instead", he continues,

"we have a number of cognitive factors making up a composite measure that can be referred to as the learner's overall capacity to master a foreign language". In other words, foreign language aptitude is not a unitary factor but rather a complex of "basic abilities that are essential to facilitate foreign language learning" (Carroll and Sapon 1959: 14). Hence, one of the above questions seems to be already answered.
Before, however, language learning aptitude is explored exceedingly and questions are debated, another field of research in SLA which only recently has advanced, deserves to be specified at this point, that is the language learner's brain. Hence, an exploration of neuro-linguistic insights into language learning shall follow next.

2.4 Second Language Learning and the Human Brain

Over the past fifteen years, foreign language learning has become of immense interest in the field of cognitive neuroscience, which is an interdisciplinary research area composed of medicine, neurology, biology, psychology, physics, linguistics, language sciences, and many more (Reiterer 2009: 155).
Technical innovations in neuroimaging, such as, fMRI, PET, or functional resonance imaging have made it possible to explore the second language learner's brain, hence, provided the opportunity to literally speaking, *watch* the processing of (new) language material: the enthusiastic search for the "language faculty" in the human brain, i.e. language talent, has thus begun (Reiterer 2009: 155-157).
Although brain research with respect to language learning backdates to the past century, it seems impossible to establish universal principles, because, according to Reiterer (2009:157) "the bilinguals themselves are so highly variable and individual, so that their internal processes in terms of neuro-fingerprints and biosignal-cascades will probably reflect this high individuality".
Brain research though made it possible to locate the most important language areas inside the human brain. The classical model of language organization in the brain dates back to Broca and Wernicke in the late nineteenth century. It identifies two areas of language processing, that is *Broca's area* and *Wernicke's area*. The former is located in the left hemisphere and is crucially involved in the production of speech, whereas the latter has traditionally been associated with receptive speech, i.e. with the understanding of it. The so-called *motor cortex* is responsible for the physical articulation of speech and finally, there is the *arcuate fasciculus* which is a cluster of

nerve fibres which connect Wernicke's and Broca's areas (Yule 2010: 157). Figure 4 below illustrates these areas inside the brain.

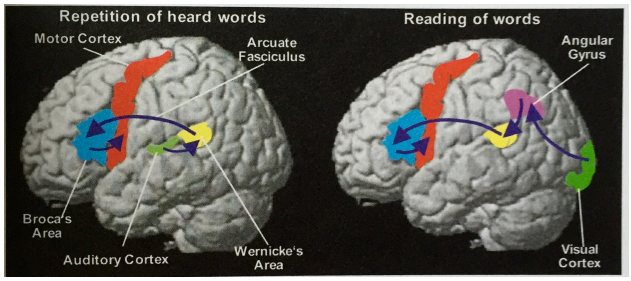


Figure 4. The classical scheme of language processing
Close to Broca's area is the motor cortex. Broca's and Wernicke's areas are connected through the arcuate fasciculus

According to Yule (2010: 159), L1 processing, i.e. the brain activity involved in hearing a word, understanding it, and then saying it, follows a definite pattern. Firstly, the word is perceived and understood via Wernicke's area, secondly, this signal is passes through the arcuate fasciculus to Broca's area which attempts to produce it by activating the motor cortex. This, of course, is a highly simplified representation of what might actually happen while processing L1.

In the case of second language acquisition, Reiterer (2009: 160) proceeds that the central question is, if there is a common faculty for all languages, i.e. if L1 and L2 processing takes place in the same areas, or if there are parts which are specifically responsible for each language? Reiterer (2009: 161) continues summarizing research findings which resulted in three different viewpoints on this question, these are:

1. There is a common area responsible for dealing with all languages an individual speaks. One might call this the *common storage* viewpoint. (Proponents of this view are Ojima et al 2005; Illes et al. 1999; Klein et al. 2006; Hasegawa et al. 2002; Hernandez et al. 2001; Xue et al. 2004a).
2. There is a specific area responsible for each language an individual speaks. This view can be referred to as *the modular view*. (Proponents of it are Kim et al. 1997; Dehaene et al. 1997; Rodriguez-Fornells et al- 2002; Kovelman et al. 2008; Perani et al. 1996).
3. There is a combination of the *common storage* and *the modular view*. Reiterer calls it the *partial overlap* view. It claims that there are some areas that show common activations for L1 and L2 processing and other areas which get only activated by the L2(s). (Supporters are Vingerhoets et al 2003; Marian et al. 2003; Chee et al. 2003; Lucas et al. 2004). Reiterer describes a sub view of the *partial overlap* which she calls the *core overlap/additional extensions* view.

> This view posits that there is a core overlap for processing L1 and L2, but additionally, this core area is surrounded by brain tissue that only get activated by the L2(s). (This view is supported by Gandour et al. 2007; Hasegawa et al. 2002; Reiterer et al. 2005a,b; Briellmann et al. 2004; Chee et al. 2001; Perani et al. 2003; Xetkin et al. 1996; Yokoyama et al. 2006; Meschyan & Hernandez 2006; Abutalenbi et al. 2008a,b).

According to Reiterer (2009: 161), a simple explanation for these many different viewpoints might be that language learners have a highly individual language learning history and thus different psychological, linguistic, socio-cultural, and biological factors play a role.

To examine the effects of second language learning on brain structure, Klein et al. (2013: 23) conducted a study among monolinguals and bilinguals. The study revealed that it does not affect brain development if L1 and L2 are acquired simultaneously, in contrast, when an L2 is learned after gaining expertise in the native language the structure of the brain gets modified. Hence, also the age of acquisition (AoA) has an effect on brain development. They therefore concluded that the later in childhood a foreign language is learned, the greater the thickness of the left inferior frontal cortex and the thinner the right one (Klein et al. 2013: 23). They continue that these findings get supported by other studies, which report that in bilinguals who acquire their languages before the age of six both hemispheres are involved, whereas those who learn an L2 later than six years of age show dominance of the left hemisphere only. Wartenburger et. al (2003) suggest that AoA affects brain activation level: while early bilinguals show to activate the same neural structures for L1 and L2 processing, late bilinguals activate additional language-related areas. Figure 5 (Perani and Abutalebi 2005, Fig. 1, p. 203, modified from Wartenburger et al. 2003) below illustrates these activation patterns in early and late bilinguals during a grammatical task.

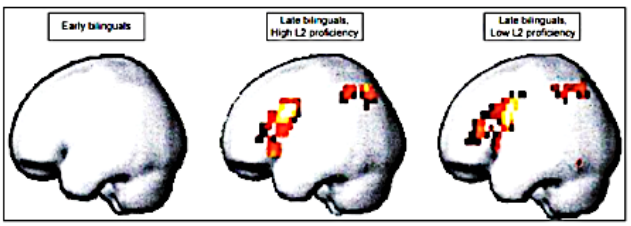


Figure 5. The bilingual brain
Whereas early bilinguals activate the same areas for L1 and L2 processing, late bilinguals use more neural substrates

Based on these findings, along with the significance of L2 proficiency, Mouthon et. al (2013: 268-269) and Perani and Abutalebi (2005: 204) suggest that the more L1 and L2 processing draw on the same brain area, the more advanced a language learner becomes, i.e. the less cortical effort is needed. In other words, the frequency and intensity of language exposure, the type of input, and other factors might shape the neural substrates of the bilingual brain (Li, Legault and Litcofsky 2014: 1-2).

Perani and Abutalebi (2005: 206) thus summarize that L1 and L2 share a common core area in the brain, whilst other areas are only activated task-specifically. Additionally, factors such as proficiency level and AoA influence the location and effort of brain activation.

With respect to language talent in the brain, not much is known. According to Reiterer (2009: 177), talent can be regarded "as a skill which is learned and improved by the complex interplay of nature, early nurture and later training". Due to these multi-componential influences that make up talent, the bunch of hypotheses which have been proposed so far, are fairly inconsistent with each other (Reiterer 2009: 177). One side argues for talent not being located in special areas of the brain, whereas the other side posits that "an intricate interplay of genetic, hormonal and immunological influences triggers the development (delayed growth or accelerated growth) of special areas of the brain in such a way that lateralization phenomena arise" (Reiterer 2009: 177). Paradis (2004: 153) hence concludes that:

> At best, neuroimaging provides us with circumstantial evidence, and like all circumstantial evidence, its credibility rests on the amount of converging data from other sources. There may come a point when there are so many coincidences that they affect our belief-even if each piece of evidence is circumstantial. However, the problem with neuroimaging studies of bilingual speakers is that they provide evidence that conflicts considerably and is sometimes incongruent with evidence from other sources.

Since the field of neuro-linguistics is fairly new, though, and brain imaging techniques are rapidly advancing, more reliable insights into the language learner's brain can perhaps be expected in the future.

By and large, the present chapter aimed to provide an overview of the most significant and relevant aspects in the field of SLA.

The following chapter, once more picks up on *language learning aptitude*- a factor which can neither be purely traced back to nature nor nurture, and thus referred to as

problematic. Nevertheless, or perhaps for exactly that reason it is one of the most fascinating factors influencing SLA though.
To begin with, a historical overview of aptitude research is given. Additionally, various approaches on linguistic giftedness and language aptitude measurement are outlined. Finally, the chapter portrays in what manner and to what degree language learning aptitude may relate to three other cognitive domains, that is musicality, working memory and intelligence so as to provide a solid and profound theoretical basis for the empirical research presented later in this thesis.

3 Language Learning Aptitude

The aim of this thesis is to explore in what way other cognitive domains affect language learning aptitude, especially phonetic aptitude, in primary school children. In view of this research question, it must be legitimate to ask why aptitude information should be of interest in an educational context, after all? Before, however, examining this issue, a closer look at aptitude, i.e. *talent*, must be provided at this stage.

3.1 Aptitude, Talent, or Giftedness? - clarifying terms

Numerous terms, such as *ability, aptitude, talent, linguistic giftedness, knack* or *flair for languages* all confusingly refer to one and the same phenomenon, that is according to the Cambridge Dictionary, "[...] a natural ability to be good at something, especially without being taught".
Since, though, it may be puzzling to distinguish between these terms, Biedron and Pawlak (2016: 155) propose a classification of terminology (see table 3), which intends to throw lights on these bewildering terminology.

Table 3. Classification of terminology (based on Renzulli 1986; Carroll 1993; Gagné 2000 in Biedron and Pawlak 2016: 155)

Term	Definition
Ability	Actual potential- what a person is able to do provided environmental conditions and psychophysical states are optimal
Aptitude	Cognitive ability that is possibly predictive of certain kinds of future learning success

Giftedness	Untrained, outstanding innate ability
Talent	Superior mastery of an innate ability

In linguistics, however, the above terms are used interchangeably, and will so be done throughout this thesis.

Two models of giftedness are often mentioned in psychology. The first one was developed by Gagné and is called *Differentiated Model of Giftedness and Talent*. Giftedness, according to this model, is an "untrained innate ability, evident in no less than one aptitude domain, to a degree that places a child at least among the upper 15% of peers. […] There exist five domains of aptitude, that is intellectual, creative, socio-affective, sensorimotor and other factors". L2 learning, belongs to intellectual undertakings and can be observed "through a capacity for acquiring new skills and the pace at which this happens. (Biedron & Pawlak 2016:154). Figure 6 below illustrates Gagnés model.

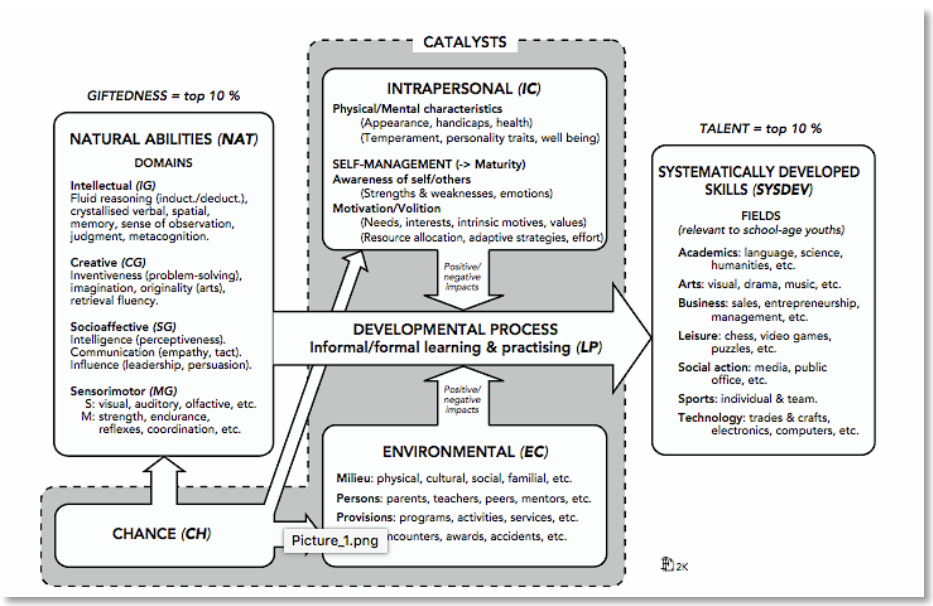


Figure 6. Gagné's (2004) Differentiated Model of Giftedness and Talent

The second view on aptitude gives Renzulli's *Three Ring Model*: it posits that there are three components which form aptitude, that is *above-average ability, high levels of task commitment,* and *high levels of creativity*. He emphasises that it is the interaction between these traits, though, which matters. For a better understanding, the Three Ring Model is illustrated in figure 7 below.

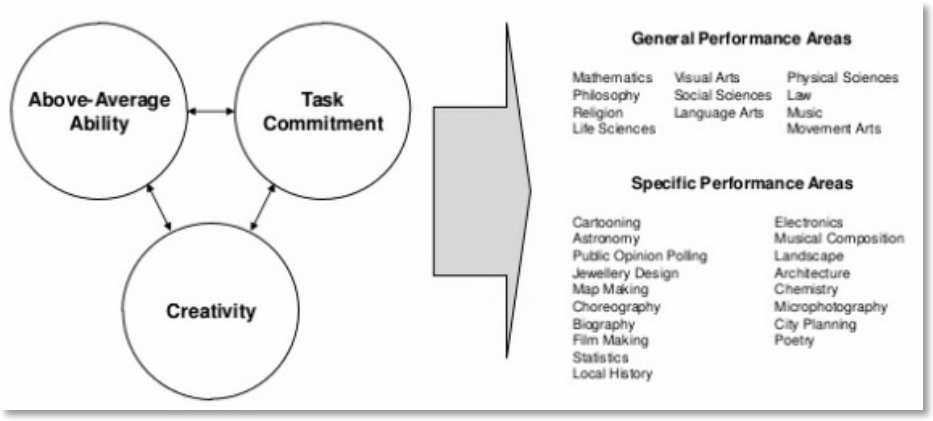


Figure 7. Renzulli's (1978) Three Ring Model

It is linguistic giftedness, i.e. the talent in learning a foreign language, that is of special interest in this thesis.

Thus, the following sections are dedicated to the swelling field of foreign language aptitude. An attempt of an agreeable definition paves the way.

3.2 Defining Language Learning Aptitude

As mentioned earlier, foreign language aptitude is considered as a complex set of cognitive abilities. According to Biedron and Pawlak (2016:155-156), a

> gifted FL learner is a person who, owing to his/her exceptional inborn gift for learning languages, especially capacious verbal working memory, as well as expertise in L2 learning, is able to learn any foreign language to a near-native level of competence, given proper motivation, time and conductive environment.

Since different scholars define language talent in diverse ways, a summary of commonly agreed research findings might be quite accommodating at this stage. Rysiewicz (2008: 572) sums up these findings below. It it thus commonly accepted that foreign language aptitude is:

* an autonomous dimension independent of both, affective (anxiety, motivation, attitudes) as well as general cognitive factors;
* independent of academic ability or intelligence, although it partially overlaps with these domains;
* relatively stable over longer periods of time; not dependent on prior learning experience; not easily modifiable through training;
* not a single, unitary capacity but a composite of several relatively independent cognitive abilities (componential/multi-factor structure);
* always a better prognostic of L2 learning success than any other ID taken singly or in combination with each other.

As this thesis is conceptualized upon an educational background, the following paragraph shall shed lights on the benefits of aptitude information.

According to Skehan (2012), aptitude information is used for the following purposes: (i) selection, (ii) counselling, (iii) remediation, and (iv) instructional modification. The first one is of value for course administrators since it uses aptitude information as a tool for deciding on either the rejection or acceptance of a participant. At this stage, however, it is essential to note that aptitude tests predict the *time or rate* which is needed to achieve something, therefore Skehan suggests to not use aptitude information for admission purposes. *Counselling* relates to the recommendation of course methodology based on the outcomes of an aptitude test, and *remediation* refers to a special pre-training based on aptitude results before actual instruction starts. The most potential aspect for educational application of aptitude information is, however, *instructional modification*. Skehan points out that "this offers the prospect of increasing the overall effectiveness of instruction, as learners are matched with appropriate methodologies […]" (Skehan 2012).

In view of this thesis, a justification of the educational benefits of aptitude information is of utmost relevance. Therefore, this issue is revisited once more in chapter 4, where research findings are discussed and outlooks are presented.

The thesis continues with a glimpse into the history of language learning aptitude research. Different conceptualizations of language talent are described along with their corresponding measurement tools. Finally, language aptitude is set into relation to other cognitive domains, such as musicality, working memory, and intelligence as these theoretical foundations constitute the basis of the research findings that are presented below.

3.3 Historical Overview of Aptitude Research and Measurement

3.3.1 Aptitude research up to 1990

With regard to Sparks and Ganschow, the first attempts of language aptitude research developed in the 1920s and 1930s by universities and colleges in the USA. (Sparks & Ganschow 2001: 91). They mainly aimed at predicting foreign language (FL) performance and at analysing who will and will not benefit from FL instruction. These tests were called *prognosis tests* and consisted of tasks which tested for native language abilities, general intelligence, and quick learning in the foreign language. Kaulfers

suggested that IQ predicted FL performance better than those prognosis tests (Kaulfers 1931 in Sparks and Ganschow 2001: 91).

During World War II, however, language aptitude research became of great interest for the U.S. Army since foreign language proficiency was essential to succeed in military actions. Hence, admission to intensive language training courses should only be given to those who would most likely succeed (Spolsky 1995). Sasaki claims that this was mainly due so to keep language programmes most cost-effective (Sasaki 2012: 317). Therefore, a test was developed but, according to Sparks and Ganschow (2001: 91), results were rather as insignificant as the prognosis tests before.

A new era in language aptitude research, however, began in the early 1960s with a cognitive psychologist named John B. Carroll, who can be seen as a pioneer in this field. He measured aptitude in terms of speed, i.e. "aptitude as speed of learning a foreign language in the context of some sort of formal instruction, be it a language course or a self-study program" (Wen and Skehan 2011: 17ff). Sparks and Ganschow explain that Carroll's investigations is rooted in two ideas: (i) the "facility to learn to speak a FL is a specialized talent, or group of talents, independent of intelligence; and (ii) strong FL aptitude is rare in the general population" (Carroll 1962 in Sparks and Ganschow 2001: 91). Skehan (2012) sums up Carroll's assumptions as follows:

* the constellation of abilities that capture the notion of foreign language aptitude is distinct from other cognitive abilities, including intelligence,
* aptitude is fairly stable in nature, and
* is itself componential

In respect of the last assumption, Carroll by means of factor analysis, found that four different variables make language aptitude, those are

* phonetic coding ability,
* grammatical sensitivity,
* rote learning ability, and
* inductive language learning ability.

Carroll defines *phonetic coding ability* as "an ability to identify distinct sounds, to form associations between these sounds and symbols representing them, and to retain these associations", *grammatical sensitivity* as "the ability to recognize the grammatical functions of words (or other linguistic entities) in sentence structure", *rote learning ability* as the "ability to learn associations between sounds and meaning rapidly and efficiently, and to retain these associations", and *inductive language learning ability*

as “the ability to infer or induce the rules governing a set of language materials, given samples of language materials that permit such inferences” (Carroll 1982: 105). According to Skehan (2012), Carroll’s contributions were twofold: on the one hand- in view of his four constituent model of aptitude- Carroll has been the most influential researcher of language aptitude, on the other hand, he, together with his colleague Stanley Sapon, created the Modern Language Aptitude Test (MLAT). The test is based on his four component model and consists of five parts. Based on Sasaki (2012: 316), who has carefully analysed the MLAT, the five sub-tests contain the following:

> Number learning (43 items): is intended to measure the ‘memory component of foreign language aptitude’ (Carroll et al., 2010: 2). The test requires the candidates to learn numbers in an unknown language through oral input […] and to translate new combinations of numbers from that language into English numerals.
> Phonetic script (30 items): is intended to measure ‘phonetic coding ability’. The test requires the candidates to learn the association between several phonetic symbols […] and sounds […] and select a symbol corresponding to a sound they hear.
> Spelling clues (50 items): is intended to measure English vocabulary knowledge as well as ‘phonetic coding ability’. The test requires the candidates to recognize English words written in a reduced form instead of using the conventional spelling system […] and choose from four options the one that is closest to the word in meaning […].
> Words in sentences (45 items): is intended to measure ‘grammatical sensitivity’. In this test, the candidates are given a pair of English sentences, with the first sentence having one word underlined. The candidates are then required to select one word with the same grammatical function as that of the underlined word in the first sentence […].
> Paired associates (24 items): in intended to measure ‘rote learning ability for foreign language materials’. The test requires the candidates to memorize the English meanings for a set of given words […] in an unknown language and then to choose the meaning of the given word from the multiple choice options provided […].

The MLAT was designed for adults who are literate with English as their first language. With regard to Sasaki, it is absolutely striking that the test has not changed since it was first published, and that it is still widely used today for various kind of research purposes (Sasaki 2012: 315). She continues that the MLAT has got fairly predictive power *(r= .4 to .6)* and therefore “predicts L2 learning success relatively well for both formal and informal L2 learning across different skills […]” (ibid. 315). Sasaki further offers three possible reasons for “this remarkable longevity: (a) the authors foresight, (b) the fact that the MLATs development was guided by ample empirical data collected from different types of educational settings using different types of teaching methods,

and (c) because of the relatively slow development of language aptitude research" (Sasaki 2012: 317).

For completeness, another test which was developed in the 1960s shall be briefly introduced at this point, that is the Pimsleur Language Aptitude Test (PLAB). Paul Pimsleur, so Skehan, assumed auditory impairments as one of the main reasons for underachievement in language learning, and thus he created a test for younger learners which stresses auditory abilities and downplays memory (Skehan 2012). It consists of six parts: (1) estimated previous grade point average in four major subjects, (2) a foreign language interest test, (3) an English vocabulary subtest, (4) a language structure subtest, (5) a sound discrimination subtest, and (6) a sound-symbol discrimination subtest (Pimsleur 1968).

Today the PLAB is mostly used for diagnosing foreign language learning disabilities.

By and large, throughout three decades Carroll's view on aptitude and consequently the MLAT as a tool of measurement dominated aptitude research.

