A Study on the Acquisition of Phonotactic Knowledge by Second and Third Language Learners

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Abstract

This study aimed to see whether there was a difference between second and third language learners with regard to the acquisition of new phonotactic knowledge. It did so by comparing native speakers of American English who were learning Italian as a second language with those who were learning Italian as a third language. These participants were asked in an online task to listen to Italian sounding non-words presented as auditory stimuli and to write down the first syllable. The target items started with the clusters /zb/, /zm/ and /zv/, which are all attested in Italian but in few other languages. The mean accuracy scores showed no difference between the second and third language learners. Accuracy scores were also calculated for each consonant cluster, which did not provide support for the Sonority Sequencing Principle. Additionally the responses were coded based on which strategy was used to cope with the unknown consonant clusters following Davidson (2006), which showed that both groups followed the same distribution of strategies, with Segment change as the most used strategy.

Keywords: Third language acquisition, second language acquisition, L3 phonology, phonotactics, sonority sequencing principle, use of strategies, American English, Italian.

1 Introduction

One of the fields of linguistics that is very practical and noticeable in everyday society is second language acquisition. Studying a second language is highly advocated, for instance by governmental organisations like the European Union. The European Commission published a report in 2012 which not only showed all the languages spoken in Europe but also showed that over half of Europe's population spoke at least two languages. The Commission states on their website that "[o]ne of the EU's multilingualism goals is for every European to speak 2 languages in addition to their mother tongue" ("Multilingualism," n.d.). The 2012 report names the Netherlands as one of the countries with the highest percentage of speakers of a second language (94% compared to the average of 54% for all the countries in the report). This is the result of a national educational policy which states that at least three foreign languages should be taught to each student in secondary schools (generally English, German and French) (Rijksoverheid, n.d.). One might wonder why studying a second language is so beneficial, and whether studying additional languages provides additional benefits. Aside from the practical implications such as better job prospects, research has shown that bilingualism can lead to higher intelligence (Bialystok 2001), and a delay in the onset of dementia (Gold, 2017).

While the field of second language acquisition has long been established and expanded into many other areas such as psycholinguistics, the study of additional languages has not received as much attention. This does not correspond with reality, as it could be seen before that one of the goals of the European Union is that every European citizen is not a bilingual, but a tri- or multilingual. The current study addressed this issue, by citing sources regarding the field of third language acquisition and by empirically researching whether having learnt a second language had a beneficial effect on the acquisition of a third language, specifically with regard to phonology and phonotactics. It did so by comparing a group of second language learners (L2 learners) of Italian with a group of third language (L3) learners who had already learned at least one other language besides their native language and were learning Italian as a third language. First, section two describes relevant literature in the field of third language acquisition and L3 phonology, followed by an account of the phonotactic feature of Italian that is being studied and literature that described the methodology for this study. This methodology is then further extended in section 3, after which the results are presented in section 4 and analysed in section 5. Section 6 provides a conclusion to this study.

2 Literature Review

This section discusses relevant literature that outlines the basis for the current research, which aimed to answer the research question to what extent there is a difference between second and third language learners with regard to acquiring new phonological knowledge. The first subsection 2.1 discusses literature in the field of third language acquisition with a focus on the development of the field, what the current issues are in this field, and which models are used to describe third language acquisition. Subsection 2.2 discusses research in the field of second and third language acquisition with a specific focus on the acquisition of phonology and phonotactics. Subsection 2.3 outlines the phonological issue that was used in this study to determine to what extent there is a difference between second and third language learners, namely voiced consonant clusters in Italian. This subsection first discusses the voiced consonant clusters in Italian, followed by an overview of this type of clusters in other languages. The last subsection 2.4 discusses a study that was used as the basis for the methodology of this study, namely Altenberg (2005).

2.1 Third language acquisition

A large field of research in the domain of linguistics deals with language acquisition. Within this field of research, there is a clear distinction made between first language acquisition and second language acquisition. A consensus has been reached among researchers that first and second language acquisition are vastly different processes. One could name differences such as the implicit way of acquiring a first language compared to the explicit way of acquiring a second language, the fact that first language learners have to start from the very beginning while second language learners already have a system for language in place, and very simply that when speaking of first language acquisition one deals with children while with second language acquisition one generally deals with (young) adults. This is all stated in the Fundamental Difference Hypothesis, which was first formulated by Bley-Vroman (1989, cited in Bley-Vroman, 2009). As De Angelis (2007) describes "[i]f one were to state that learning a first language does not substantially differ from learning a second one, a chorus of objections would be raised in no time – and rightly so" (pp. 4).

On the other hand, whenever someone claims that second and third language acquisition are the same, it "does not seem to cause much of a stir" (De Angelis, 2007, pp. 4). In fact, this

claim has been made, although not always explicitly. De Angelis explained this by saying that "[m]ost people understand SLA [second language acquisition, IH] to be a field of research concerned with how second languages are acquired" (pp. 5). For them, this process is no different whether another language has been learned previously or not. While some researchers had already asked themselves whether this previous knowledge had an influence on the acquisition of the new language (for example Ringbom, 1987), only recently has the study of third language acquisition gained supporters for a separate field of research. Cabrelli Amaro, Flynn and Rothman (2012) outline the path that the field has followed:

> "[h]istorically, most research in L3 acquisition has focussed on the structure of the mental lexicon, education and sociolinguistics. More recently, the field has witnessed a sharp increase in the domain of L3/Ln acquisition of morphosyntax. However, in spite of these recent trends during the last two decades, we believe that it is fair to say that the linguistic study of L3/Ln acquisition is still in its infancy" (Cabrelli Amaro et al., 2012, pp. 1).

As this field of research has only recently been developed, there are still some issues that need to be solved before this field of research can advance. For some of the issues, it can look back to the field of second language acquisition, while others are inherent to this new field of research. One of the issues is terminology, which is discussed in subection 2.1.1, and others are methodological, which are discussed in subsection 2.1.2.

2.1.1 Terminology

One issue that comes with a relatively young field of research is a certain lack of consistency in the terminology. In the field of second language acquisition, there generally are only two scenarios: either the two languages are learned simultaneously (early child bilingualism), or they are learned consecutively (late child bilingualism or, if the second language is learned after puberty, adult bilingualism). However, in the case of third language acquisition, there are four scenarios (Cenoz, 2003): "[t]he three languages can be acquired consecutively (L1->L2->L3); two languages could be acquired simultaneously before the L3 is acquired (Lx/Ly->L3) or after the first language (L1->Lx/ Ly) or the three languages could be acquired simultaneously in early trilingualism (Lx/Ly/ Lz)" (pp. 72). It is therefore not surprising that the term 'third language acquisition' is used in different ways for different scenarios. Generally, the third language is believed to be the language which is chronologically acquired after both the first and a second

language, which suits the first scenario described by Cenoz in which all three languages are learned consecutively. Following this reasoning, it would also be possible to individually label all subsequent languages that one could learn, namely L4, L5, L6 and so forth, for as many languages as that individual has learned. This is clearly the way in which Cabrelli Amaro, Flynn and