Spolsky (Spolksy 1995: 338 in Sparks and Ganschow 2001: 92) sums up Carroll´s contributions as follows: firstly, he

> developed a test that measured, as well as anything can, some of the components of individual variation in ability to learn to speak a FL (p. 338). Second, Carroll developed a model of FL aptitude that showed how measureable abilities interact with goals and methods (p.338). Third, his model made the whole issue of [FL aptitude] clearer, by showing that aptitude was only one of the factors involved (p.338) in a general theory of FL learning.

According to Sparks and Ganschow in the 1970s and 1980s researchers started to investigate the influence of affective variables on aptitude. For example, studies by Gardner indicated that motivation and attitudes are fairly independent of language talent. Additionally, negative correlations between anxiety and FL achievement were found. Sparks and Ganschow mention personality as another ID which was investigated in relation to aptitude at that time. They report of studies conducted by Ehrman and Oxford which indicated that foreign language achievement cannot sufficiently be predicted by personality traits (Sparks and Ganschow 2001: 93). Research on IDs and aptitude further developed in the 1990s until present.

Aside from these attempts in 1970s and 1980s, research in language aptitude lay fairly waste for almost twenty years. The 1990s, however, brought a new era in aptitude research. These more recent perspectives will be outlined in the following section.

3.3.2 Aptitude research from 1990

As seen above, Carroll dominated the field of aptitude research for more than thirty years. The interest in FL aptitude apparently disappeared after the publication of the MLAT. Block (2003) explains this by a so-called 'social turn' in SLA- according to Mercer (2012) "a trend emphasizing the social and cultural context of this process over congenital cognitive factors" (Block 2003; Mercer 2012 in Biedron and Pawlak 2016: 151). Biedron and Pawlak (2016: 152) continue, that the basic idea of this view is that differentiation between humans in relation to their abilities is not fair since it undermines the effort of the individual in foreign language learning. Skehan adds two more reasons for the lack of interest in aptitude research: for once, aptitude back then was associated with audiolingual and grammar translation teaching methodologies. The moment, however, where communicative language teaching has entered SLA studies, aptitude suddenly appeared irrelevant. Secondly, Skehan points out that "catering for individual learning preferences, styles, or aptitudes in not an attractive commercial option" (Skehan 2002: 73) since this would mean to publish different learning materials for all the various aptitudes, styles, or preferences different learners have.

In the last twenty years, however, new views on language aptitude have evolved and one, in fact, may say that Carroll and Sapon have supplied all the subsequent researchers with an essential and profound base for their new conceptualizations on FL aptitude.

According to Dörnyei (2006: 47), the revival of aptitude research in the 1990s took place mainly because the rapid development in cognitive psychology "allowed for a more accurate representation of the various mental skills and aptitudes that make up the composite language learning ability. Second, scholars started to explore ways of linking aptitude to a number of important issues in SLA research. Thus, he concludes "the common theme in the various post-Carroll research directions has been the examination of the SLA-specific impact of specific cognitive factors and subprocesses, going beyond the use of the language aptitude metaphor as an umbrella term". Based on Wen and Skehan (2011:19) table 4 below presents a summary of post-MLAT aptitude research.

Table 4. Summary of Post-MLAT Aptitude Research (Wen 2005: 385).

Orientations	Representative Studies	Major Findings and Implications
Measurement-oriented	Pimsleur's PLAB, 1966; Green's York Language Aptitude Test, 1975; Petersen and Al-Haik's DLAB, 1976; Parry and Child's VORD, 1990; Sternberg and Ehrman's CANAL-F, 2000	Psychometric in nature; Empirically based; Mostly were MLAT alternatives or complementary tests; Mostly associated with military or government initiatives/funding.
Components-oriented	Sparks and Ganschow, 1991; Skehan, 1982 & 1986a; Sasaki, 1996; Ranta, 2002	The concept of factor-components is still viable; Relatively little research has been conducted; Much room for development (esp. memory).
Aptitude-treatment interaction: General	Reves, 1982; Wesche, 1981; Robinson, 1995 & 2002; Erlam, 2005	aptitude information (profile) is not only desirable but also has tremendous pedagogical implications under different L2 learning conditions.
Aptitude and age	Johnson & Newport, 1989; Dekeyser, 2000; Harley and Hart, 1997 & 2002	Younger learners tend to show higher correlations with memory components and older learners with analytical components.
Aptitude and intelligence	Skehan, 1982; Wesche, Edwards & Wells, 1982; Sasaki, 1996;	Skehan reported low to moderate correlations; Wesche et al & Sasaki reported moderate correlations.
Relationship between L1 and L2 abilities	Skehan, 1986b and 1990;	Aptitude is a product of two separate groups of influences: inner capacity for learning and the ability to handle language in a decontextualized way.

Several relatively new lines of research shall be highlighted in the following section. It has to be noted though, that not all of the following concepts form part of table 4 above. However, what all these approaches seem to have in common, is that the concept of aptitude is highly relevant in L2 learning and not restricted to traditional classroom settings (Wen & Skehan 2011: 20).

The first approach towards language aptitude summarized in this thesis, is one of the *measurement-oriented* and has been developed around the year 2000.

3.3.2.1 Grigorenko, Sternberg and Ehrman's composite aptitude concept: the CANAL-F Theory

Dörnyei refers to this relatively new approach to language aptitude as one of "most traditional" since Carroll's composite aptitude idea lies still at the bottom of it (Dörnyei 2006: 47). It is a concept based on a cognitive theory of knowledge and has been developed by Elena Grigorenko, Robert J. Sternberg and Madeline E. Ehrman around the year 2000. They called it the CANAL-F theory, which stands for *Cognitive Ability for Novelty in Acquisition of Language as applied to Foreign language*. The rationale is based on the assumption that "one of the central abilities required for foreign language acquisition is the ability to cope with novelty and ambiguity" (Ehrman 1993, 1994, 1996; Ehrman and Oxford 1995 in Grigorenko et al. 2000: 392*)*. This idea is part of Sternberg's triarchic theory of human intelligence (Sternberg 1985, 1988, 1997) which emphasises that abilities are dynamic rather than stable and foreign language learning develops gradually. Biedron and Pawlak follow that "consequently, individual differences with respect to FL aptitude should correspond to appropriate instructional approaches (see Robinson 2002)" (Biedron and Pawlak 2016: 154). They continue that this dynamic perspective of FL learning is reflected in the CANAL-F test battery where test takers receive feedback during the test so as to modify their answers accordingly. The authors (Grigorenko et al. 2000: 392). consider five cognitive processes operating while learning a foreign language. Dörnyei (2015: 53-54) sums them up as follows:

- selective encoding: distinguishing between more and less relevant information for one's purposes
- accidental encoding: encoding background or secondary information and grasping the background context of the information stream.
- selective comparison: determining the relevance of old information for current tasks to enhance learning.
- selective transfer: applying decoded or inferred rules to new contexts and tasks.
- selective combination: synthesizing the disparate pieces of information that have been collected via selective and accidental encoding.

As the FL learner has to consistently deal with new language material, "he or she has to decide where to focus his or her attention and how to use these processes

accordingly" According to Grigorenko et al. (2000: 393), those processes operate at four levels of

- lexis: dealing with one's learning, understanding, and use of words;
- morphology: dealing with the words' structures and derivations;
- semantics: dealing with one's understanding and use of the meaning of the words, based on information from the higher order units into which the words combine, such as sentences and paragraphs; and
- syntax: dealing with one's learning, understanding, and use of the grammatical principles of organization that connect the words to the higher order units.

The CANAL-F test battery expects the participant to learn elements of an artificial language. This new language, named *Ursulu*, is presented gradually in a naturalistic context, meaning in the beginning of the test participants do not know it at all, whereas in the end they know enough *Ursulu* to understand a little story. The CANAL-F consists of five sections (Grigorenko et al. 2000: 394-396):

> Section I: Learning meanings of neologisms from context intends to assess all five cognitive processes primarily at the lexical, morphological, and semantic levels of operation within a language.
> Section II: Understanding the meaning of passages intends to measure (a) use of selective and accidental encoding, comparison, and combination (b) for both visually and orally presented material (c) as encoded into working memory and stored in long-term memory (d) for the semantic mode of information.
> Section III: Continuous paired-associate learning intends to measure the selective comparison and combination of lexical and morphological material encoded into working memory and stored in long-term memory, in both visual and oral forms.
> Section IV: sentential inference aims to measure selective and accidental encoding, selective comparison, selective transfer, and selective combination, primarily at the syntactic and morphological levels and only secondarily at the lexical and semantic levels.
> Section V: learning language rules aims to measure selective and accidental encoding, selective comparison, and selective combination at the lexical, semantic, morphological, and syntactic levels, for material presented visually and for encoding into working memory and storage in long-term memory.

The authors conclude that the test is a valid measure of foreign language aptitude, although, results do, of course, not *prove* the correctness of the CANAL-F theory (Grigorenko et al. 2000: 400).

Another interesting conceptualization of aptitude was born in the early 1990s and shall be roughly outlined next.

3.3.2.2 Sparks and Ganschow's Linguistic Coding Differences Hypothesis

This line of research in the field of language aptitude has been developed by Richard Sparks and Leonore Ganschow in the early 1990s. They proposed the *Linguistic Coding Differences Hypothesis* (LCDH), which roots in first language reading research done by Vellutini and Scanlon (1986), and which suggests that poor L1 readers struggle with syntactic and phonological/orthographic language components but not with semantic ones (Sparks & Ganschow 2001: 97). According to Sparks and Ganschow (2001: 97), the hypothesis posits that

- native language skills serve as the foundation for learning a FL;
- difficulties with one component of language (e.g. phonology/orthography) are likely to have a negative effect on both native and FL learning; and
- there are innate individual differences in students' ability to use language.

In summary, the basic idea of the LCDH is that L1 skills are crucial for foreign language learning. The hypothesis was tested and findings showed three things: successful learners of a FL display

- significantly higher L1 skills than unsuccessful learners,
- significantly higher scores on the MLAT, and
- finally, people with high L1 skills and language aptitude reach higher levels of foreign language proficiency (Sparks and Ganschow 2001: 97).

According to Dörnyei, many studies support the LCDH, for instance, Tarone and Bigelow (2005) found evidence that alphabetic literacy significantly affects oral language processing tasks. Hence, "the acquisition of the ability to decode an alphabetic script changes the way in which the individual processes oral language in certain kinds of cognitive tasks, which supports the claim that literacy should be seen as a human capacity central to SLA" (Dörnyei 2006: 48).

In terms of foreign language aptitude and L1, it is rather reasonable to conclude that L1 skills relate to the capacity to master a foreign language (Dörnyei 2015: 39). Skehan, for instance, conducted a study (for reviews, see Skehan, 1989, 1991) and found correlations between language aptitude and L1 scores. So he concluded "that aptitude for foreign languages, was, to some extent, a residue of first language learning ability" (Dörnyei 2015: 39). Dörnyei (2015: 40) further reports of several studies which all show consistent evidence that SLA is related to cognitive abilities in the first language, and that language talent thus cannot be seen isolated from L1 learning.

The following section presents a conceptualization of aptitude which, according to Biedron and Pawlak (2016: 153), can be regarded as one of the most important ones in the latest aptitude research.

3.3.2.3 Skehan's Processing Stage Model

This approach towards language aptitude has been developed by Peter Skehan (2002) and considers foreign language aptitude as a combination of several cognitive abilities. It differs to other models in the aspect that it assumes FL aptitude components relating to different stages of acquiring a second language (Dörnyei 2006: 49). Skehan reconsiders Carroll's four components of *phonetic coding ability, grammatical sensitivity, rote learning ability, and inductive language learning ability* into a three component model. Hence, Skehan's (1998: 203) aptitude factors are:

- *phonemic coding ability*,
- a merge of grammatical sensitivity and inductive language learning which he calls *language analytic abilit*y, and
- *memory*

He, then, matches these components to stages of processing a foreign language, consistent with a psycholinguistic and cognitive view of SLA. Based on Skehan (2012), six different phases are involved in acquiring a foreign language. These are:

- Input Processing and Noticing
- Pattern identification
- Complexification / Restructuring / Integration
- Error avoidance
- Repertoire development: readiness of access to emerging forms
- Automatization / Lexicalisation

Skehan explains that "the first three are concerned with apprehension of the rule based nature of language, and the capacity to complexify and reorganise these rules as learners develop. "The capacity", he continues "to identify and manipulate rules requires flexibility as an interlanguage system grows, and it also requires a potential to respond to feedback" (Skehan 2012). In contrast to the first three stages, Skehan points out that the last three are quite different since they affect the way how learners gain control of and access to already acquired language material. He claims that "the implication for aptitude would be more the need to measure speed of learning and

proceduralisation. One assumes that learners vary in these areas, and so an important part of aptitude would be how learners convert noticing and pattern insight into fluent and error-free performance" (Skehan 2012). Table 5 below illustrates how these stages, according to Dörnyei and Skehan, relate to aptitude factors.

Table 5. Skehan's Aptitude factors and stages of SLA (Dörnyei & Skehan 2003: 597)

SLA Stage	Corresponding Aptitude Constructs
Input processing strategies, such as segmentation	*Attentional control* *Working memory*
Noticing	Phonetic coding ability *Working memory*
Pattern identification	Phonetic coding ability *Working memory* Grammatical sensitivity Inductive language learning ability
Pattern restructuring and manipulation	Grammatical sensitivity Inductive language learning ability
Pattern control	*Automatization* *Integrative memory*
Pattern integration	*Chunking* *Retrieval memory*

Table 5 above shows how stages of SLA may relate to aptitude components. Skehan proposed this model in 2002. Dörnyei and Skehan (2003), however, adapted the table by adding potential components of aptitude which tests have not targeted so far. These potential factors are printed in italics.
Another highly influential line of research in language aptitude has been developed by Peter Robinson and is introduced in the next section.

3.3.2.4 Robinson's Aptitude-Treatment Interaction

Peter Robinson developed a model of aptitude intending to be applied to L2 learning contexts. It is, to some extent, similar to Skehan's *stage processing model*. Robinson hypothesizes that different combinations of ID variables affect FL learning in different

ways. Thus, his approach assumes that there are optimal ID clusters that affect efficient FL learning. He termed these ID clusters *aptitude complexes* (Dörnyei 2006: 49). According to his idea some "FL learners might possess strengths in abilities facilitative under specific learning conditions but less efficient in others (Biedron and Pawlak 2016: 152). So Ackerman (2003: 92) concludes that potentially "[…] combinations of traits have more predictive power than traits in isolation". Robinson himself describes his hypothesis as follow:

> I argue that aptitude for L2 learning needs to be examined in relation to the processing demands of different learning conditions and tasks, and that different complexes of cognitive abilities are involved in aptitude for learning under these different processing conditions. […].
> I claim that there are multiple aptitudes for L2 learning, and that previous measures of aptitude, such as Carroll and Sapon's Modern Language Aptitude Test, are not sufficiently sensitive to capture the interaction of cognitive abilities with the processing demands of contemporary classroom learning conditions and pedagogic interventionist techniques for focus on form. […].
> I also argue that abilities, or complexes of abilities are much more differentiated in some learners than in others, and that it is especially important to match learners with widely differing strengths and abilities in aptitude complexes to the learning conditions, tasks or techniques most suited to their abilities. (Robinson: http://www.cl.aoyama.ac.jp/~peterr/hf/index.html 1.6.2016)

Robinson's model consists of primary cognitive abilities, these are: *working memory capacity, pattern recognition, grammatical sensitivity and speed of processing* (Skehan 2012). These abilities are directly measured by various psychological tests, if available. Second-order abilities are clusters of primary abilities and involve cognitive constructs such as *noticing the gap, memory for contingent speech, memory for contingent text, deep semantic processing* and *metalinguistic rule rehearsal* (Skehan 2012). Dörnyei sums up that the described primary- or lower abilities can be grouped into the latter secondary- or higher cognitive factors, "which differentially support learning in various learning situations/conditions" (Dörnyei 2006: 49). Robinson's approach thus recommends the matching of learning conditions and aptitudes since different techniques of input will influence the development of needed abilities.

According to Dörnyei, Robinson's conceptualization provides rather promising views on future aptitude research as it is the first that links aspects of SLA with IDs (Dörnyei 2006: 49).

The historical review of aptitude research and measurement shall end with another aptitude test that has fairly recently been developed. It cannot directly be tied to any particular school of thought in aptitude research, however, it must be acknowledged at this stage as it serves as one of the research instruments used the empirical research of the present thesis.

3.3.2.5 Meara's LLAMA Aptitude Battery

In 2005, Paul Meara developed a test which is loosely based on Carroll's work. The author, however, perceives aptitude as an entirely cognitive concept which consists of several components. The *LLAMA* is a computer based test and is- in contrast to the MLAT- designed without the first language being a requirement (Meara 2005). It consists of four parts which are illustrated in table 6 below.

Table 6. The LLAMA Aptitude Test (P. M. Meara *Llama Language Aptitude Test*. Swansea: Lognostics. 2005)

LLAMA B	intends to measure the candidates' ability to learn large amounts of vocabulary in a relatively short space of time. The program is loosely based on the original vocabulary learning subtask of Carroll and Sapon (1959) […] This version no longer requires any L1 input, so the test is suitable for use with tests of any L1. […]
LLAMA D	is a sound recognition task. It is a new task that does not appear in the work of Carroll and Sapon (1959). It is designed to test if you can recognise short stretches of spoken language that you were exposed to a short while previously. […] These writers suggest that a key skill in language ability is your ability to recognise patterns, particularly patterns in spoken language. If you can recognise repeated patterns, then you are more likely to be able to recognise words when you hear them for a second time. This helps you to acquire vocabulary. It also helps you to recognise the small variations in endings that many languages use to signal grammatical features.
LLAMA E	is a sound-symbol correspondence task. It presents a set of twenty-two recorded syllables, along with a transliteration of these syllables in an unfamiliar alphabet. Your task is to work out the relationship between the sounds you hear and the writing system. It is particularly good at picking out learners who were able to dissociate sounds from the way they are normally written in English.
LLAMA F	intends to assess grammatical inference that presents you with sentences in an unknown language, and translations of these sentences in your L1. The task is to work out the grammatical rules

	that operate in the unknown language. Llama F has been designed with a new interface that requires no L1 input.

As the thesis addresses the question of language aptitude and its connection to other cognitive factors, the nature of these special relationships as well as current research findings are compiled in the following sections.

3.4 Language Learning Aptitude and its relationship to other (cognitive) domains

Based on Reiterer (2009: 162) Language, which obviously is of developmental nature, is shaped by biological as well as environmental factors. The interplay of these *nature-nurture* factors determine the success of this process, that is, in view of SLA, the *ultimate attainment* a learner can reach.

Thus, Reiterer (2009: 162) identifies the *biological factors* influencing L2 learning as one's DNA, sex, hormones, neural organisation, and brain maturation.

The nurture side, thus *environmental factors* cover socio-cultural or linguistic factors, such as "manner of acquisition/teaching method, amount and quality of input/ training, exposure time, purpose of language use and linguistic environment, language attitudes of social group and individuals […]" (Reiterer 2009: 162). This list may be extended by the age of onset which, as previously discussed, has become an indispensable factor influencing foreign language proficiency and aptitude (DeKeyer, Alfi-Shabtay and Ravid 2010).

Sadly, this simple model of nature and nurture is complicated by the so-called *psychological factors,* which seem to be neither truly acquired nor purely inherent. These factors are motivation, learning strategies/styles, personality, empathy and language learning aptitude (Reiterer 2009:162).

As they are most relevant to the empirical study, some of these factors have already been touched and set into relation to SLA and to each other above.

The following sections, however, provide further insight into the domain of language talent by thoroughly inspecting the truly special relationship between language aptitude and other cognitive domains.

To start with, the factor of age needs to be revisited once more.

3.4.1 Age of Acquisition and Language Aptitude

The age-factor with respect to SLA has already been discussed in chapter 1. Since the present thesis, yet, aims to explore language learning aptitude in primary school-aged children, special attention to this particular target group has to be given once more.
Thus, this section intends to further reveal the distinctness of young and adult language learners and its effects on language teaching philosophy. Moreover, it attempts to debate the special relationship between age of acquisition and foreign language learning aptitude.
It has already been stated earlier that one reason for early foreign language teaching is the *Critical Period Hypothesis*. Essentially, the CPH assumes that young children are equipped with certain language learning abilities which will disappear right before puberty. Hence, the younger the learner is, the more likely he or she will achieve high language proficiency.
Although there is lack of research evidence with regard to critical or sensitive periods, the age-factor is still used as an argument for introducing a foreign language at primary level today (Legutke et. al 2014: 15). Lightbrown and Spada (1999: 164-165) consider this as another "popular idea about language learning […]. Research doesn't show any particular age when there's a sudden change in attainment across the board- either for phonology or grammar. And there is also evidence of [a minority] of learners achieving native-like proficiency well after any purported critical age".
Yet, it is commonly agreed that language learning becomes increasingly difficult within aging, which might rather be due to a natural preference to the native language in both perception and production than to any CPs (Christiner and Reiterer 2013: 1).
In summary, adults and children might not differ in their ultimate L2 attainment, but there surely do exist differences. According to Cameron (2001: 1) these are rather obvious:

> children are more often enthusiastic and lively as learners. They want to please the teacher […]. They will have a go at an activity even when they don´t quite understand why or how. However, they also lose interest more quickly and are less able to keep themselves motivated on tasks they find difficult. Children […] do not have the same access as older learners to meta-language that teachers can use to explain about grammar or discourse. Children often seem less embarrassed than adults at talking in a new language, and their lack of inhibition seems to help them get a more native-like accent.

This view has also been confirmed by several studies, and as previously mentioned, the seemingly only domain where young learners outperform adults is their positive and sustainable attitude and motivation (Legutke et al. 2014: 12).

Aside from the idea of critical or sensitive periods, there are also socio-cultural reasons for the introduction of foreign languages at primary level. The council of Europe declares that "the ability to understand and communicate in other languages is a basic skill for all European citizens" (Commission of the European Communities 2003 in Legutke et al. 2014: 15). Hence, the EU aims for a trilingual European language community with English as the lingua franca. Each European citizen should, therefore, be able to speak his mother tongue and two other languages fluently. Additionally, the EU is concerned "to improve the quality of communication among Europeans of different languages and cultural backgrounds. This is because better communication leads to freer mobility and more direct contact, which in turn leads to better understanding and closer co-operation [...which] contributes to the promotion of democratic citizenship" (CEF 2001, xi-xii in Legutke et al. 2014: 16).

To sum up, adult and young language learners do differ. Yet, they do not differ in their overall L2 attainment. Selinger (1978) argues that there are many sensitive periods for different linguistic domains, and considered pronunciation, hence accent imitation, as the first ability to disappear around the beginning of puberty. Based on these research findings, one might assign different age groups to different linguistic domains, i.e. pronunciation as the domain of young learners, whereas syntax and morphology might be regarded as the domains of older learners (Lightbrown and Spada 2013: 94). Thus, according to Moyer "phonetic ability has often been considered the first or only sub-ability in language learning which is ultimately subjected to a critical period" (Moyer 2014 in Christiner and Reiterer 2015: 2).

Another question, though, is if, and to what degree, foreign language aptitude is affected by age of acquisition? Unfortunately, not much is known. Caroll and Sapon (1959, 1981) claim that language aptitude does not change within time, thus it is relatively fixed (Dörnyei 2015: 42). Also, Skehan (1989) conducted studies which confirm this view.

Another study by Harley and Hart (1997) analysed, to what extent the different components of aptitude correlate to different age groups. Whereas older learners scored higher in analytic tests, young learners were better in the memory components. Therefore, Harley and Hart (2002: 329) assume that aptitude can change with age:

> In sum, there are several findings in the study that provide some support for the argument that analytical language ability is more closely associated with second language outcomes when intensive exposure to the language is first experienced in adolescence. This relationship appears to hold, though not as strongly, even when exposure takes place in an environment outside the second language classroom.

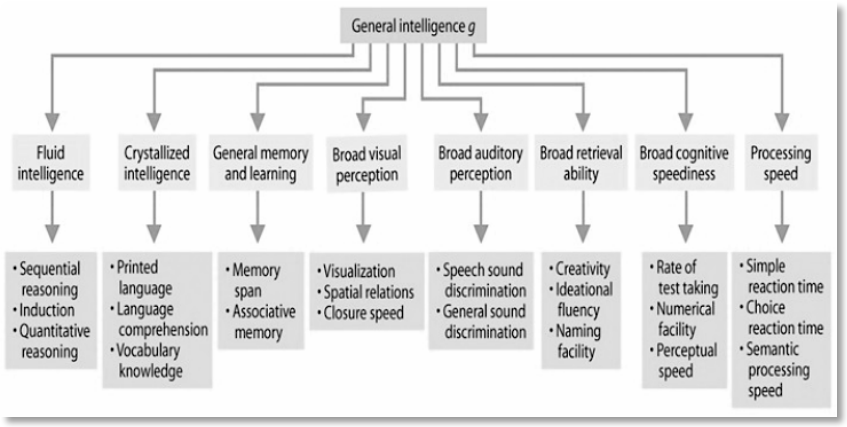
In summary, it might be agreed that "some of the age-related variation is mediated through aptitude changes that occur over time" (Dörnyei 2015:42). As has already been demonstrated in chapter 2, one promising line of research regarding language learning aptitude and age seems to be neuro-linguistic brain imagining. Thus, future research in this area will hopefully shed more lights on this special relationship.

3.4.2 Intelligence and Language Aptitude

One of the most investigated issue in language aptitude research is its relationship to intelligence. Intelligence is often associated with cognition which, again, is "associated with knowing and knowledge representation, memory, attention, learning, information processing, abstract thinking, appraisal, judging, reasoning, problem-solving, decision-making, etc." (Dörnyei 2009: 202). Hence, the term *intelligence* has a quite broad meaning, referring to several abilities. This general usage, according to Dörnyei and Ryan (2015: 36) "is explained by the fact that scores on all subtests of abilities measured by intelligence tests are positively intercorrelated, which makes it possible to compute a single higher-order factor, usually labelled as *g*, that describes the commonalities of the various abilities". This *g* factor is assessed by the famous IQ coefficient.

Neisser (1998) claims that "individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought". More scientifically speaking, intelligence is a composite of many abilities, and many theories have been proposed to grasp the hierarchical organization of these. Spearman's theory, for instance, has become rather influential. He suggests that intelligence is a general cognitive ability that can be measured, and which can be seen as the ability of problem solving, analysing situations and thinking (Spearman 1904). He followed that while working on a cognitive task, specific skills (factor *s*), along with the general factor *g,* which is equally available for all intellectual acts, are working (Spearman 1927).

Carroll (1993) proposed another model of cognitive abilities which is illustrated in figure 8 below.



| Figure 8. Carroll's conceptualization of cognitive abilities

Figure 8 above illustrates Carroll's three-stratum theory of human intelligence. Stratum I consists of *specific abilities*, stratum II comprises *broad abilities*, and stratum III is the *general intellectual ability* similar to Spearman's "g" factor- a general factor that influences intelligent performance.

Gardner (1983, 1999) refuted Spearman's conceptualization since it would fail to address other relevant skills of humans. Gardner, thus, developed the theory of *multiple intelligences,* which suggests eight types of intelligence which are evolutionary independent. The eight domains are *verbal-linguistic, visual-spatial, logical-mathematical, interpersonal, kinaesthetic, intrapersonal, musical,* and *naturalistic*. Table 7 below illustrates Gardner´s eight intelligences along with their characteristics.

Table 7. Multiple Intelligences and their characteristics (Gardner 1983, 1999).

Intelligence	Characteristics
Verbal-linguistic	Ability to use language for effective communication; mastering of syntax, structure, and phonetics
Visual-spatial	Visualization and manipulation of spatial information; good visual memory; artistic talent
Logical-mathematical	Logic reasoning; abstraction; ability to discern numerical patterns

Interpersonal	Understanding moods, temperaments, and motivations of others; sensitivity to other people´s needs and feelings; respectful and cooperative attitude; successful communication; empathetic skills
Kinaesthetic	Enjoying physical activity; ability to control body movements and handling objects
Intrapersonal	Self-awareness and reflection; knowledge of own strengths and weaknesses
Musical	Good sense for music, tones, and rhythm, pitch, and timbre
Naturalistic	Sensitivity to nature; passion and care for growing and nurturing living beings

Over the last years, the above outlined approach of *multiple intelligences* has become rather popular since it proposes that intelligence in not *one* general ability, but that it is made up of a composite of various skills.

With respect to aptitude and intelligence, Dörnyei (2015: 41) points out that both domains are composite concepts. Thus, both consist of several distinct aspects. It can therefore be inferred that they are somehow complexly interrelated and as Dörnyei puts it "we can assume that because both intelligence and language aptitude are composite constructs that involve a range of cognitive factors- some of which, but not all, clearly overlap- we can expect considerable but not perfect correlations between the two higher-order factors" (Dörnyei 2015: 41). Thus, intelligence and aptitude seem to interrelate, but only to some extent. Nevertheless, Dörnyei and Ryan agree with Sawyer and Ranta (2001: 329) that "treating L2 aptitude in a monolithic way obscures the nature of the relationship between general cognitive abilities and specific linguistic ones".

On the other hand, recent research suggests that there is no correlation between general non-verbal IQ and second language aptitude (Rota and Reiterer 2009: 88). Aside from the overlapping Dörnyei mentions, language aptitude is considered as distinct from the concept of intelligence, otherwise the whole undertaking of aptitude research would somehow be carried ad absurdum.

A factor, that is fairly related to intelligence and greatly relevant to this study is that of working memory. It is examined in the section below.

3.4.3 Working Memory and Language Aptitude

Working memory (WM) capacities have been identified as a crucial factor for scholastic success. Rota and Reiterer (2009: 80) report from various studies (Swanson 2006; Swanson et. al 1996; Gathercole et al. 2004) which all show that WM skills predict academic achievement.

In his four-component model, Carroll defines memory as the "ability to learn associations between sounds and meaning rapidly and efficiently, and to retain these associations" (Carroll 1982: 105). This, however, is a rather limited and indifferent view on it, hence, researchers nowadays distinguish between various types of memory. That is short-term memory (STM), working memory and long-term memory (LTM). LTM consists of implicit and explicit memory. According to Dörnyei (2015: 61), the former relates to memory that is used unintendedly, the latter, in contrast, is used with awareness.

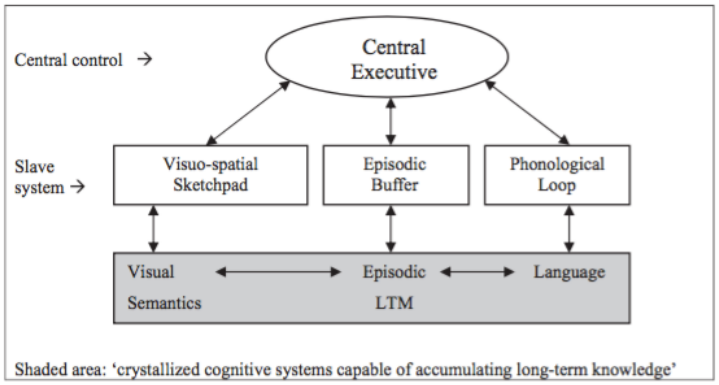
The concept of WM was originally proposed by Baddeley and Hitch (1974), and, with reference to Wen and Skehan, is defined as "the cognitive capacity to simultaneously store and process information in real time (Harrington & Sawyer 1992)" (Wen & Skehan 2011: 21).

According to Juffs and Harrington (2011: 138), WM is responsible for both the storage and the processing of information. In relation to SLA, researchers agree upon the following assumptions concerning WM: WM is multi-componential, consisting of a

- *central executive* -which directs attentional processes,
- the *phonological loop*- a language acquisition device which is needed so as to learn phonological forms of new words,
- the *visuo-spatial sketchpad*- a visual equivalent to the phonological loop;
- the *episodic buffer*- a control system which combines information (Dörnyei 2015: 64); and
- WM may turn into LTM (Wen and Skehan 2011: 22).

Figure 9 below illustrates Baddeley and Hitch's latest conceptualization of WM. It shows how the *central executive* controls the three short-term storage mechanisms (*phonological loop, visuo-spatial sketchpad, and episodic puffer*) by binding "information from a number of sources into a coherent episode by coordinating the working of the various stores [...], controlling the continues shifts between immediate task performance and the retrieval processes needed to carry out the task [...] controlling the selective attention needed to maintain focus and inhibit information

that might distract from or interfere with successful task execution" (Juffs and Harrington 2011: 14).



| Figure 9. Development of the WM Model (Baddeley 2000)

According to Biedron and Pawlak, however, two aspects of WM are particularly important in SLA, that is the *phonological loop* and the *central executive* (Biedron and Pawlak 2016: 170). The former allows for language learning and forms the basis of memorizing linguistic material (Rota and Reiterer 2009: 80). The Phonological Memory (PM) thus is central to language use and learning since it is responsible for the temporary retention and processing of phonological information (Juffs & Harrington 2011: 139). Juffs and Harrington (2011: 139) report of a study by Adams and Gathercole (1996) which suggests that children with a higher PM capacity show more advanced narratives and utterances in terms of length as well as grammatical and semantic complexity.

Table 8 below shows how several aspects of language learning (in this case L1) are related to WM, in particular to the phonological loop and the central executive.

Table 8. WM and L1 Learning (based on Gathercole & Baddeley 1993: 232 in Wen and Skehan 2011: 23).

Language Activities	Phonological Loop	Central Executive
Comprehension	Used to maintain a phonological record that can be consulted during off-line language processing	Involved in processing syntactic and semantic information and storing products of processing
Vocabulary acquisition	Critical for the long-term learning of phonological forms of new words	Involved in interpreting the semantic characteristics of new words?
Learning to read	Contributes to the development of a phonological recoding strategy	unknown (*as of 1993*)
Reading familiar words	None, except when complex judgments about phonological structure required	unknown (*as of 1993*)
Speech production	none (*as of 1993*)	Involved in planning the conceptual content of speech?

However, WM does not only affect L1 acquisition. It underlies our ability to think and thus, also has a rather huge effect on both the comprehension and production of a foreign language.

Skehan emphasises the impact of WM on aptitude and its crucial relevance by relating it to the stages in SLA. This relation is illustrated in table 9 below.

Table 9. Involvement of WM in language processing stages (Skehan 2012).

SLA stage	WM Involvement
Input processing	More phonological memory enables longer stretches of language to be processed, and therefore parsing is more efficient
Noticing and handling form and meaning simultaneously	Greater capacity can enable parts of input to be extracted, and facilitate how form-meaning connections are made

Pattern identification	More input available enables patterns of greater length to be identified
Complexification/restructuring	More capacity enables connections to be made between current working memory and long-term memory, as well as enabling long term memory to be changed
Error avoidance	More working memory capacity enables attention to be directed to monitoring and so error can be avoided
Response to feedback	More memory enables attention to be directed to feedback, and the incorporation of feedback into performance, as well as the potential to change long-term memory
Automatization/lexicalisation	More material in working memory enables chunking which can be transferred to long term memory

Table 9 clearly illustrates the crucial role of WM in complex cognitive abilities, such as second language acquisition is one.

Since table 8 and table 9 above provide evidence that WM has an impact on first- and second language acquisition processes, it can be assumed that WM also plays a role in aptitude research. In fact, the link between WM and language aptitude is one of the most recent and most promising lines in aptitude research (Dörnyei 2006: 48). Several scholars even assume WM as the most central constituent of foreign language aptitude. Baddeley (2003: 189), for instance, claims that the "temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities", such as foreign language learning, is entailed in WM. Rota and Reiterer (2009: 83) confirm this view by pointing at research evidence which reveals close correlations between phonological WM and language aptitude, thus, individuals with high WM capacities most likely encounter less difficulties in second language learning. It can therefore be summarized that WM (and the results of WM tests) indicates our general cognitive abilities.

With respect to aptitude measurement and WM, a recently developed test on the basis of WM is the *High-Level Language Aptitude Battery* (Hi-LAB) has to be introduced at this point. The test designers point out that the Hi-LAB is the first test which emphasises WM, including short-term, long-term and WM, and is „a composite set of tests that measures cognitive and perceptual abilities designed to predict aptitude for learning foreign language to advanced levels" (Doughty 2013). Doughty further explains that „the individual sub-tests of CASL's Hi-LAB battery have been combined into various composite scores, in order to provide information on a range of dimensions of language learning". Doughty further claims that "all language learning involves processing rich and varied *input* from the target language, *interaction* of the learner with other speakers and with a variety of tasks in the language, and the processing of *feedback* in order to refine language proficiency to be more target-like" (Doughty 2014). Factors, which Doughty et al. consider affecting input-processing are: variability, authenticity, pattern learning, meaning association, and phonological perception. In terms of interaction, the Hi-LAB investigates the levels of attention switching and scaffolding (Doughty 2014). Another factor involved in language learning is the processing of feedback. "Recasts, Error ID, and Corrections/Explanations represent three different types of feedback on error given to language learners, usually by an instructor" (Doughty 2014). The test intends to find out which type of feedback the particular language learner will find most effective. It consists of a language history questionnaire and eleven cognitive and perceptual subtests. The test designers conclude that the Hi-LAB is a rather successful tool to predict high achievers, underpinning the significance of working memory, associative learning and implicit learning (Biedron and Pawlak 2016: 170).

Apparently, the Hi-LAB looks fairly different from the first published aptitude test, the MLAT. With regard to Dörnyei, it altogether "represents a richer, theoretically grounded conceptualization of language learning ability" (Dörnyei 2015: 58). Nevertheless, it is important to note at this stage that aptitude tests, such as the MLAT, CANAL-F, LLAMA, or Hi-LAB still fail to say anything about the language learning process itself. Robinson (2013: 2) emphasises this issue by the following:

> Learning a language involves different abilities at different stages of *development*. The MLAT and other current aptitude tests don't measure these. Learning a language takes place in many different situations and classroom contexts. The MLAT and other current aptitude tests are *insensitive* to these.

To sum up, Skehan claims that several studies show significant correlations between WM and language development, and thus "one can consider that working memory is a fundamental component of a foreign language aptitude" (Miyake and Friedman 1998 in Skehan 2012).

3.4.4 Musicality and Language Aptitude

> *The suspicion does not appear improbable*
> *that the progenitors of man, either the males or the females,*
> *or both sexes,*
> *before they had acquired the power*
> *of expressing their mutual love in articulate language,*
> *endeavoured to charm each other*
> *with musical notes and rhythm.* (Darwin 1871)

According to Charles Darwin, musical ability thus preceded linguistic ability and our early ancestors seemingly communicated through musical notes (Yules 2010: 1). Be that as it may, a close relationship between music and general language ability cannot be denied.

Research on musicality and language aptitude suggests that people with a higher musical aptitude also have higher pronunciation skills in foreign languages, also known as phonetic ability (Nardo and Reiterer 2009; Reiterer et. al 2011; Christiner and Reiterer 2013).

Yet, the concept of musicality needs to be looked at in more detail. Based on Gordon (1989a) there exist two perspectives on music aptitude. The first one sees it as a unitary trait which belongs somehow to overall intelligence. The second perspective, which has generally become accepted, views music aptitude as multi-componential, rather independent of intelligence (Nardo and Reiterer 2009: 215). Shuter-Dyson (1999) claims that music aptitude consists of five groups of abilities, which can, again, be subdivided into sub-traits (Nardo and Reiterer 2009: 216). These five ability groups are:

* Tonal abilities: consist of pitch perception, sense of tonality, and harmony-polyphony.
* Rhythmic abilities: correspond to meter abstraction, perception of rhythmic structures, rhythmic anticipation, practo-rhythmic factor, and tempo-tapping.

- Kinesthetic abilities (the motor-components): linked to the ability to improvise, expressivity, and auditory perception.
- Aesthetic abilities: related to expression, appreciation, and emotion.
- Creative abilities: linked to musical extensiveness, flexibility, and originality.

According to Carroll (Nardo and Reiterer 2009: 218), musical aptitude consists of 31 factors, which can be sub-divided into four groups: (i) general sound discrimination factors, (ii) sound-frequency discrimination factors, (iii) sound intensity and duration discrimination factors, and (iv) musical sensitivity and judgment factors.

As mentioned above, there is tremendous evidence of significant correlations between musicality and L2 acquisition, especially talent for L2 pronunciation (see Nardo and Reiterer 2009: 233 for a review). Thus, "the higher the musicality, the better the pronunciation and the imitation in a second language" (Christiner & Reiterer 2013: 1). This finding can, essentially, be partly explained by the fact that language and music share some features. Nardo and Reiterer (2009: 339) sum them up as follows:

- Both of them are auditory phenomena that follow a time line (temporal aspect).
- Rhythm and melody in music can be compared to stress and intonation in language (Arleo 2000).
- Both of them are human universals consisting of perceptually discrete elements organized into hierarchically structured sequences, be it from the individual note to the larger constituent of a musical composition, or from phonemes to the discourse units (Sloboda 1985; Patel 2003).
- Both of them share a serious of fundamental characteristics, such as the processing of sounds, the conveyance of messages, the learning by exposure, the sharing of intrinsic features like pitch, volume, prominence, stress, tone, rhythm, and pauses (Fonseca Mora 2000).

Christiner and Reiterer (2013) add that several studies have demonstrated that people with musical talent also show an improved auditory working memory (Phonological Memory PM) and are able to remember stretches of speech longer than people who are not gifted in music.

Nardo and Reiterer (2009: 238) report that there exist several studies which provide evidence for the hypothesis that music and language are partially processed in the same brain areas. Christiner and Reiterer posit that they even largely overlap in the short term memory. They thus conclude that

> music and language perception is not an either/or choice but highly interconnected and may be one of the underlying mechanisms why musicians are advantaged in the oral acquisition of foreign languages:

> musical expertise leads to an improvement of both, music and speech perception (Oechslin et al. 2010) but also to enhanced literacy and attentional skills (Seither-Preisler et al. 2014). (Christiner and Reiterer 2013: 2).

Hence, according to Nardo and Reiterer (2009: 233), there is tremendous evidence of a positive relationship between second language acquisition and musicality. Studies by Dexter and Omwake 1934, Eterno 1961, Pimsleur et al 1962, Leutenegger et al 1965, Arellano & Draper 1972, Fish 1984, or more recent ones, such as Stevenson 1999, Tucker 2000, Morgan 2003, Slevc and Myiake and Milanov 2008 all reveal significant correlations between music skills (especially rhythm and pitch discrimination) and L2 proficiency, in particular in the phonological and phonetic domain. (For a detailed review see Nardo and Reiterer 2009).

With respect to measuring musicality, several approved tests are already available. These tests, however, vary in their conceptualization since the authors look at musicality from a different perspective. One of these tests which was also used in the empirical study conducted as part of this thesis, is introduced in chapter 4.

As can be seen in this chapter, language learning aptitude has become a large field of research in SLA, and most likely there exist several cognitive as well as affective contributors to language aptitude.

With respect to cognitive factors, research provides evidence for the influence of musicality and working memory on language talent, however, correlations between aptitude and general IQ could, de facto, not be found until now.

In terms of other contributors to language aptitude not much is known, thus interrelations and interdependences between motivation, personality, age and aptitude are currently just based on hypotheses.

Dörnyei (2015: 70), therefore, outlines two directions of future aptitude research. One implies the cognitive aspect, hence intelligence or more broadly IQ, essential to language learning, the other concerns the interrelationship between various cognitive processes and other aspects of language learning beyond the IQ.

Therefore, this chapter shall close with DeKeyser and Juffs (2005: 446) who claim that:

> The future of aptitude research in the L2 domain probably lies in the study of these interactions between (components of) aptitude and learning contexts, instructional treatments, age of learning, and stages of acquisition, not only because such research gives a more accurate

empirical picture of reality and a better ability to predict success or failure than studies on any of these variables can separately, but also because establishing such interaction effects tells us more about what elementary cognitive mechanisms underlie aptitude, and what cognitive processes take place under various conditions of learning than mere correlational aptitude research or mere experimental research on treatments".

Empirical Part

4 Research

As outlined in earlier chapters, there exists evidence for the relationship between foreign language learning aptitude and the cognitive domains working memory and musicality. The theoretical part of the present thesis sought to shed lights on these special relationships by summarizing current research discoveries.
The empirical section presents the results of a cross-sectional psycholinguistic study that was conducted so to prove previous research findings.
Before however results can be discussed and conclusions can be drawn, the study's aim and methods are briefly sketched below.

4.1 Aim of the study

Based on the discussed findings, the study seeks to enrich the existing research body in the field of language aptitude, as well as aims at expanding our knowledge about the interrelation between language learning aptitude, working memory, musicality, and intelligence.
As this thesis is set against an educational background, the main intention is to gain insight into the mental capacities of young language learners so as to make important assets for Early Language Teaching.
Figure 10 below visualizes the rationale of this research project.

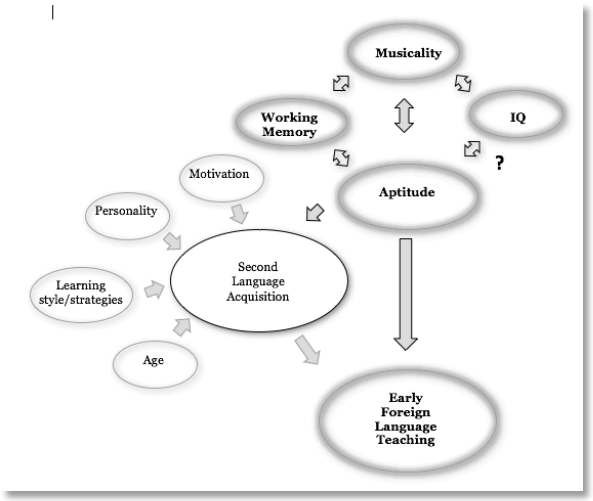


Figure 10. Research Rationale
Illustration of the three investigated factors (WM, Musicality, IQ) affecting language aptitude, and consequently SLA.

As can be seen, figure 10 above represents the thesis' aim, that is to investigate the interrelation between working memory, musicality and IQ and language learning

aptitude so as to finally draw important conclusions for early foreign language teaching.
An overview of the study's research questions and hypotheses is given in the following section.

4.2 Research Questions and Hypotheses

As Christiner and Reiterer (2015: 1) claim, recent research has revealed that people with a higher musical expertise and better memory skills are also more successful oral speech imitators. In their study, Christiner and Reiterer tested foreign speech imitation aptitude in an unknown language, Hindi, as well as the participant's musical ability. It turned out that the better one imitates utterances of an unknown language the more musical one is as well. Whereas Christiner and Reiterer looked at adults, this study aims at detecting language aptitude and its interrelation with musicality and working memory in pre-adolescent children at the age of ten -a time in life supposed to be before any critical period- to investigate if this phenomenon occurs in this age group as well. If so, the findings would certainly contribute to seeing the interrelation between phonetic aptitude and the other two investigated cognitive domains as a human universal.
In line with these research findings the study's aim is twofold:
(1) it wants to prove and confirm previous research results by investigating young foreign language learners and seeks to expand our knowledge on the relationship between language aptitude, in particular phonetic ability, working memory and musicality. To verify Christiner and Reiterer's results, Chinese and Tagalog were chosen to test the participant's speech imitation aptitude. As a control-language, i.e. prove variable, Turkish -as the native language of most participants- was used. It was assumed that whilst the reproduction of a native language would not show any correlations with musicality or working memory, unintelligible speech such as Chinese or Tagalog would significantly correlate with these domains.
Furthermore (2), the study seeks for other correlations between all the investigated variables. Figure 11 below illustrates this research aim.

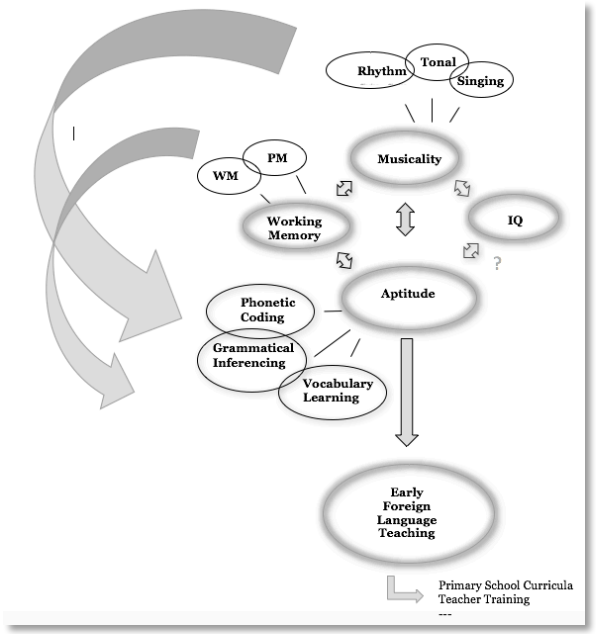


Figure 11. The interrelation of aptitude and other cognitive domains
Illustration of the study's research questions on the relationship between the various components of aptitude and components of the other cognitive domains.

As figure 11 clearly shows, the study is concerned with the relationship between language aptitude, in particular phonetic coding or speech imitation aptitude, musicality, working memory, and IQ in primary school-aged children. Moreover, it seeks to find further correlations between the investigated components of each domain.

Table 10 contains the thesis' research questions and their hypotheses.

Table 10. Overview of research questions and hypotheses.

1. Does language aptitude correlate with musicality? *It is expected that language aptitude correlates with musicality.*
2. Does language aptitude correlate with working memory? *It is expected that language aptitude correlates with working memory.*
3. Does language aptitude correlate with IQ? *No correlations are expected.*
4. Are there any significant correlations between the various components of the investigated variables?

4.3 Participants

As the study is placed against an educational background which findings hopefully contribute to valuable and beneficial insights for early language teaching, the investigated target group were primary school—aged children.

The Austrian curriculum for primary schools demands foreign language exposure from grade one onwards. According to the curriculum, language input should be given in so-called *integrated mini-sequences* at first and second grade, that is a content and language integrated learning (CLIL) -based approach where the foreign language (English) functions as the language of instruction while teaching any content of different subject areas (except German) of the curriculum. At grade three and four the syllabus requires one foreign language lesson a week. According to the Austrian Ministry of Education, the goal of foreign language teaching at primary level is to move learners towards A1 level (pre-A1) based on the Common European Framework of Reference for Languages (CEFR).

To follow the idea of a sample as homogeneous as possible, thirty fourth-graders were selected to participate in the study. Their age ranged between 9,5 and 10 years. All participants attended the same primary school, distributed to two classes. Consequently, all of them were in their fourth year of foreign language learning.

Candidates were fourteen boys and sixteen girls. Only eight out of thirty spoke German as their mother tongue. Eighteen of the non-natives came from Turkey, four from Serbia, Bosnia and Macedonia. Approximately half of the non-native speakers of German were born in Austria, the others arrived during their first years of living.

Nineteen of the thirty participants will continue their school life in a lower secondary school (NMS), whilst only 11 will transfer to a AHS, i.e. secondary school which ends with A-levels (Matura). For a better understanding of the sample, figures 12 to 14 provide some illustrations.

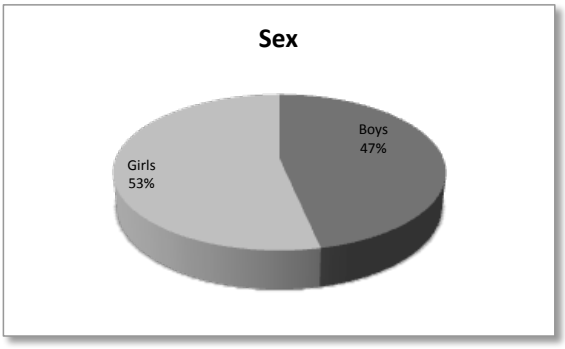
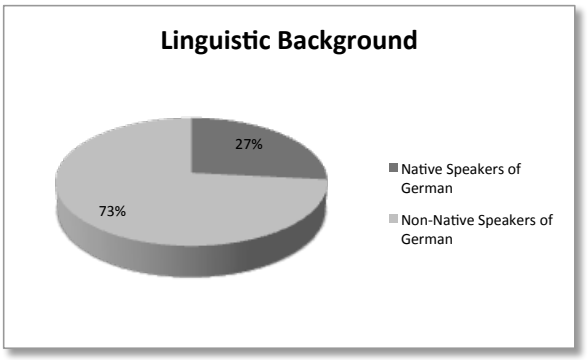
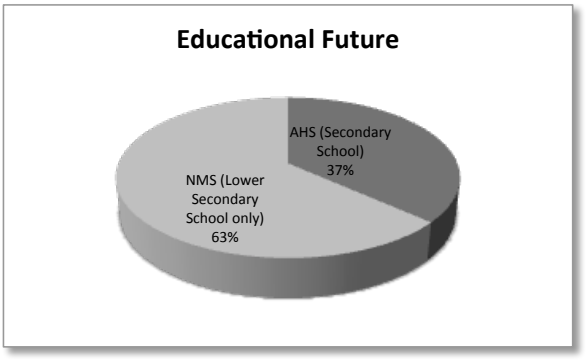


Figure 12. Sex.
14 boys and 16 girls participated in the study



| **Figure 13. Linguistic Background**
8 German native speakers (monolinguals) and 22 participants with German as their L2 (bilinguals) participated in the study



| **Figure 14. Educational Future**
Only 11 children will transfer to a secondary school (AHS)

4.4 Procedure

The testing took place at the *Praxisvolksschule der PH Wien*- a primary school mainly used for research and teacher training purposes. An extra research permission of the Viennese Department of Education was unneeded. Nevertheless, the participants' parents were informed of the study's aim and additionally were asked for their permission. It was emphasized that the candidates could quit testing at any point of time, without stating any reasons.

Technical equipment, such as a computer, headphones, recording devices, etc. were provided in an extra soundproof room. Agreeable conditions with respect to light, heat, and air were provided.

All participants were tested within one month. Each child took eight tests on one single day. Therefore, the tested child was taken out of their class for fifty to sixty minutes to complete all tests. The final test (non-verbal intelligence / phase 9, see table 11) took place on a different day.

It was set great value upon equal testing conditions among all children. Hence, the tests always followed the same sequence within the same span of time. Table 11 in the following section illustrates the nine testing phases participants had to pass through.

4.5 Methods

In the hope to receive valid, significant, and plenty research findings, 9 different tests were administered to the participants. Table 11 below provides an overview of the several testing phases.

Table 11. Administered tests in chronological sequence; classified into research domains and test components.

Phase	Domain	Component	Test	Time
Phase 1	Musicality	Tonal Ability	IMMA Tonal (Gordon)	15-20
Phase 2	Memory	Working Memory	WM 1, 2 (Wechsler)	2
Phase 3	Memory	Phonological Memory	PM (Wechsler)	2
Phase 4	Language Aptitude	Phonetic Coding / Speech Imitation Aptitude	Speech Stimuli (Christiner/Reiterer)	10-12
Phase 5	Musicality	Singing Ability	Happy Birthday	1
Phase 6	Language Aptitude	Rote Memory	Llama B (Meara)	5-8
Phase 7	Language Aptitude	Grammatical Inferencing	Llama F (Meara)	10-12
Phase 8	Musicality	Rhythm Ability	IMMA Rhythm (Gordon)	15-20
Phase 9	Intelligence	IQ	CFT20-R (Weiß)	40

As can be seen in table 11 above, each child had to pass through 9 phases. Classified into their particular cognitive domain, all tests are described in detail below.

4.5.1 Testing Musicality

4.5.1.1 The IMMA

Phase 1	Musicality	Tonal Ability	IMMA Tonal	15-20’
Phase 8	Musicality	Rhythm Ability	IMMA Rhythm	15-20’

The *IMMA (Intermediate Measures of Music Audiation)* test belongs to the so-called *developmental music aptitude tests*. It has been designed by Edwin Gordon in 1982, particularly for kindergarten to primary school-aged children.
The IMMA is a computer-based test and employs tonal pattern, i.e. tunes, and rhythmic patterns. In both sections, the participants have to listen to two musical statements and need to discriminate between them by either identifying them as “same” or “different”.
The participants of the study used headphones and were required to complete both parts. Each part lasted approximately between 15 to 20 minutes.

4.5.1.2 Singing Aptitude

Phase 5	Musicality	Singing Ability	Happy Birthday	1’

In order to test the participant’s ability to sing, they were asked to sing the popular and well-known song “Happy Birthday”. The song was recorded and got evaluated by a musician.

4.5.2 Testing Memory

Phase 2	Memory	Working Memory	WM 1, 2	2’
Phase 3	Memory	Phonological Memory	PM	2’

In order to test the participants working memory, a WM test (Wechsler 1939) was used. The working memory test consisted of three parts.
In the first part, the participants were asked to repeat a string of numbers forwards, whereas in the second part, participants had to repeat a digit span backwards. Additionally, their Phonological Memory (PM) was tested by recalling and repeating German non-words (Benner 2005). Figure 15 below illustrates the WM test (part 1 and 2).

1 Versuch		2 Versuch		Punkte
5 – 8 – 2		6 – 9 – 4		
6 – 4 – 3 – 9		7 – 2 – 8 – 6		
4 – 2 – 7 – 3 – 1		7 – 5 – 8 – 3 – 6		
6 – 1 – 9 – 4 – 7 – 3		3 – 9 – 2 – 4 – 8 – 7		

Figure 15. Working Memory Digit Span
Candidates are required to repeat digits forward and backward

4.5.3 Testing Foreign Language Aptitude

4.5.3.1 LLAMA B & LLAMA F: Testing rote memory & grammatical inferencing ability

Phase 6	Language Aptitude	Rote Memory	Llama B	5-8’
Phase 7	Language Aptitude	Grammatical Inferencing	Llama F	10-12’

In order to test the participant’s foreign language learning aptitude, they had to complete two parts of the Llama Aptitude Test (Meara 2005).

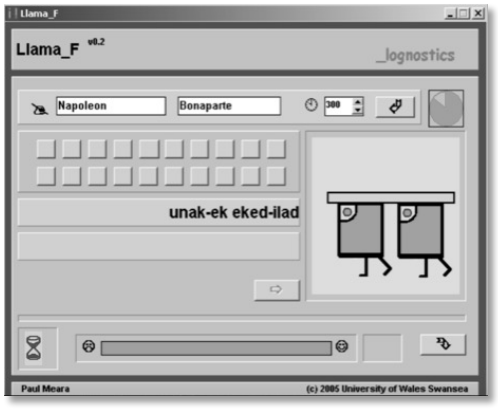
Since the four different aspects of the Llama have already been described in the theoretical part, only the two parts used in the study are illustrated below.

First, the participants had to complete the Llama B, a vocabulary learning task, which is designed to measure the rote memory ability. Participants thus are to learn relatively large amounts of vocabulary in a rather short span of time. Candidates were presented with 20 different items which names they have to study in a relatively short time. In the testing phase, a name appears on the screen and the candidates were required to identify the corresponding item. Figure 16 below shows the panel of the Llama B.

Figure 16. The panel of the Llama B- a rote memory task
Candidates are required to learn as many item names as possible in a short span of time

Llama F is a grammatical inferencing task, where the candidates were presented with 20 sentences in a non-language and corresponding drawings that illustrate the meaning of these sentences. Participants had some time (5 minutes) to study the sentences along with their illustrations and had to infer grammatical rules of the pseudo language. In the test phase, participants were presented with one drawing and two sentences. They, thus, were asked to choose between the two sentence options, accordingly. Figure 17 shows the panel of the grammatical inference task.

Figure 17. The panel of the Llama F- a grammatical inferencing task
Candidates are required to figure out the grammatical rules of the pseudo language



4.5.3.2 Speech Imitation: Testing phonetic coding ability

Phase 4	Language Aptitude	Phonetic Coding	Speech Stimuli	10-12’

For testing the speech imitation ability of the participants, i.e. pronunciation, they were presented to fifteen speech stimuli of two to eleven syllables-length. The stimuli were given in the following order:

Stimulus 1	Tagalog	4 syllables
Stimulus 2	Tagalog	4 syllables
Stimulus 3	Tagalog	2 syllables
Stimulus 4	Chinese	4 syllables
Stimulus 5	Chinese	5 syllables
Stimulus 6	Chinese	5 syllables

	Stimulus 7	Turkish	4 syllables
	Stimulus 8	Turkish	4 syllables
	Stimulus 9	Turkish	5 syllables
	Stimulus 10	Tagalog	9 syllables
	Stimulus 11	Tagalog	11 syllables
	Stimulus 12	Tagalog	11 syllables
	Stimulus 13	Chinese	9 syllables
	Stimulus 14	Chinese	11 syllables
	Stimulus 15	Chinese	11 syllables

After listening to each stretch of speech, participants were required to repeat it in their best accent they could manage. Whilst they were not allowed to listen to the four and five syllables-length words a second time, words of nine to eleven syllable-length were repeated twice before an imitation was required. This procedure got repeated until participants had imitated all fifteen utterances. Each utterance was rated by native speakers: six natives for Turkish and Tagalog, and three for Chinese. The recording was performed in a soundproof room.

4.5.4 Testing Intelligence: The CFT20-R

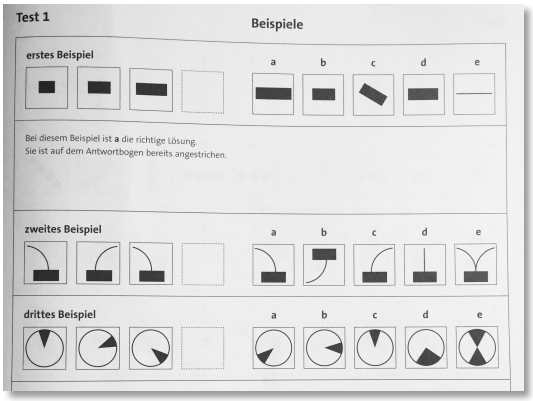
Phase 9	Intelligence	IQ	CFT20-R	40’

To test the general cognitive-analytic ability of the participants (IQ), a non-verbal intelligence test was employed. The used test, the CFT20-R, has been designed for children from 8,5 to 19 years, and been approved as reliable and valid measurement tool. The CFT20-R (Rudolf H. Weiß 2006) consists of two parts. They can, but must not, be employed together.

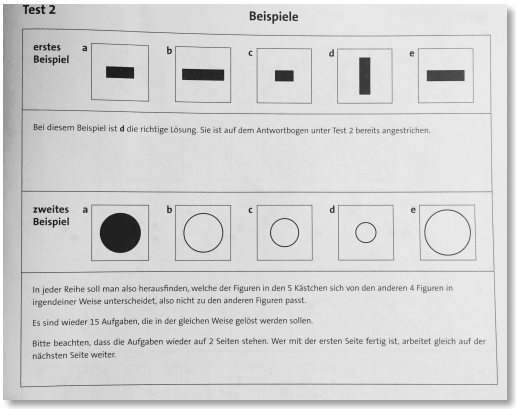
In consideration of the participant’s age, candidates were only asked to complete the first part. It is divided into four sub-tests. These are:

* Subtest 1: continuation of rows
* Subtest 2: classifications
* Subtest 3: matrixes
* Subtest 4: topological inferences

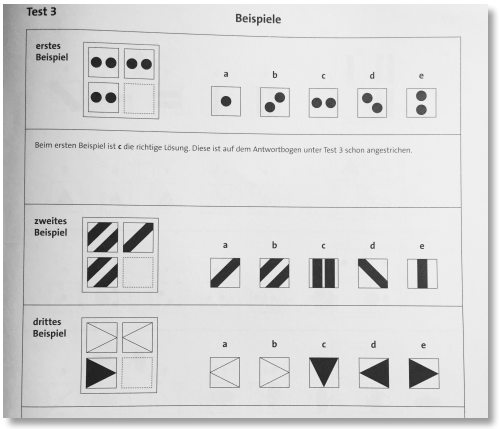
For equal conditions, all thirty participants did the test at the same time. The instructor precisely followed the instructions outlined in the test's manual. Right before each of the subtests, the candidates were talked through two or three examples.
For subtest 1, they were given exactly five minutes to complete the test. For subtest 2, candidates had five minutes as well. Subtest 3 had to be done in four minutes. Finally, also subtest 4 had to be completed in four minutes. For a better understanding, figure 18 to 21 exemplify each subtest.



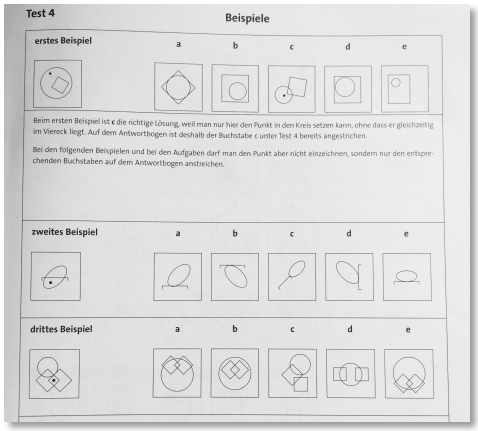
| **Figure 18. Subtest 1- continuation of rows**
In subtest 1 a continuation of each row is required. In the case of the first example, the correct answer would be (a) since it is a logical continuation of the picture row



| **Figure 19. Subtest 2- classifications**
Candidates are required to choose the one picture which does not fit. In example 1, the correct answer would be (d) since it looks differently than the others



| **Figure 20. Subtest 3- matrixes**
Candidates have to fill in the proper picture. In the case of example 1, the correct answer would be (c) since it is follows the same pattern

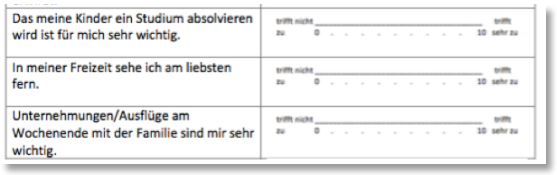


| **Figure 21. Subtest 4- topological inferences**
Candidates are required to choose the picture that shows the same pattern as the picture in the left. In the first example, answer (c) would be correct since the black dot is inside the circle but outside the square

4.5.5 Questionnaire of Socio-Economic Status (SES)

To elicit the participants' personal and linguistic background as well as social status, a questionnaire was distributed to the parents as a final step.

The questionnaire consisted of two parts. The first one asked for educational, professional and linguistic information, whereas the second part elicited social information. It consisted of several statements about recreational activities and life style so as to gather information on the socio-economic background of each tested child. These statements then had to be evaluated by the parents on a scale from 0 to 10. Figure 22 illustrates part 2 of the questionnaire.



Das meine Kinder ein Studium absolvieren wird ist für mich sehr wichtig.	trifft nicht zu 0 . . . . . 10 trifft sehr zu
In meiner Freizeit sehe ich am liebsten fern.	trifft nicht zu 0 . . . . . 10 trifft sehr zu
Unternehmungen/Ausflüge am Wochenende mit der Familie sind mir sehr wichtig.	trifft nicht zu 0 . . . . . 10 trifft sehr zu

Figure 22. Questionnaire on Socio-Economic Background

The complete data then was entered into the statistical computer program SPSS. The following chapter presents the study's results.

5 Results

As just mentioned, all statistical analyses were operated by SPSS Statistics 20.0 (IBM Corporation, New York, USA). For analysis one-tailed Spearman's correlation tests were run to find out whether language aptitude, in particular speech imitation ability, affects musical and working memory aptitude. It was also investigated to what extent IQ and the educational background of the participant's parents played a role.

5.1 Results: Foreign Language Aptitude, Musicality, Working Memory, and Intelligence

The following subsections provide an overview of the individual descriptive statistics of the most important variables.

5.1.1 Results: Foreign Language Aptitude

The mean of the rote memory task (Llama B) was 27,33; SD = 12,02. The grammatical inferencing task (Llama F) showed a mean of 16,83; SD= 18,03. The Chinese imitation mean was 3,18, SD= ,67; Tagalog: 4,02; SD= ,69, and Turkish: 7,71; SD=1,51. Table 12 illustrates further frequencies of the variable foreign language aptitude.

Table 12. Descriptive statistics of Foreign Language Aptitude.

	Results Foreign Language Aptitude					
	M	*MD*	*SD*	*Skewness*	*min*	*max*
LLAMA B	27,33	27,50	12,02	-,004	5,00	50,00
LLAMA F	16,83	10,00	18,03	-,636	0,00	50,00
Chinese	3,18	3,22	,67	-,026	1,83	4,61
Tagalog	4,02	4,02	,69	,229	2,75	5,53
Turkish	7,71	8,14	1,51	-,821	4,00	9,50

As can be clearly seen in table 12, participants scored better in the rote memory task (Llama B) than in the grammatical inferencing task (Llama F). Chinese was hardest to imitate; both Tagalog and Chinese were averagely more difficult to reproduce than Turkish, which, in fact, was expected since Turkish- as the native language of most of the participants- only served as a prove variable for the study's hypothesis that phonetic aptitude draws on other cognitive processes, irrespective of any language.

5.1.2 Results: Musicality

The mean of the tonal discrimination task (IMMA Tonal) was 31,40; SD=4,31; the mean of the rhythmic discrimination task (IMMA Rhythm) was 28,60; SD=4,27. The total mean of the musicality test was 60,00; SD= 7,43. Table 13 shows more descriptive details of the variable musicality.

Table 13. Descriptive statistics of Musicality.

Results Musicality						
	M	*MD*	*SD*	*Skewness*	*min*	*max*
IMMA Tonal	31,40	32,50	4,312	-,186	22	39
IMMA Rhythm	28,60	29,50	4,272	-,108	21	36
IMMA Total	60,00	60,00	7,428	-,068	46	73

As illustrated in table 13, participants performed better at the tonal discrimination task than at the rhythmic discrimination task. In total they reached an average score of 60%.

5.1.3 Results: Working Memory

The mean of the working memory-forward task was 5,17; SD= 1,29; memorizing a string of digits backward showed a mean of 4,11; SD= 1,27, whilst memorizing non-words revealed a mean of 3,93; SD=,740. Further details are shown in table 14.

Table 14. Descriptive statistics of Working Memory.

Results Working Memory						
	M	*MD*	*SD*	*Skewness*	*min*	*max*
Memory forward	5,17	5,00	1,29	,807	3	9
Memory backward	4,03	4,00	1,27	-,289	2	6
Memory non-words	3,93	4,00	,740	,108	3	5

As can be seen in table 14, participants scored highest in memorizing a string of digits forward and lowest in memorizing German non-words.

5.1.4 Results: Intelligence (IQ) and Educational Background

The mean of IQ was 95,63; SD= 10,78. The mean of the educational background of the participant's parents was 5,13; SD=2,43; the mothers showed a mean of 5,29; SD=2,84; the fathers mean was 5,15; SD=2,70. More statistical descriptions of IQ and educational background are illustrated in table 15 and table 16.

To get a better impression of the participant's educational background, figure 23 firstly illustrates the educational levels of the parents. It shows that one quarter of the parents attended compulsory school only, almost 40% went to a vocational school and only 16% received an academic education. On average, however, the parents keep a secondary school degree.

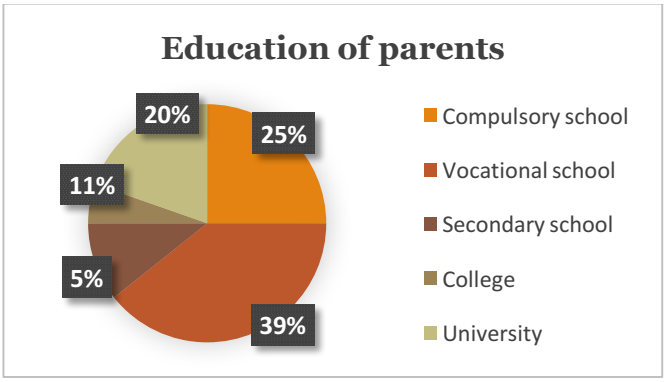


Figure 23. Education of the participant's parents.

Table 15. Descriptive statistics of Intelligence.

	Results IQ					
	M	*MD*	*SD*	*Skewness*	*min*	*max*
IQ	95,63	96,00	10,78	,646	77	127

Table 15 reveals that the average IQ of the participants was 95,63.
Furthermore, table 16 below illustrates the descriptive statistics of the educational status of the participant's parents.

Table 16. Descriptive statistics of Educational Background.

	Results Educational Background					
	M	*MD*	*SD*	*Skewness*	*min*	*max*
Education father	5,15	4,00	2,70	1,26	3,00	10,00
Education mother	5,29	4,00	2,84	,952	3,00	10,00

The next section is dedicated to the central core research questions of this thesis. Hence, it reveals if and to what extent foreign language aptitude affects the cognitive domains musicality, working memory and intelligence. It also investigates the role of education with regard to these abilities.

5.2 Core Results: The Interrelation of Foreign Language Aptitude, Musicality, Working Memory, and General Intelligence

5.2.1 Foreign Language Aptitude and Musicality

The musicality test (IMMA total) was correlated with the Chinese and Tagalog speech imitation (SI) tasks.

Chinese was highly correlated with musicality, r_s= 0,46, *p* (one-tailed) < 0,01. In particular, the tonal discrimination ability showed a significant relation, r_s= 0,51, *p* (one-tailed) < 0,01, which in fact can be easily explained since Chinese is a tone language. The rhythmic discrimination ability in Chinese showed a significant correlation at the 0,05 level, r_s= 0,33.

Furthermore, Tagalog significantly related to musicality (IMMA total), r_s= 0,58 *p* (one-tailed) < 0,01. Tonal (r_s= 0,55) and rhythmic (r_s= 0,48) discrimination ability both correlated at the 0,01 level.

Turkish did not show any correlations with musicality. Which, in fact, proves the foregoing assumption that the reproduction of a native language is not tied to the investigated cognitive abilities whereas, in contrast, foreign language aptitude is highly related to musical abilities.

No relationship was found between musicality and rote memory ability (Llama B). However, musical ability (IMMA) and the grammatical inferencing task (Llama F) revealed a negative correlation at the 0.01 level, r_s= -0,50 *p* (one-tailed) < 0,01. Table 17 below summarizes the most important results of foreign language aptitude and musicality. Additionally, the vocal performance of the well-known song “Happy Birthday”, i.e. singing, correlated significantly with rote memory ability (Llama B) at the 0.01 level, r_s= -0,49 *p* (one-tailed) < 0,01.

Table 17. Correlations between Language Aptitude and Musicality.

Correlations Foreign Language Aptitude and Musicality

			IMMA Tonal	IMMA Rhythm	IMMA Total	LLAMA_B	LLAMA_F	Tagalog	Chinese	Turkish
Spearmans's rho	IMMA Tonal	Correlation Coefficient	1,000	,503**	,853**	,075	-,514**	,549**	,514**	-,040
		Sig. (1-tailed)	.	,002	,000	,347	,002	,001	,002	,418
		N	30	30	30	30	30	30	30	30
	IMMA Rhythm	Correlation Coefficient	,503**	1,000	,871**	,173	-,359*	,475**	,327*	,078
		Sig. (1-tailed)	,002	.	,000	,181	,026	,004	,039	,340
		N	30	30	30	30	30	30	30	30
	IMMA Total	Correlation Coefficient	,853**	,871**	1,000	,158	-,496**	,579**	,457**	,027
		Sig. (1-tailed)	,000	,000	.	,203	,003	,000	,006	,443
		N	30	30	30	30	30	30	30	30
	LLAMA_B	Correlation Coefficient	,075	,173	,158	1,000	,195	,118	,331*	,090
		Sig. (1-tailed)	,347	,181	,203	.	,151	,267	,037	,317
		N	30	30	30	30	30	30	30	30
	LLAMA_F	Correlation Coefficient	-,514**	-,359*	-,496**	,195	1,000	-,109	,015	,252
		Sig. (1-tailed)	,002	,026	,003	,151	.	,283	,469	,089
		N	30	30	30	30	30	30	30	30
	Tagalog	Correlation Coefficient	,549**	,475**	,579**	,118	-,109	1,000	,591**	,292
		Sig. (1-tailed)	,001	,004	,000	,267	,283	.	,000	,059
		N	30	30	30	30	30	30	30	30
	Chinese	Correlation Coefficient	,514**	,327*	,457**	,331*	,015	,591**	1,000	,432**
		Sig. (1-tailed)	,002	,039	,006	,037	,469	,000	.	,009
		N	30	30	30	30	30	30	30	30
	Turkish	Correlation Coefficient	-,040	,078	,027	,090	,252	,292	,432**	1,000
		Sig. (1-tailed)	,418	,340	,443	,317	,089	,059	,009	.
		N	30	30	30	30	30	30	30	30

** Correlation is significant at the 0,01 level (1-tailed).
* Correlation is significant at the 0,05 level (1-tailed).

As table 17 clearly points out there exists a significant correlation between musicality and speech imitation ability of unknown languages, i.e. Chinese and Tagalog. Turkish however- being the native language of most of the participants- shows no relation to musicality. Thus, Turkish is accepted as a prove variable and serves to demonstrate that foreign speech imitation aptitude draws on other cognitive abilities, such as musicality and -as will be revealed below- working memory, whereas these abilities are not needed for the reproduction of a native language.

5.2.2 Foreign Language Aptitude and Working Memory

The working memory tasks (WM) were analysed together with SI (Chinese and Tagalog) as well as grammatical inferencing (Llama F) and rote memory (Llama B).

The working memory task (forward) significantly correlated with Chinese, r_s= 0,56 *p* (one-tailed) < 0,01, and Tagalog r_s= 0,49 *p* (one-tailed) < 0,01. Thus, similar to musicality, it was revealed that the higher the participants working memory skills are, the better they imitate unintelligible speech. This is illustrated in table 18 below.

Turkish did not show any correlation to working memory and so, once again, proved the study's assumption. No relation was found between WM, grammatical inferencing, and rote memory.

Table 18. Correlations between Language Aptitude and Working Memory

Correlations Foreign Language Aptitude and Working Memory								
			Memory forward	Memory backward	Memory non-words	Tagalog	Chinese	Turkish
Spearmans's rho	Memory forward	Correlation Coefficient	1,000	-,114	,209	,481**	,557**	,052
		Sig. (1-tailed)	.	,275	,134	,004	,004	,392
		N	30	30	30	30	30	30
	Memory backward	Correlation Coefficient	-,114	1,000	,376*	,278	-,121	,278
		Sig. (1-tailed)	,275	.	,020	,068	,261	,068
		N	30	30	30	30	30	30
	Memory non-words	Correlation Coefficient	,209	,376*	1,000	-,005	-,108	-,005
		Sig. (1-tailed)	,134	,020	.	,489	,284	,489
		N	30	30	30	30	30	30
	Tagalog	Correlation Coefficient	,481**	,278	-,005	1,000	,591**	,292
		Sig. (1-tailed)	,004	,068	,489	.	,000	,059
		N	30	30	30	30	30	30
	Chinese	Correlation Coefficient	,557**	-,121	-,108	,591**	1,000	,432**
		Sig. (1-tailed)	,004	,261	,284	,000	.	,009
		N	30	30	30	30	30	30
	Turkish	Correlation Coefficient	,052	,278	-,005	,292	,432**	1,000
		Sig. (1-tailed)	,392	,068	,489	,059	,009	.
		N	30	30	30	30	30	30
** Correlation is significant at the 0,01 level (1-tailed).								
* Correlation is significant at the 0,05 level (1-tailed).								

As table 18 illustrates, working memory, in particular memorizing and repeating a string of digits forward, interrelates with speech imitation ability of the unknown languages Chinese and Tagalog. In contrast, there is no correlation between working memory and the reproduction of a native language.

5.2.3 Foreign Language Aptitude and IQ

As mentioned in the theoretical part, recent research suggests that there is no correlation between general non-verbal IQ and second language aptitude (Rota and Reiterer 2009: 88). Language aptitude thus is considered as distinct from the concept of intelligence. This finding can be confirmed by the study since no relationship could be found between vocabulary learning, grammatical inferencing, speech imitation ability and IQ. IQ, however, seems to relate to the socio-economic status of the participants. This interrelation will be explored in section 5.3.2. below.

5.2.4 Multiple Regression (MLR)

To detect the cognitive abilities which influence the variability of phonetic aptitude most a stepwise multiple linear regression analysis was applied. As dependent variables the two unknown languages Chinese and Tagalog were used. All other

variables were entered into the MLR as independent ones and the criterion for entering the variables was reliant on their probability of F-change <0,05.

As shown in table 19 below, it could be revealed that 69,5% of the variability of the Chinese and Tagalog imitation score can be explained by the cognitive abilities musicality (IMMA total), working memory forward (WM) and grammatical inferencing (Llama F) as well as the educational level of the participant's fathers. The variables IQ, rote memory, and singing did not appear to justify the speech imitation ability of the participants.

Table 19. Multiple Regression Models explaining the variance in imitating unknown languages

	R	R^2	F Change	Sig. F Change
Model 1	,621	.385	15,677	.001
Constant				
Musicality				
Model 2	.724	.525	7,031	.014
Constant				
Musicality				
Working Memory				
Model 3	,774	,599	4,284	,050
Constant				
Musicality				
Working Memory				
Grammatical inferencing				
Model 4	,834	.695	6,884	.016
Constant				
Musicality				
Working Memory				
Grammatical inferencing				
Education father				

Dependent variables: Chinese and Tagalog imitation

As can be seen above, almost 70% of the performances in Chinese and Tagalog can be explained by the factors musicality, working memory, grammatical inferencing and the educational level of the participant's fathers.

5.3 Further Results

5.3.1 Musicality, Working Memory and IQ

The total results of the IMMA were correlated with the working memory tasks. The analysis revealed a significant correlation at the 0.01 level, r_s= 0,42 *p* (one-tailed) < 0,01; thus, the more musical the participants, the better their memory skills were as well. Musicality therefore affects working memory and vice versa.

Rhythmic discrimination ability significantly correlated with IQ, r_s= 0,33 *p* (one-tailed) < 0,01. A discussion of this result would however go far beyond the scope of this thesis. No relation could be found between working memory and IQ, as well as musicality and IQ.

5.3.2 Socio-Economic Effects

The educational background (illustrated in figure 22) of the participant's parents was correlated with IQ, memory and musicality. The analysis revealed a significant correlation between both the educational level of the mother (r_s= 0,51 *p* (one-tailed) < 0,01) and the father (r_s= 0,38 *p* (one-tailed) < 0,05) with musicality.

Moreover, IQ correlated with the education of both the parents at the 0,05 level; mother: r_s= 0,36 *p* (one-tailed) < 0,05; father: r_s= 0,45 *p* (one-tailed) < 0,05). Finally, also working memory correlated with the educational background of both the parents, mother: r_s= 0,34 *p* (one-tailed) < 0,05; father: r_s= 0,42 *p* (one-tailed) < 0,05. The results are shown in table 20 below.

Table 20. Educational background and cognitive domains.

Educational Background, Musicality, Working Memory and Intelligence							
			Education mother	Education father	IMMA total	IQ	Memory forward
Spearmans's rho	Education mother	Correlation Coefficient	1,000	,677**	,510**	,360*	,341*
		Sig. (1-tailed)	.	,000	,003	,030	,038
		N	30	30	30	30	30
	Education father	Correlation Coefficient	,677**	1,000	,378*	,445*	,421*
		Sig. (1-tailed)	,000	.	,026	,010	,014
		N	30	30	30	30	30
	IMMA total	Correlation Coefficient	,510**	,378*	1,000	,271	,423**
		Sig. (1-tailed)	,003	,026	.	,074	,010
		N	30	30	30	30	30
	IQ	Correlation Coefficient	,360*	,445*	,271	1,000	,118
		Sig. (1-tailed)	,030	,010	,074	.	,267
		N	30	30	30	30	30
	Memory forward	Correlation Coefficient	,341*	,421*	,423**	,118	1,000
		Sig. (1-tailed)	,038	,014	,010	,267	.
		N	30	30	30	30	30
** Correlation is significant at the 0,01 level (1-tailed).							
* Correlation is significant at the 0,05 level (1-tailed).							

As can be seen in table 20, it seems that the higher the parents are educated, the higher their children's IQ, working memory ability, and musical skills are. No relationship could be found between speech imitation ability and education. A significant correlation at the 0,01 level could be detected between the education of the mother and the father, r_s= 0,68 *p* (one-tailed) < 0,01.

A summary of the study's main research questions together with their findings is presented in table 21 below.

Table 21. Summary of Research Findings.

Research question 1: *Does language aptitude (speech imitation, rote memory and grammatical inferencing) correlate with musicality?* **Result: Speech imitation ability correlates significantly with musicality.** Hypothesis justified: It is expected that language aptitude correlates with musicality.
Research question 2: *Does language aptitude (speech imitation, rote memory and grammatical inferencing) correlate with working memory?*

Result: Speech imitation ability correlates significantly with working memory.
Hypothesis justified: It is expected that language aptitude correlates with working memory.

Research question 3:
Does language aptitude correlate with IQ?
Result: Language aptitude does not correlate with IQ.
Hypothesis justified: It is expected that language aptitude does not correlate with IQ.

Research question 4:
Are there any significant correlations between the various components of the investigated variables?
Results:
Musicality correlates with grammatical inferencing.
Musicality correlates with working memory.
Rhythmic ability correlates with IQ.
Educational level correlates with IQ.
Educational level correlates with musicality.
Educational level correlates with working memory.
Educational level of females correlates with educational levels of males.
69,5% of the variability of speech imitation can be explained by working memory, musicality, grammatical inferencing, and educational background.

The next chapter is dedicated to a discussion of the above sketched main results.

6 Discussion

As assumed, the study's outcome is consistent with previous research on phonetic aptitude and musical expertise (Christiner and Reiterer 2015). Results thus revealed that musical ability and working memory are most relevant when it comes to speech imitation. A detailed discussion of the investigated aspects is given below.

6.1 The effect of Musicality on Linguistic Performance

In the theoretical part of the present thesis it has already been stated that there exists vast evidence of an interrelation between L2 acquisition, in particular pronunciation aptitude, and musicality. Several studies have revealed significant correlations between music skills (especially rhythm and pitch discrimination) and L2 proficiency, in particular in the phonological and phonetic domain (see Nardo and Reiterer 2009: 233 for a review). Christiner and Reiterer (2013: 1) therefore conclude that "the higher the musicality, the better the pronunciation and the imitation in a second language".
This study's findings support previous research since it has been shown that also in young foreign language learners both tonal and rhythmic discrimination ability correlate with speech imitation talent: the more musical a particular child, the better its pronunciation of the foreign language is as well.
These findings can partly be explained by the mutual properties of language and music. Gardner (1999), for instance, considers musical and linguistic intelligence as two of the nine intelligences which reveal human cognition. Brown even claims that both language and music share their evolutionary history:

> the musilanguage stage in evolution […] was neither linguistic nor musical but […] embodied the shared features of modern day music and language, so that evolutionary divergence led to the formation of two distinct and specialized functions with retention of the shared features conferred onto them by the joint precursor […] (Brown 2001: 277).

While the first sounds toddlers make is crying, they soon become able to imitate rhythm and melody. These features occur before the ability to pronounce single words, and only after a period of time these musical aspects of language get substituted by phonemes. Summed up, music and language have following similarities (Sloboda 1989):

* Both language and music are human universals.

- They share three kinds of expression: vocal, gestural and written expression.
- Speech and song are spontaneously developed at the same time.
- Both share an auditory-vocal natural environment.
- Humans are able to create an infinite number of different constructions using both musical contours or words.
- Rhythm in music equals stress in language and melody in music equals intonation in language (Arleo 2000).
- In a fixed order, musical notes create a melody and words create sentences.
- First receptive ability is developed, then the productive one.
- Both are culturally influenced.
- Language and music are auditory phenomena consisting of temporal AND spectral aspects.

Nardo and Reiterer (2009: 339) complete this list by the following mutual characteristics:

- Both language and music consist of perceptually discrete elements organized into hierarchically structured sequences, be it from the individual note to the larger constituent of a musical composition, or from phonemes to the discourse units.
- Both of them share a serious of fundamental characteristics, such as the processing of sounds, the conveyance of messages, the learning by exposure, the sharing of intrinsic features like pitch, volume, prominence, stress, tone, rhythm, and pauses (Fonseca Mora 2000).

Furthermore, Stansell identifies the following shared characteristics of music and language:

> Activities of melody recognition, contour processing, timbre discrimination, rhythm, tonality, predictions, body movement, tactile involvement, and sound, sight, and form of symbols, with their context in song, phrases, and rule structure are all common in the musical and language learning processes (Stansell 2002:11).

Moreover, Christiner and Reiterer claim that music and language even largely overlap in the short term memory (Christiner and Reiterer 2013: 2) and say that “music and language perception is […] highly interconnected […]: musical expertise leads to an improvement of both, music and speech perception (Oechslin et al. 2010) but also to enhanced literacy and attentional skills (Seither-Preisler et al. 2014)”.

All these arguments are highly reflected in the study's outcome: there apparently exists an interrelation between musicality and language performance, independent of the individual's age.

The present study, moreover, detected a significant relation between tonal discrimination ability and the reproduction of Chinese. This is quite reasonable since Chinese, in fact, is a tone language and hence requires tonal discrimination ability. Additionally, Tagalog highly correlates with musicality as well. Once again, verifying that foreign language aptitude, in particular speech imitation ability, is highly connected to musical aptitude.

Expectedly, the study's control-variable, Turkish which is the second mother tongue of the participants, did not show any correlations with musicality. The thesis' underlying assumption can therefore be justified: whereas the imitation of foreign languages draws on musical and working memory abilities, the reproduction of a native language does not require any special ability in these domains.

Tonal discrimination ability, interestingly, correlated negatively with grammatical inferencing, which means that the more tonally apt participants are, the less they are able to infer grammatical rules of a pseudo-language. This could well be since both the tasks greatly differ in their design: whilst the tonal discrimination task requires well-developed aural processing strategies, the grammatical inferencing task requires visual strategies. Consequently, these tasks address different learner types, and, according to their particular processing strategy, learners might approach the tasks differently. The detected negative correlation could perhaps arise from a sample consisting of both auditory as well as visual learners.

Be that as it may, based on the study's results it can well be concluded that unintelligible speech imitation ability is significantly higher in people with higher musical aptitude.

6.2 The effect of Working Memory on Linguistic Performance

It was already outlined earlier that working memory (WM) has an impact on first- and second language acquisition processes. As assumed, the study's findings support this claim: the more effective working memory functions, the more musical participants appear to be.

According to Sawyer and Ranta (2001), the relationship between WM and L2 achievement can be explained „by the fact that a more efficient WM allows learners to

notice important aspects of the language input by freeing up necessary attentional resources that would otherwise be tied up in processing incoming material“ (Sawyer and Ranta 2001 in Hummel 2009: 239ff). In her study, Hummel (2008) found that that WM plays this particular role with respect to the processing of acoustic and auditory input. Therefore, she concludes that the faster individuals process, retain, and repeat new phonetic material, the better they are in processing and dealing with unfamiliar sound patterns in a language that is being learned. A rather relevant point with respect to the present thesis is that, in her study, Hummel investigated WM in beginning and intermediate learners. She detected that at earlier stages of learning a foreign language, whether for children or adults learning a second or foreign language, or children learning their L1, efficient functioning of the phonological loop, i.e. WM, seems to be of great advantage. Therefore, WM might well be seen as a potential component of aptitude predicting foreign language achievement. The results, however, indicate that once a solid basis of phonetic and lexical knowledge in the target language has been attained, the phonological loop apparently does no longer contribute significantly to further L2 outcome, and other factors, such as already acquired L2 knowledge, most likely play a more important role (Hummel 2009: 242).

Furthermore, Dörnyei claims that the link between WM and language aptitude is one of the most recent and most promising lines in aptitude research (Dörnyei 2006: 48). Many scholars even consider WM as the most central and important factor affecting foreign language aptitude. Baddeley (2003: 189) posits that “temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities”, such as foreign language learning, is entailed in WM.

Rota and Reiterer (2009: 83) support this idea by referring to research evidence which detects close interrelations between phonological WM and language aptitude. Thus, people with high WM capacities most likely encounter less difficulties in second or foreign language learning. It can therefore be summarized that WM (and the results of WM tests) indicates our general cognitive abilities.

Based on these research outcomes it can well be assumed that WM affects foreign language aptitude and thus is another essential predictor of speech imitation ability. These findings are also reflected in the present study’s results since it has been revealed that memorizing a string of digits forward highly correlates with Chinese and Tagalog, but does not relate to Turkish. Therefore, similar to musicality, it can be concluded that the higher the working memory ability of beginning language learners, the higher also

their phonetic aptitude is. The reproduction of the native language, however, seems to not require extraordinary working memory skills.

6.3 The effect of Musicality on Working Memory

The study revealed that the more musical children are, the more efficient their working memory functions as well. This finding supports previous research, i.e. by Christiner and Reiterer (2013). They claim that several studies have shown that individuals who are musically talented also show an improved auditory working memory. Thus they are better in remembering stretches of speech longer than people who are not talented in music. Furthermore, Nardo and Reiterer (2009: 238) refer to several brain studies which have investigated these two domains. They claim that recent brain studies have reported that processing language and processing music happen to occur partially in the same area, that is in the working memory. This might be an explanation for the fact that "musical training leads to an improvement of the short term memory when it comes to verbal material with the playing of a musical instrument and singing exercising the memory" (Christiner and Reiterer 2013: 2). They (2013: 5) further claim that neuroscientific findings indicate that musically talented people "possess a better working memory [...] and have anatomical endowments in the brain [...] which differentiates them from average people".
Based on the above outlined explanations, the findings indicate that the more musical children are the better their memory skills are as well. This is particular relevant for early language teaching and will be discussed in more detail below.

6.4 The effect of Intelligence on Linguistic Performance

According to Dörnyei (2015: 41) both aptitude and intelligence consist of several distinct aspects, however they seem to complexly interrelate to some extent as well. Dörnyei claims that "we can assume that because both intelligence and language aptitude are composite constructs that involve a range of cognitive factors- some of which, but not all, clearly overlap- we can expect considerable but not perfect correlations between the two higher-order factors" (Dörnyei 2015: 41).
Based on Rota and Reiterer (2009:88) recent research suggests that there is no correlation between general non-verbal IQ and second language aptitude. Thus, aside from the overlapping Dörnyei mentions, language aptitude is considered as distinct from the concept of intelligence.

This claim can only be supported by the study's results since non-verbal IQ showed no correlations with language aptitude, musicality or working memory.
Two aspects with respect to IQ might yet be interesting and worth being mentioned. Firstly, on average the participants show an IQ of *95,6*! This, according to the scale of the test's developer Weiß (2006), can be regarded as low average. Secondly, IQ shows a significant correlation with the educational background of the participant's parents. This aspect, among other socio-educational factors, is discussed in the next subchapter.

6.5 Central Factors affecting Linguistic Performance

Furthermore, a multiple regression analysis revealed that musicality, working memory, grammatical inferencing and educational background are the most crucial factors influencing phonetic talent. These four components are able to explain 69% of the variability of the performances in both unknown languages Chinese and Tagalog. Whilst the impact of musicality and working memory on linguistic performance have already been vastly proved in previous studies, the factors grammatical inferencing and educational background shed new and fascinating lights on the subject matter.
It seems rather obvious that educational background plays a crucial role in a child's cognitive development. Generally speaking, children of socially lower status are less exposed to input than their educationally higher counterparts (Hof-Ginsberg 1991). Input apparently is related to output. Simultaneously, higher educated parents tend to encourage their children in their cognitive as well as verbal development more. Thus, it seems to be no surprise that educational background plays a crucial role in linguistic performance. However, due to the low sample size no generalizations can be made at this point. Only further studies on a larger sample can prove these considerations right or wrong.
More surprisingly than the impact of education appears to be the impact of grammatical inferencing on speech imitation ability. The Llama F has been designed to test the participant's ability to induce grammatical rules that operate in an unknown language. By comparing and studying a number of pictures and their corresponding verbal description test-takers are asked to work out grammatical features of a non-language. The elements of the verbal descriptions differ only slightly- sometimes only in one syllable indicating gender for nouns, singular or plural number, word-order, etc. In the testing phase participants then need to identify whether a sentence is

grammatically and semantically correct. Since, however, participants need to remember the established grammatical features which illustrate how the language works during both the studying as well as the testing phase, the Llama F obviously requires strategies which demand working memory ability. As the present as well as several previous studies have already proved working memory as a factor significantly affecting speech imitation ability, this might explain why grammatical inferencing contributes to the ability to imitate unknown languages.
However, it has to be noted that these considerations are only fascinating hypotheses which, in fact, yearn for being investigated in further studies.

6.6 The effect of Education on Intelligence, Working Memory, and Musicality

The present study revealed that musicality and working memory go hand in hand with the educational level of the parents. Thus, the higher the parents' educational level, the higher the participant's musical and working memory ability is. Moreover, the more educated the parents are, the higher the children's IQ is. Furthermore, education levels of mothers and fathers significantly correlate. Thus, it seems that people partner up according to their educational status.
These socio-educational findings may be reliant on the fact that input is significantly correlated with output, which might also affect IQ. A longitudinal study by Hof-Ginsberg (1991), for instance, revealed that children of lower social status are exposed to far less input than children of socially higher status. As already mentioned above, consequently less input results in less output, and perhaps might influence IQ as well. This is also reflected in a more recent study by Nelson et al. (2011: 181) which suggests that children with a socially lower background not only show significant language delays but "are likely to experience difficulties in all areas of their academic development".
The positive relationship between educational status and musicality as well as educational level and working memory might also be partly explained by Nelson's claim: the lower the educational status of the parents, not only the less linguistic but also the less content-related input their children might be exposed to. It thus could be inferred that a lack of verbal input also implies a lack of musical input or any input that fosters working memory abilities. Input is significantly correlated with output and so the circle would be completed.

To what extent the study's results may inform foreign language teaching in Austrian primary schools will be explored and analysed in the next subchapter.

6.7 Implications for the Early Foreign Language Classroom

Based on the above discussed research's findings it may be justified to incorporate much more musical input and tasks which foster working memory ability in the early foreign language classroom.

Since previous research suggests that an efficient working memory function is of great advantage for beginning language learners (Hummel 2008), the latter appears most relevant for early language teaching. Although everybody is able to learn a foreign language to some extent, some learners are higher achievers than others. High achievers are individuals who are capable of using a second language more effectively than others, that means having a high sensitivity to phonetics and phonology, syntax, semantics or pragmatics. As already mentioned, Skehan (1998: 201) defines language aptitude as a triarchic concept based on auditory ability, linguistic ability and memory ability. He continues (1998) that talented and exceptional foreign language learners are those, who- in a rather short period of time- become very fluent speakers that show a significantly developed memory ability. They thus are excellent at processing large amounts of unfamiliar linguistic material and at storing it while interacting. Furthermore, previous research (comp. Hummel 2009) indicates that working memory is a composite construct and that different brain areas are actively involved in the task of encoding and retrieving new material. Musical elements in foreign language learning contribute to the persistence of memory and a later effective recollection.

These claims not only support the fostering of working memory training but highly recommend the increased use of music in the early foreign language classroom: musical elements in language teaching not only enhance phonetic and phonological awareness but can also increase the learner's concentration ability. Moreover, music supports a creative, stimulating, motivating and productive learning atmosphere in the classroom, all aspects which are likely to contribute to successful language learning.

An increased use of music, however, might call for a rethinking of the Austrian foreign language curriculum at primary level in relation to the fulfilment of required educational standards.

Currently, education policy, i.e. the Austrian primary school curriculum for foreign languages, suggests an unspecified number of so-called *integrated mini-sequences* of foreign language input at *Grundstufe I* (grade 1 and 2), and one foreign language lesson a week at *Grundstufe II* (grade 3 and 4). Similarly, it aims at achieving A1 competence based on the Common European Framework of Reference for Languages (CEFR). Due to this European language policy, English language objectives in Austrian primary schools have become rather transparent. Since, however, A1 language level demands basic abilities in all five language skills primary school teachers of English are obliged to develop receptive as well as productive language skills in their pupils in a rather small amount of time. On behalf of the Austrian Ministry of Education these basic abilities were described by the Austrian Language Competence Centre (*Österreichische Sprachenzentrum)* and have become the educational standards for English at primary school level, called the *Grundkompetenzen 4* (*GK4*).

Furthermore, the Austrian Language Competence Centre designed specific exercises - so-called *Orientierungsaufgaben*- to be used optionally at the meeting point of grade 4 and grade 5. These tasks aim at supporting secondary school teachers in eliciting their pupils' pre-knowledge in English. Teachers thus can easily identify to what extent primary school teachers have already developed speaking-, listening- and literacy skills, and consequently if they fulfilled the given educational standards.

Even though the *Orientierungsaufgaben* should only serve as a supportive and optional tool for English teachers at secondary as well as primary level and are presently not planned to become standardized tests, they yet might pressure primary school teachers of English to design their foreign language programs according to the fulfilment of norms and goals set by the Ministry of Education only.

In the light of such great demands together with the comparatively relative small amount of time allocated for foreign language teaching, primary language teachers therefore might probably use the precious teaching time pursuing educational standards and thus conforming to education policy rather than emphasizing musical input in the early foreign language classroom. From this point of view, it seems rather questionable if teachers can even implement more musical tasks into their teaching under current conditions? Emphasizing the importance of musical input in the early language classroom would consequently mean rethinking the allocated foreign language teaching time as well as the required language goals.

Although Austrian educational language policy seems fairly beneficial with regard to transparency and coherence of foreign language teaching and learning in general, an implementation and facilitation of musical input into the early foreign language classroom would perhaps require its light softening.

To sum up, the present study sought to contribute to foregoing research findings on the interrelation between language aptitude, in particular imitation ability, working memory and musicality. As a matter of fact, the conducted psycholinguistic research shows evidence that these relationships actually exist. The study thus highly supports previous research findings which deeply suggest that working memory and musicality seem to be essential predictors of foreign language aptitude.

Finally, it has to be emphasized that the study has examined only thirty young foreign language learners and their parents. Therefore, the above discussed results need to be considered rather carefully and can only be proved through further investigations.

7 Conclusion

The present thesis sought to enrich the existing research body in the field of language aptitude and aimed at expanding our knowledge about the interrelation between language learning aptitude, working memory, intelligence, and musicality.

Since this thesis is set against an educational background, the central goal was to gain insight into the mental capacities of young language learners so as to make important assets for Early Language Teaching in Austrian primary schools.

In line with previous research in this interdisciplinary field the study's findings revealed that musicality and working memory seem to be important predictors of phonetic ability: musical expertise and strong working memory most likely enhance language ability.

Moreover, the comparative perspective taken in this study has thrown new light on native language production behaviour. By comparing unintelligible with native speech imitation ability with regard to other cognitive domains, the study proved that the reproduction of a native language behaves differently than reproducing foreign languages. Apparently, the reproduction of a native language does not require special musical talent or working memory ability, whilst the imitation of an unknown language is highly related to these skills. Hence, the results of the study verify the hypothesis that foreign speech imitation ability goes hand in hand with musicality and working memory.

It must though be pointed out that the study has examined only thirty young foreign language learners. Therefore, results need to be considered carefully and its representativeness can only be proved through further investigations on a larger sample. Despite its limited scope this study has interesting implications for the understanding of foreign language teaching and learning at primary level in Austria which all have been discussed above.

Based on the study's fascinating results and the previously discussed aspects, the present thesis finishes by advocating a slight turn from haunting educational standards stipulated by the government to an increased focus on musical input as well as working memory training in early foreign language teaching since it, apparently, is music that leads to higher language proficiency.

Therefore, I would like to conclude with Brewer and Campbell (1991: 231) who claim that

Music has the unique quality of integrating emotional, cognitive and psychomotor elements that activate and synchronise brain activity. Not only does music relax and stimulate the listener simultaneously, it also educates learners with regard to listening skills and refined architecture of sound.

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Appendix

Tables of Statistical Analyses

1. Descriptive Statistics / further frequency tables & histograms

Frequencies: Language Aptitude, IQ, Memory

Statistics

		LLAMA_B	LLAMA_F	Turkish123	Tagalog123456	Chinese123456	Chinese123456_Tagalog123456	IQ	memory_fw	memory_bw	non-words
N	Valid	30	30	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		27,3333%	16,8333%	7,7093	4,0185	3,1796	3,5991	95,63	5,17	4,03	3,93
Std. Error of Mean		2,19369%	3,29126%	,27504	,12558	,12229	,11229	1,968	,235	,232	,135
Median		27,5000%	10,0000%	8,1389	4,0278	3,2222	3,5625	96,00	5,00	4,00	4,00
Mode		30,00%[a]	0,00%	8,89[a]	3,28[a]	3,22	3,04[a]	89[a]	5	4	4
Std. Deviation		12,01532%	18,02696%	1,50646	,68786	,66980	,61505	10,778	1,289	1,273	,740
Skewness		-,004	,636	-,821	,229	-,026	,144	,646	,807	-,389	,108
Std. Error of Skewness		,427	,427	,427	,427	,427	,427	,427	,427	,427	,427
Kurtosis		-,904	-1,061	-,099	-,145	-,278	-,232	,992	1,426	-,789	-1,085
Std. Error of Kurtosis		,833	,833	,833	,833	,833	,833	,833	,833	,833	,833
Minimum		5,00%	0,00%	4,00	2,75	1,83	2,39	77	3	2	3
Maximum		50,00%	50,00%	9,50	5,53	4,61	4,85	127	9	6	5
Sum		820,00%	505,00%	231,28	120,56	95,39	107,97	2869	155	121	118

a. Multiple modes exist. The smallest value is shown

Frequencies: Musicality (Tonal, Rhythm, Total)

Statistics

		Ton_RAW	Rhy_RAW	Com_RAW
N	Valid	30	30	30
	Missing	0	0	0
Mean		31,40	28,60	60,00
Std. Error of Mean		,787	,780	1,356
Median		31,50	29,50	60,00
Mode		35	30	60
Std. Deviation		4,312	4,272	7,428
Variance		18,593	18,248	55,172
Skewness		-,186	-,108	-,068
Std. Error of Skewness		,427	,427	,427
Kurtosis		-,497	-,928	-,899
Std. Error of Kurtosis		,833	,833	,833
Minimum		22	21	46
Maximum		39	36	73

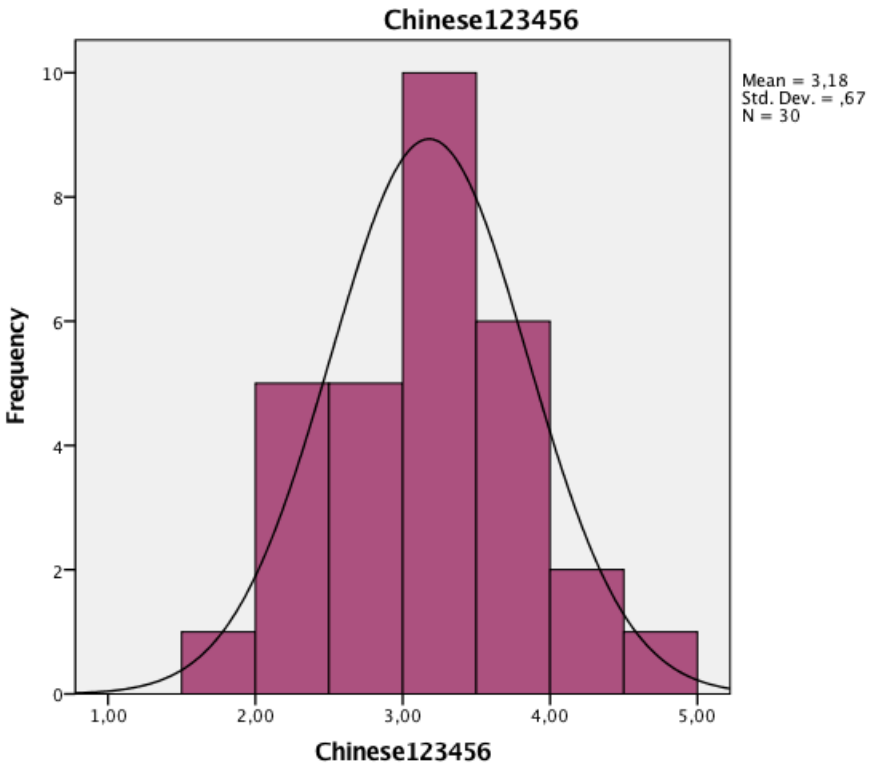
Frequencies: Education

Statistics

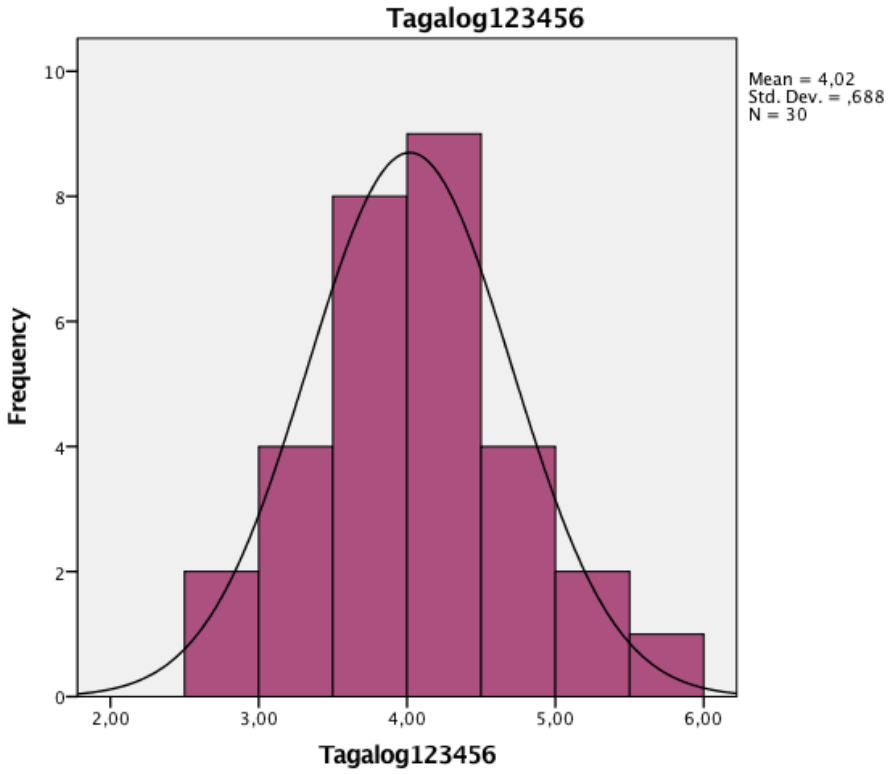
		Education_mother	Education_father	Education_sum
N	Valid	28	27	0
	Missing	2	3	30
Mean		5,2857	5,1481	
Std. Error of Mean		,53664	,51943	
Median		4,0000	4,0000	
Mode		4,00	4,00	
Std. Deviation		2,83963	2,69906	
Skewness		,952	1,263	
Std. Error of Skewness		,441	,448	
Kurtosis		-1,005	-,189	
Std. Error of Kurtosis		,858	,872	
Minimum		3,00	3,00	
Maximum		10,00	10,00	
Sum		148,00	139,00	

Foreign Language Aptitude Testing

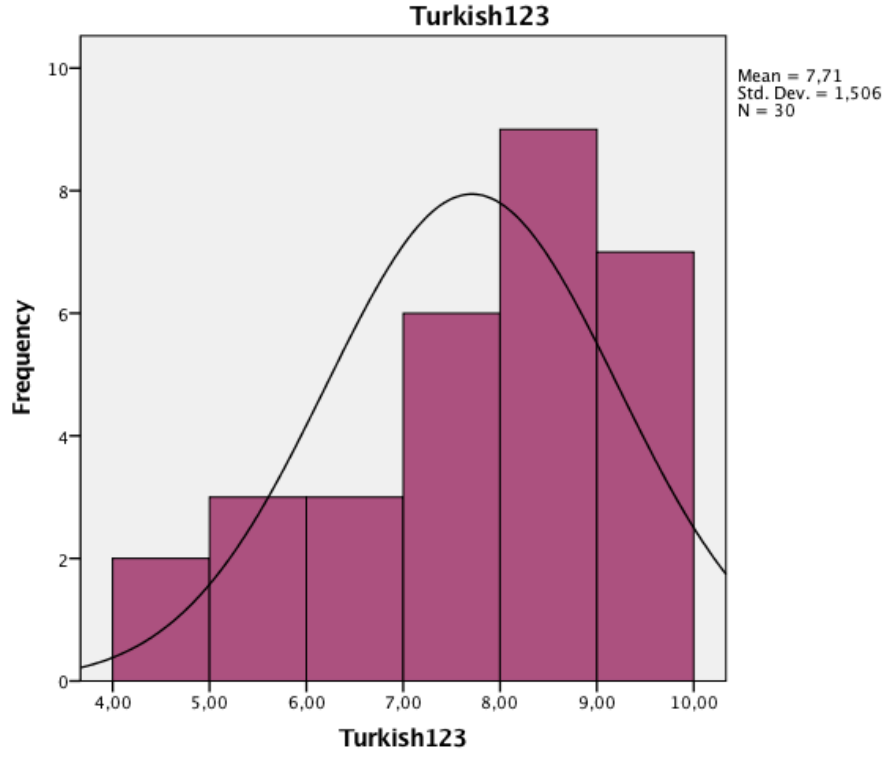
Speech Imitation Task: Chinese



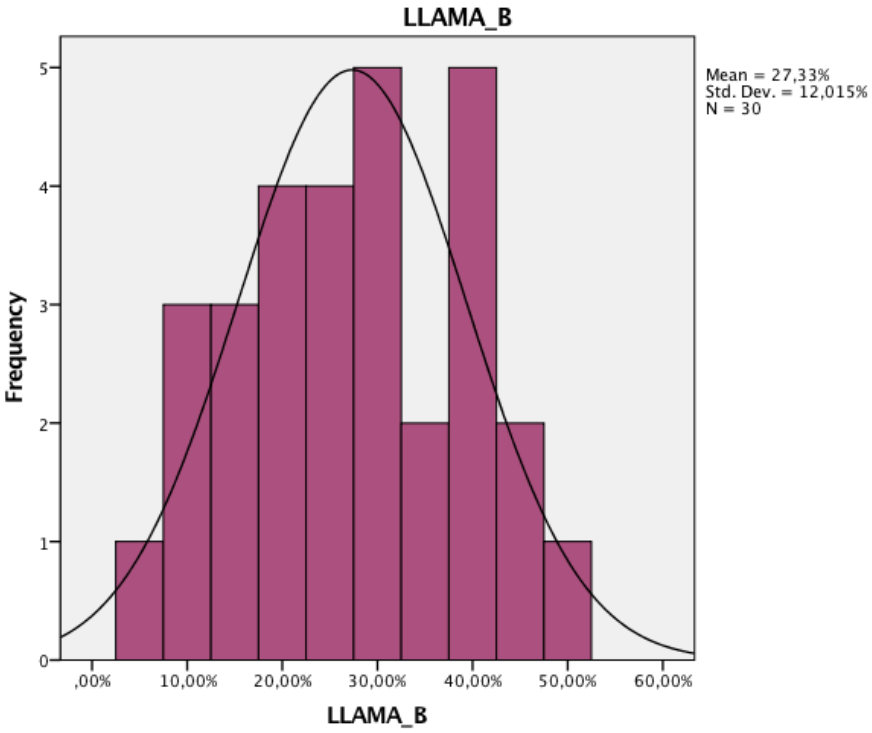
Speech Imitation Task: Tagalog



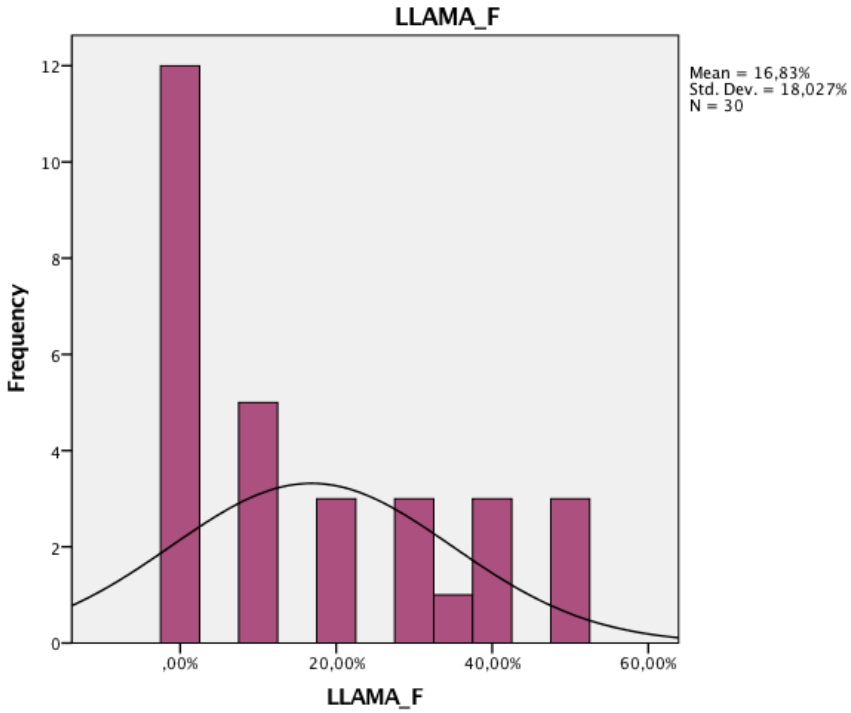
Speech Imitation Tasks: Turkish



Vocabulary Learning: Llama B

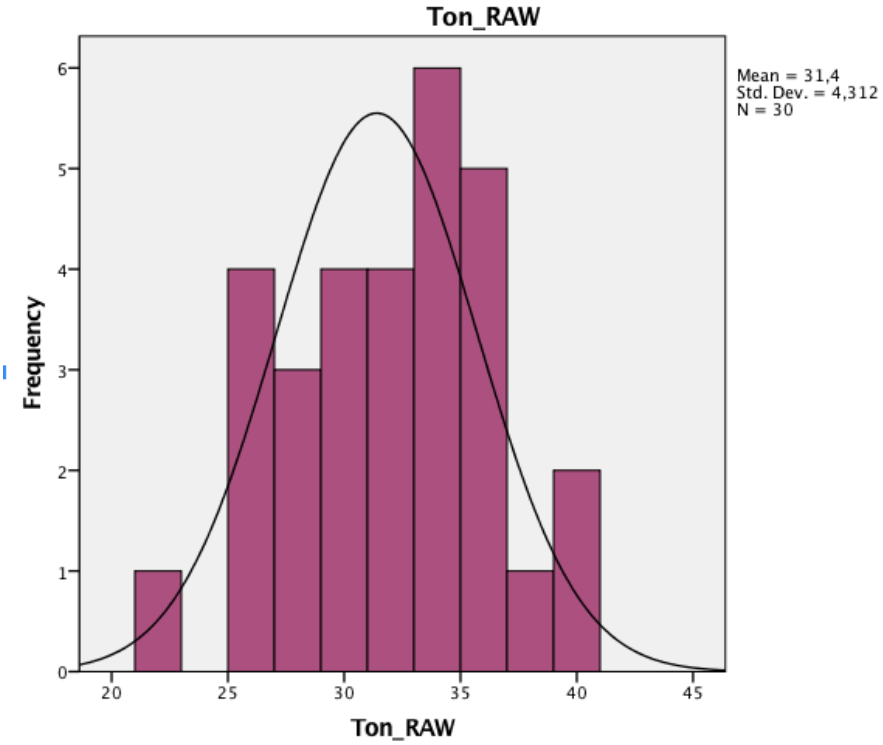


Grammatical Inferencing: Llama F

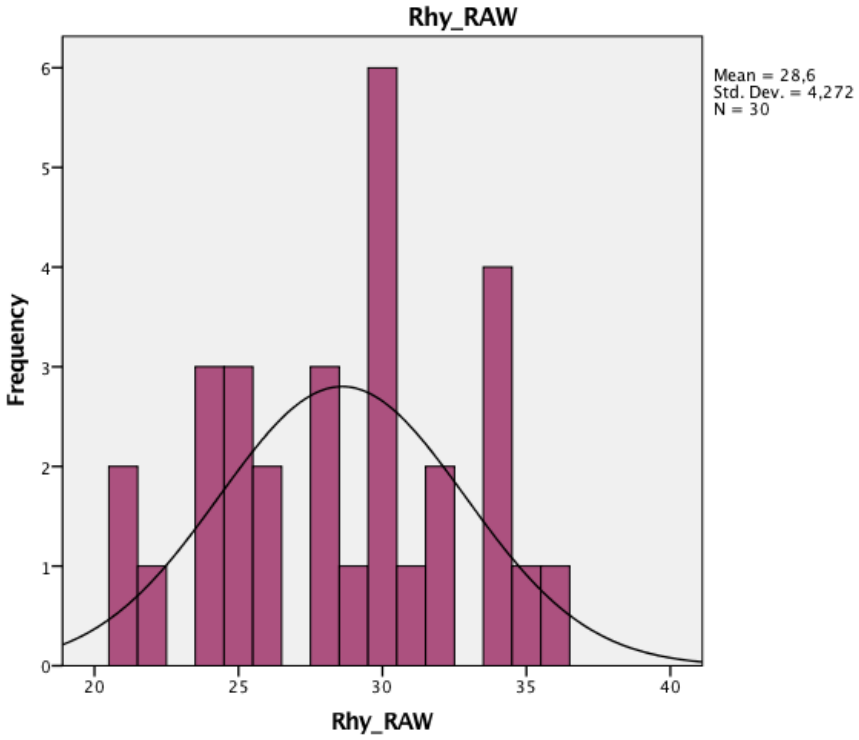


Musicality Tests

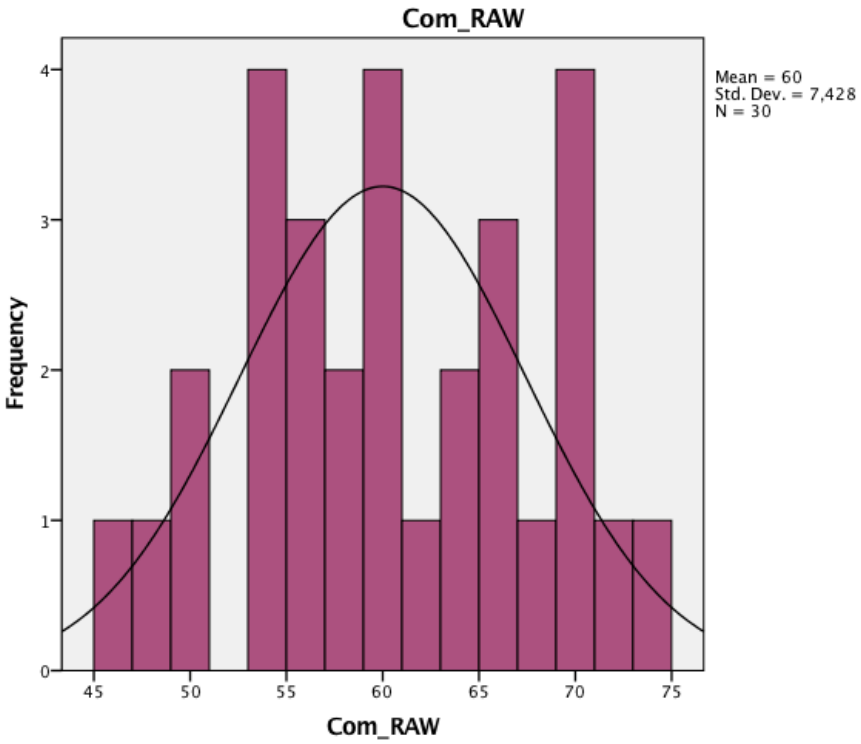
IMMA Musicality Test Tonal



IMMA Musicality Test Rhythm

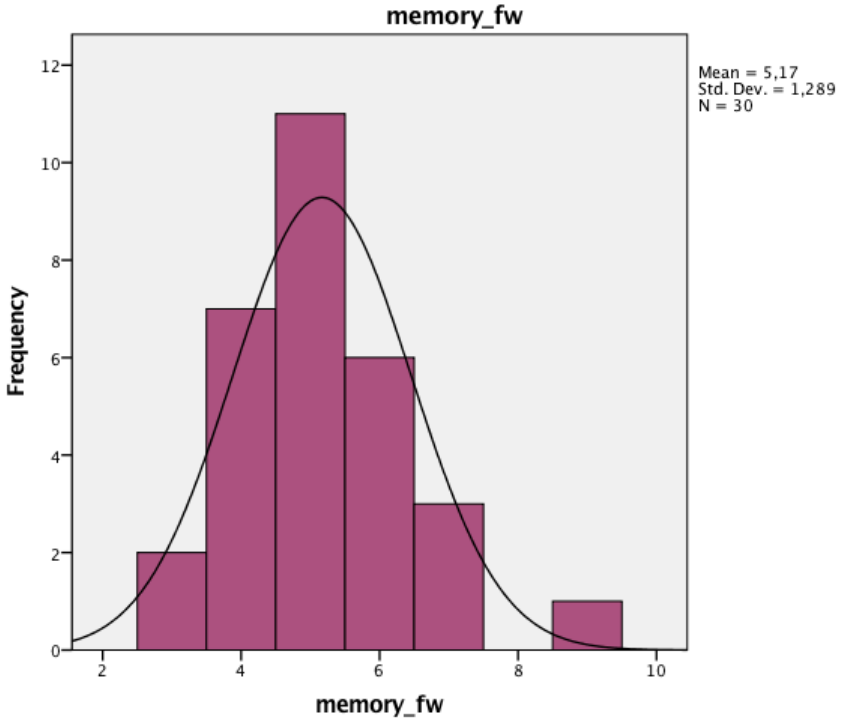


IMMA Musicality Test Total

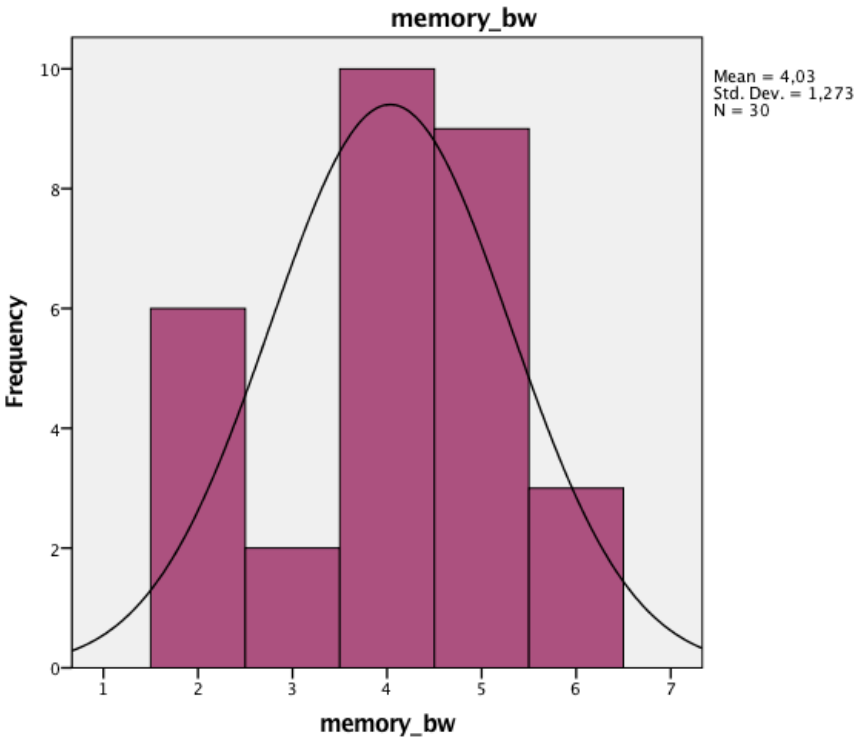


Working Memory

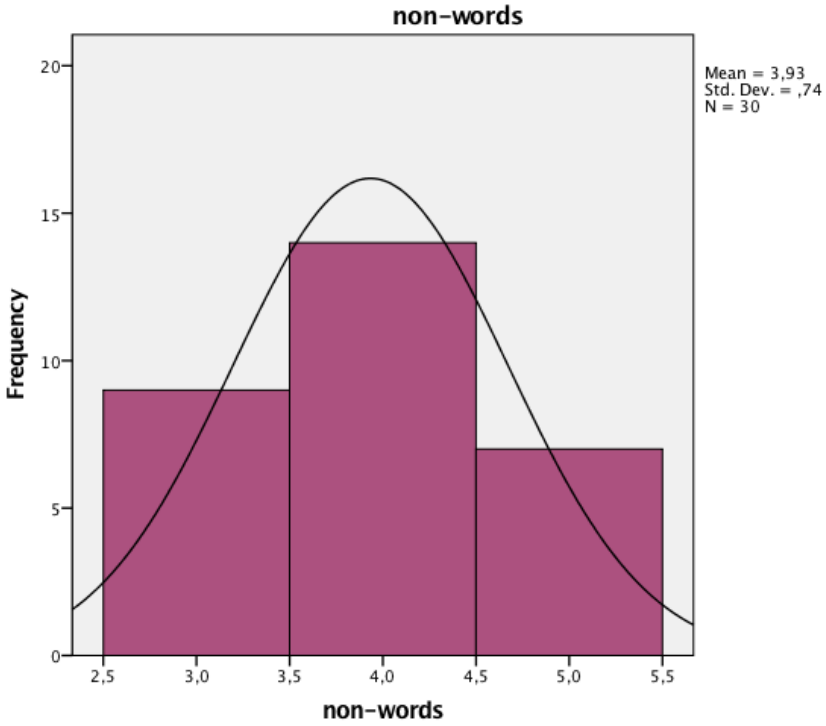
Working Memory Forward



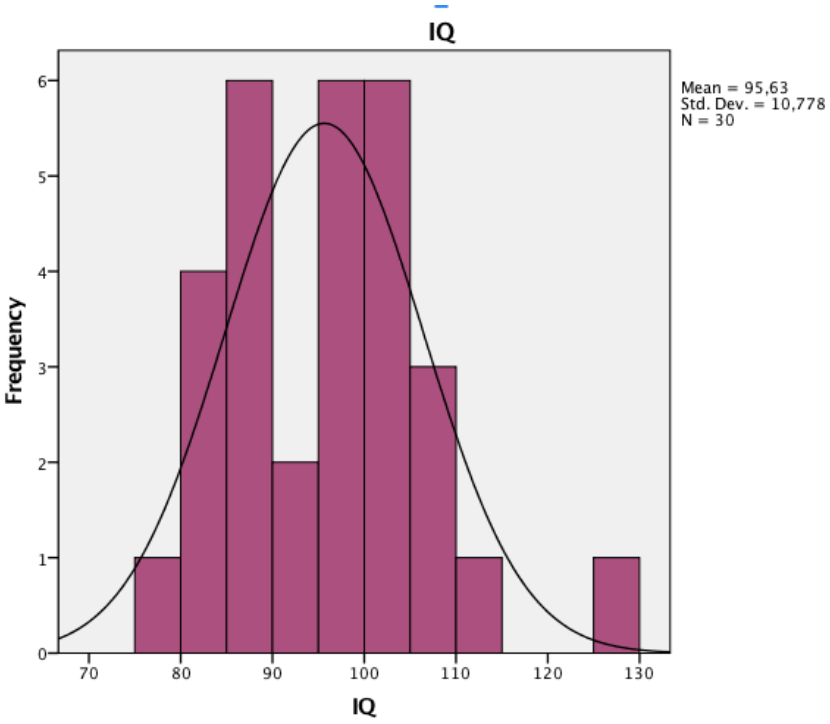
Working Memory Backward



Working Memory Non-words

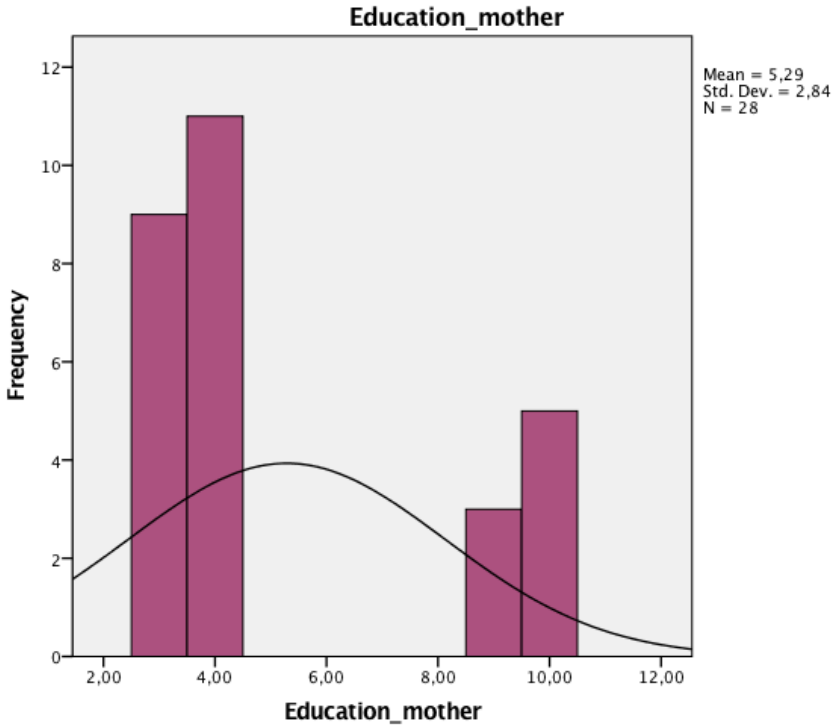


IQ

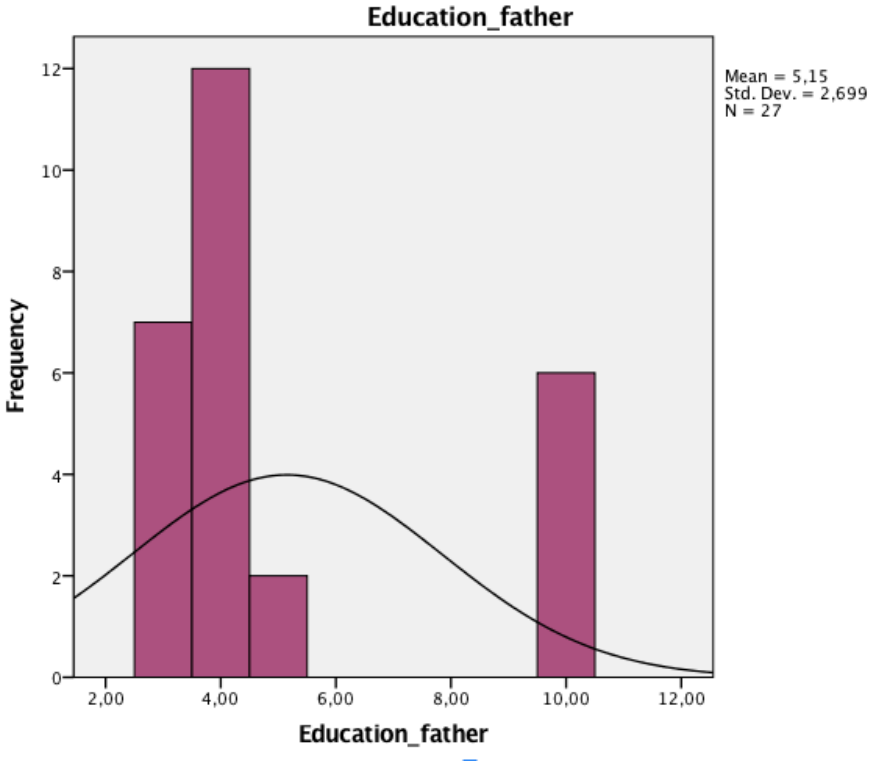


Educational Background

Education: mothers



Education: fathers



2. Correlation Charts

Language Aptitude and Musicality

Musicality & Speech Imitation: Turkish

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	Turkish_1	Turkish_2	Turkish_3	Turkish123
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	-,025	-,163	-,016	-,040
		Sig. (1-tailed)	.	,002	,000	,449	,195	,467	,418
		N	30	30	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,265	-,194	-,009	,078
		Sig. (1-tailed)	,002	.	,000	,078	,152	,481	,340
		N	30	30	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,127	-,173	-,017	,027
		Sig. (1-tailed)	,000	,000	.	,251	,180	,464	,443
		N	30	30	30	30	30	30	30
	Turkish_1	Correlation Coefficient	-,025	,265	,127	1,000	,048	,491**	,647**
		Sig. (1-tailed)	,449	,078	,251	.	,400	,003	,000
		N	30	30	30	30	30	30	30
	Turkish_2	Correlation Coefficient	-,163	-,194	-,173	,048	1,000	,586**	,677**
		Sig. (1-tailed)	,195	,152	,180	,400	.	,000	,000
		N	30	30	30	30	30	30	30
	Turkish_3	Correlation Coefficient	-,016	-,009	-,017	,491**	,586**	1,000	,935**
		Sig. (1-tailed)	,467	,481	,464	,003	,000	.	,000
		N	30	30	30	30	30	30	30
	Turkish123	Correlation Coefficient	-,040	,078	,027	,647**	,677**	,935**	1,000
		Sig. (1-tailed)	,418	,340	,443	,000	,000	,000	.
		N	30	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

Musicality & Speech Imitation: Chinese

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	Chinese_1	Chinese_2	Chinese_3	Chinese_4	Chinese_5	Chinese_6	Chinese123456
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	,365*	,397*	,381*	,297	,108	,373*	,514**
		Sig. (1-tailed)	.	,002	,000	,024	,015	,019	,055	,286	,021	,002
		N	30	30	30	30	30	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,138	,212	,449**	,322*	-,235	,156	,327*
		Sig. (1-tailed)	,002	.	,000	,233	,131	,006	,041	,106	,206	,039
		N	30	30	30	30	30	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,273	,336*	,460**	,338*	-,066	,269	,457**
		Sig. (1-tailed)	,000	,000	.	,072	,035	,005	,034	,364	,075	,006
		N	30	30	30	30	30	30	30	30	30	30
	Chinese_1	Correlation Coefficient	,365*	,138	,273	1,000	,247	,066	,329*	,003	,267	,568**
		Sig. (1-tailed)	,024	,233	,072	.	,094	,364	,038	,493	,077	,001
		N	30	30	30	30	30	30	30	30	30	30
	Chinese_2	Correlation Coefficient	,397*	,212	,336*	,247	1,000	,317*	,557**	,214	,173	,732**
		Sig. (1-tailed)	,015	,131	,035	,094	.	,044	,001	,128	,180	,000
		N	30	30	30	30	30	30	30	30	30	30
	Chinese_3	Correlation Coefficient	,381*	,449**	,460**	,066	,317*	1,000	,103	,084	,253	,426**
		Sig. (1-tailed)	,019	,006	,005	,364	,044	.	,295	,330	,089	,010
		N	30	30	30	30	30	30	30	30	30	30
	Chinese_4	Correlation Coefficient	,297	,322*	,338*	,329*	,557**	,103	1,000	,138	,146	,748**
		Sig. (1-tailed)	,055	,041	,034	,038	,001	,295	.	,233	,221	,000
		N	30	30	30	30	30	30	30	30	30	30
	Chinese_5	Correlation Coefficient	,108	-,235	-,066	,003	,214	,084	,138	1,000	,127	,404*
		Sig. (1-tailed)	,286	,106	,364	,493	,128	,330	,233	.	,252	,013
		N	30	30	30	30	30	30	30	30	30	30
	Chinese_6	Correlation Coefficient	,373*	,156	,269	,267	,173	,253	,146	,127	1,000	,502**
		Sig. (1-tailed)	,021	,206	,075	,077	,180	,089	,221	,252	.	,002
		N	30	30	30	30	30	30	30	30	30	30
	Chinese123456	Correlation Coefficient	,514**	,327*	,457**	,568**	,732**	,426**	,748**	,404*	,502**	1,000
		Sig. (1-tailed)	,002	,039	,006	,001	,000	,010	,000	,013	,002	.
		N	30	30	30	30	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Musicality & Speech Imitation: Tagalog

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	Tagalog_1	Tagalog_2	Tagalog_3	Tagalog_4	Tagalog_5	Tagalog_6	Tagalog123456
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	,027	,104	,519**	,387*	,385*	,273	,549**
		Sig. (1-tailed)	.	,002	,000	,443	,292	,002	,017	,018	,072	,001
		N	30	30	30	30	30	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,303	,204	,518**	,229	,126	-,037	,475**
		Sig. (1-tailed)	,002	.	,000	,052	,139	,002	,112	,254	,423	,004
		N	30	30	30	30	30	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,181	,156	,584**	,352*	,284	,155	,579**
		Sig. (1-tailed)	,000	,000	.	,169	,206	,000	,028	,064	,207	,000
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog_1	Correlation Coefficient	,027	,303	,181	1,000	,146	-,026	-,045	,078	,161	,352*
		Sig. (1-tailed)	,443	,052	,169	.	,220	,446	,406	,341	,198	,028
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog_2	Correlation Coefficient	,104	,204	,156	,146	1,000	,056	,064	,026	-,194	,335*
		Sig. (1-tailed)	,292	,139	,206	,220	.	,384	,369	,446	,153	,035
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog_3	Correlation Coefficient	,519**	,518**	,584**	-,026	,056	1,000	,345*	-,110	,269	,628**
		Sig. (1-tailed)	,002	,002	,000	,446	,384	.	,031	,281	,076	,000
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog_4	Correlation Coefficient	,387*	,229	,352*	-,045	,064	,345*	1,000	,240	,328*	,690**
		Sig. (1-tailed)	,017	,112	,028	,406	,369	,031	.	,101	,039	,000
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog_5	Correlation Coefficient	,385*	,126	,284	,078	,026	-,110	,240	1,000	,354*	,365*
		Sig. (1-tailed)	,018	,254	,064	,341	,446	,281	,101	.	,027	,024
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog_6	Correlation Coefficient	,273	-,037	,155	,161	-,194	,269	,328*	,354*	1,000	,572**
		Sig. (1-tailed)	,072	,423	,207	,198	,153	,076	,039	,027	.	,000
		N	30	30	30	30	30	30	30	30	30	30
	Tagalog123456	Correlation Coefficient	,549**	,475**	,579**	,352*	,335*	,628**	,690**	,365*	,572**	1,000
		Sig. (1-tailed)	,001	,004	,000	,028	,035	,000	,000	,024	,000	.
		N	30	30	30	30	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Musicality & LLAMA B & LLAMA F

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	LLAMA_B	LLAMA_F
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	,075	-,514**
		Sig. (1-tailed)	.	,002	,000	,347	,002
		N	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,173	-,359*
		Sig. (1-tailed)	,002	.	,000	,181	,026
		N	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,158	-,496**
		Sig. (1-tailed)	,000	,000	.	,203	,003
		N	30	30	30	30	30
	LLAMA_B	Correlation Coefficient	,075	,173	,158	1,000	,195
		Sig. (1-tailed)	,347	,181	,203	.	,151
		N	30	30	30	30	30
	LLAMA_F	Correlation Coefficient	-,514**	-,359*	-,496**	,195	1,000
		Sig. (1-tailed)	,002	,026	,003	,151	.
		N	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Language Aptitude and Working Memory

Correlations

			memory_fw	memory_bw	non-words	Turkish123	Tagalog123456	Chinese123456
Spearman's rho	memory_fw	Correlation Coefficient	1,000	-,114	,209	,052	,481**	,557**
		Sig. (1-tailed)	.	,275	,134	,392	,004	,001
		N	30	30	30	30	30	30
	memory_bw	Correlation Coefficient	-,114	1,000	,376*	,278	-,139	-,121
		Sig. (1-tailed)	,275	.	,020	,068	,232	,261
		N	30	30	30	30	30	30
	non-words	Correlation Coefficient	,209	,376*	1,000	-,005	,101	-,108
		Sig. (1-tailed)	,134	,020	.	,489	,297	,284
		N	30	30	30	30	30	30
	Turkish123	Correlation Coefficient	,052	,278	-,005	1,000	,292	,432**
		Sig. (1-tailed)	,392	,068	,489	.	,059	,009
		N	30	30	30	30	30	30
	Tagalog123456	Correlation Coefficient	,481**	-,139	,101	,292	1,000	,591**
		Sig. (1-tailed)	,004	,232	,297	,059	.	,000
		N	30	30	30	30	30	30
	Chinese123456	Correlation Coefficient	,557**	-,121	-,108	,432**	,591**	1,000
		Sig. (1-tailed)	,001	,261	,284	,009	,000	.
		N	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Language Aptitude and IQ

Correlations

			Education_mother	Education_father	Turkish123	Tagalog123456	Chinese123456	IQ
Spearman's rho	Education_mother	Correlation Coefficient	Zum Aktivieren doppelklicken	,677**	-,183	,199	,202	,360*
		Sig. (1-tailed)	.	,000	,175	,156	,151	,030
		N	28	27	28	28	28	28
	Education_father	Correlation Coefficient	,677**	1,000	-,301	,154	,128	,445*
		Sig. (1-tailed)	,000	.	,064	,221	,262	,010
		N	27	27	27	27	27	27
	Turkish123	Correlation Coefficient	-,183	-,301	1,000	,292	,432**	,298
		Sig. (1-tailed)	,175	,064	.	,059	,009	,055
		N	28	27	30	30	30	30
	Tagalog123456	Correlation Coefficient	,199	,154	,292	1,000	,591**	,167
		Sig. (1-tailed)	,156	,221	,059	.	,000	,189
		N	28	27	30	30	30	30
	Chinese123456	Correlation Coefficient	,202	,128	,432**	,591**	1,000	,218
		Sig. (1-tailed)	,151	,262	,009	,000	.	,124
		N	28	27	30	30	30	30
	IQ	Correlation Coefficient	,360*	,445*	,298	,167	,218	1,000
		Sig. (1-tailed)	,030	,010	,055	,189	,124	.
		N	28	27	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Musicality and Working Memory

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	memory_fw	memory_bw	non-words
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	,503**	-,226	-,035
		Sig. (1-tailed)	.	,002	,000	,002	,115	,428
		N	30	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,197	,119	-,047
		Sig. (1-tailed)	,002	.	,000	,149	,266	,403
		N	30	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,423**	-,058	-,043
		Sig. (1-tailed)	,000	,000	.	,010	,380	,410
		N	30	30	30	30	30	30
	memory_fw	Correlation Coefficient	,503**	,197	,423**	1,000	-,114	,209
		Sig. (1-tailed)	,002	,149	,010	.	,275	,134
		N	30	30	30	30	30	30
	memory_bw	Correlation Coefficient	-,226	,119	-,058	-,114	1,000	,376*
		Sig. (1-tailed)	,115	,266	,380	,275	.	,020
		N	30	30	30	30	30	30
	non-words	Correlation Coefficient	-,035	-,047	-,043	,209	,376*	1,000
		Sig. (1-tailed)	,428	,403	,410	,134	,020	.
		N	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Musicality and Education

Correlations

			Education_mother	Education_father	Ton_RAW	Rhy_RAW	Com_RAW
Spearman's rho	Education_mother	Correlation Coefficient	1,000	,677**	,293	,502**	,510**
		Sig. (1-tailed)	.	,000	,065	,003	,003
		N	28	27	28	28	28
	Education_father	Correlation Coefficient	,677**	1,000	,185	,421*	,378*
		Sig. (1-tailed)	,000	.	,178	,014	,026
		N	27	27	27	27	27
	Ton_RAW	Correlation Coefficient	,293	,185	1,000	,503**	,853**
		Sig. (1-tailed)	,065	,178	.	,002	,000
		N	28	27	30	30	30
	Rhy_RAW	Correlation Coefficient	,502**	,421*	,503**	1,000	,871**
		Sig. (1-tailed)	,003	,014	,002	.	,000
		N	28	27	30	30	30
	Com_RAW	Correlation Coefficient	,510**	,378*	,853**	,871**	1,000
		Sig. (1-tailed)	,003	,026	,000	,000	.
		N	28	27	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Education, IQ and Working Memory

Correlations

			Education_mother	Education_father	IQ	memory_fw	memory_bw	non-words
Spearman's rho	Education_mother	Correlation Coefficient	1,000	,677**	,360*	,341*	,066	,211
		Sig. (1-tailed)	.	,000	,030	,038	,369	,141
		N	28	27	28	28	28	28
	Education_father	Correlation Coefficient	,677**	1,000	,445*	,421*	,228	,393*
		Sig. (1-tailed)	,000	.	,010	,014	,126	,021
		N	27	27	27	27	27	27
	IQ	Correlation Coefficient	,360*	,445*	1,000	,118	,329*	,234
		Sig. (1-tailed)	,030	,010	.	,267	,038	,107
		N	28	27	30	30	30	30
	memory_fw	Correlation Coefficient	,341*	,421*	,118	1,000	-,114	,209
		Sig. (1-tailed)	,038	,014	,267	.	,275	,134
		N	28	27	30	30	30	30
	memory_bw	Correlation Coefficient	,066	,228	,329*	-,114	1,000	,376*
		Sig. (1-tailed)	,369	,126	,038	,275	.	,020
		N	28	27	30	30	30	30
	non-words	Correlation Coefficient	,211	,393*	,234	,209	,376*	1,000
		Sig. (1-tailed)	,141	,021	,107	,134	,020	.
		N	28	27	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Complete Correlation Charts

Complete correlation chart: mean of Chinese & Tagalog; except Turkish

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	memory_fw	memory_bw	non-words	Singing_total	LLAMA_B	LLAMA_F	IQ	Chinese123456_Tagalog123456
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	,503**	-,226	-,035	,150	,075	-,514**	,114	,615**
		Sig. (1-tailed)	.	,002	,000	,002	,115	,428	,214	,347	,002	,273	,000
		N	30	30	30	30	30	30	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,197	,119	-,047	,151	,173	-,359*	,332*	,496**
		Sig. (1-tailed)	,002	.	,000	,149	,266	,403	,213	,181	,026	,036	,003
		N	30	30	30	30	30	30	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,423**	-,058	-,043	,181	,158	-,496**	,271	,619**
		Sig. (1-tailed)	,000	,000	.	,010	,380	,410	,169	,203	,003	,074	,000
		N	30	30	30	30	30	30	30	30	30	30	30
	memory_fw	Correlation Coefficient	,503**	,197	,423**	1,000	-,114	,209	,212	,101	-,132	,118	,586**
		Sig. (1-tailed)	,002	,149	,010	.	,275	,134	,131	,298	,244	,267	,000
		N	30	30	30	30	30	30	30	30	30	30	30
	memory_bw	Correlation Coefficient	-,226	,119	-,058	-,114	1,000	,376*	-,206	-,057	,171	,329*	-,114
		Sig. (1-tailed)	,115	,266	,380	,275	.	,020	,138	,383	,183	,038	,275
		N	30	30	30	30	30	30	30	30	30	30	30
	non-words	Correlation Coefficient	-,035	-,047	-,043	,209	,376*	1,000	,113	-,187	,150	,234	,031
		Sig. (1-tailed)	,428	,403	,410	,134	,020	.	,275	,161	,214	,107	,435
		N	30	30	30	30	30	30	30	30	30	30	30
	Singing_total	Correlation Coefficient	,150	,151	,181	,212	-,206	,113	1,000	,487**	,157	,397*	,115
		Sig. (1-tailed)	,214	,213	,169	,131	,138	,275	.	,003	,204	,015	,273
		N	30	30	30	30	30	30	30	30	30	30	30
	LLAMA_B	Correlation Coefficient	,075	,173	,158	,101	-,057	-,187	,487**	1,000	,195	,105	,204
		Sig. (1-tailed)	,347	,181	,203	,298	,383	,161	,003	.	,151	,291	,140
		N	30	30	30	30	30	30	30	30	30	30	30
	LLAMA_F	Correlation Coefficient	-,514**	-,359*	-,496**	-,132	,171	,150	,157	,195	1,000	,176	-,074
		Sig. (1-tailed)	,002	,026	,003	,244	,183	,214	,204	,151	.	,176	,349
		N	30	30	30	30	30	30	30	30	30	30	30
	IQ	Correlation Coefficient	,114	,332*	,271	,118	,329*	,234	,397*	,105	,176	1,000	,216
		Sig. (1-tailed)	,273	,036	,074	,267	,038	,107	,015	,291	,176	.	,125
		N	30	30	30	30	30	30	30	30	30	30	30
	Chinese123456_Tagalog123456	Correlation Coefficient	,615**	,496**	,619**	,586**	-,114	,031	,115	,204	-,074	,216	1,000
		Sig. (1-tailed)	,000	,003	,000	,000	,275	,435	,273	,140	,349	,125	.
		N	30	30	30	30	30	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Complete correlation chart: all variables

Correlations

			Ton_RAW	Rhy_RAW	Com_RAW	memory_fw	memory_bw	non-words	Singing_total	LLAMA_B	LLAMA_F	IQ	Chinese_total	Tagalog_total	Turkish_total
Spearman's rho	Ton_RAW	Correlation Coefficient	1,000	,503**	,853**	,503**	-,226	-,035	,194	,075	-,514**	,114	,514**	,549**	-,040
		Sig. (1-tailed)	.	,002	,000	,002	,115	,428	,156	,347	,002	,273	,002	,001	,418
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	Rhy_RAW	Correlation Coefficient	,503**	1,000	,871**	,197	,119	-,047	,060	,173	-,359*	,332*	,327*	,475**	,078
		Sig. (1-tailed)	,002	.	,000	,149	,266	,403	,379	,181	,026	,036	,039	,004	,340
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	Com_RAW	Correlation Coefficient	,853**	,871**	1,000	,423**	-,058	-,043	,146	,158	-,496**	,271	,457**	,579**	,027
		Sig. (1-tailed)	,000	,000	.	,010	,380	,410	,225	,203	,003	,074	,006	,000	,443
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	memory_fw	Correlation Coefficient	,503**	,197	,423**	1,000	-,114	,209	,222	,101	-,132	,118	,557**	,481**	,052
		Sig. (1-tailed)	,002	,149	,010	.	,275	,134	,123	,298	,244	,267	,001	,004	,392
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	memory_bw	Correlation Coefficient	-,226	,119	-,058	-,114	1,000	,376*	-,232	-,057	,171	,329*	-,121	-,139	,278
		Sig. (1-tailed)	,115	,266	,380	,275	.	,020	,113	,383	,183	,038	,261	,232	,068
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	non-words	Correlation Coefficient	-,035	-,047	-,043	,209	,376*	1,000	,127	-,187	,150	,234	-,108	,101	-,005
		Sig. (1-tailed)	,428	,403	,410	,134	,020	.	,255	,161	,214	,107	,284	,297	,489
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	Singing_total	Correlation Coefficient	,194	,060	,146	,222	-,232	,127	1,000	,435**	,105	,331*	,210	-,029	-,111
		Sig. (1-tailed)	,156	,379	,225	,123	,113	,255	.	,009	,294	,040	,137	,440	,283
		N	29	29	29	29	29	29	29	29	29	29	29	29	29
	LLAMA_B	Correlation Coefficient	,075	,173	,158	,101	-,057	-,187	,435**	1,000	,195	,105	,331*	,118	,090
		Sig. (1-tailed)	,347	,181	,203	,298	,383	,161	,009	.	,151	,291	,037	,267	,317
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	LLAMA_F	Correlation Coefficient	-,514**	-,359*	-,496**	-,132	,171	,150	,105	,195	1,000	,176	,015	-,109	,252
		Sig. (1-tailed)	,002	,026	,003	,244	,183	,214	,294	,151	.	,176	,469	,283	,089
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	IQ	Correlation Coefficient	,114	,332*	,271	,118	,329*	,234	,331*	,105	,176	1,000	,218	,167	,298
		Sig. (1-tailed)	,273	,036	,074	,267	,038	,107	,040	,291	,176	.	,124	,189	,055
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	Chinese_total	Correlation Coefficient	,514**	,327*	,457**	,557**	-,121	-,108	,210	,331*	,015	,218	1,000	,591**	,432**
		Sig. (1-tailed)	,002	,039	,006	,001	,261	,284	,137	,037	,469	,124	.	,000	,009
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	Tagalog_total	Correlation Coefficient	,549**	,475**	,579**	,481**	-,139	,101	-,029	,118	-,109	,167	,591**	1,000	,292
		Sig. (1-tailed)	,001	,004	,000	,004	,232	,297	,440	,267	,283	,189	,000	.	,059
		N	30	30	30	30	30	30	29	30	30	30	30	30	30
	Turkish_total	Correlation Coefficient	-,040	,078	,027	,052	,278	-,005	-,111	,090	,252	,298	,432**	,292	1,000

Multiple Regression. Model Summary

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,621[a]	,385	,361	,50130	,385	15,677	1	25	,001	
2	,724[b]	,525	,485	,44995	,139	7,031	1	24	,014	
3	,774[c]	,599	,547	,42201	,075	4,284	1	23	,050	
4	,834[d]	,695	,639	,37658	,095	6,884	1	22	,016	1,786

a. Predictors: (Constant), Com_RAW

b. Predictors: (Constant), Com_RAW, memory_fw

c. Predictors: (Constant), Com_RAW, memory_fw, LLAMA_F

d. Predictors: (Constant), Com_RAW, memory_fw, LLAMA_F, Education_father

e. Dependent Variable: Chinese123456_Tagalog123456

Abstract

One individual difference in second language acquisition which has received special attention over the past years is language learning aptitude. Research in this interdisciplinary field consistently tries to establish universal principles of language aptitude (Reiterer 2009: 157), aims at discovering the origins of linguistic giftedness, seeks to identify the various components aptitude is composed of and furthermore, tries to detect other factors which might influence and consequently add to reveal the nature of language talent. In view of this line of inquiry, the present thesis seeks to contribute to a better understanding of the relationship between the cognitive domains of language aptitude, working memory, and musicality with latest insights from a cross-sectional psycholinguistic study that was conducted among primary school-aged children. The findings aim at gaining insights into the mental capacities of young language learners so as to make important assets for Early Language Teaching.

In order to reveal the interrelation between linguistic, musical, cognitive-analytic and short-term memory abilities of young language learners, multiple tests were applied.

Results highly suggest that language aptitude, in particular phonetic ability, goes hand in hand with musical aptitude and working memory ability. Findings thus call for a more intensive facilitation of musical elements and working memory tasks into the early foreign language learning classroom and, consequently, a less focus on educational linguistic standards.

German Abstract

Ein wichtiger Faktor, der in den letzten Jahren erhebliche Beachtung in der Fremd- und Zweitsprachenforschung erfahren hat, ist -neben Motivation und Persönlichkeit- auch das Sprachentalent. Forschungen in diesem interdisziplinären Feld versuchen laufend universelle Prinzipien zu etablieren, den Ursprung von Sprachentalent zu entdecken, dessen Komponenten zu identifizieren, und andere Faktoren zu entdecken die Sprachentalent beeinflussen könnten (Reiterer 2009:157). In Anlehnung an bisherigen Studien, versucht die vorliegende Arbeit mit Hilfe einer Untersuchung an Volksschulkindern zu einem besseren Verständnis der Beziehung zwischen den kognitiven Domänen Sprachentalent, Kurzzeitgedächtnis und Musikalität beizutragen. Die Forschungsergebnisse sollen Einblick in die mentalen Kapazitäten junger Sprachenlerner und Sprachenlernerinnen ermöglichen, um so wichtige Schlussfolgerungen für den frühen Fremdsprachenunterricht zu ziehen.

Um die Wechselbeziehung zwischen linguistischen, musikalischen und kognitiv-analytischen Fähigkeiten zu entdecken, wurden mehrere Tests angewandt. Die Forschungsergebnisse bestätigen vorangegangene Studien und legen nahe, dass Fremdsprachentalent, ins besondere Sprachimitationstalent, einhergeht mit Musikalität und einem besser entwickelten Kurzzeitgedächtnis.

Die aus dieser Studie gewonnenen Erkenntnisse rufen demnach vorranging nach einer gesteigerten Implementierung musikalischer Elemente im frühen Fremdsprachenunterricht.

Declaration of Authenticity

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Stefanie Rüdegger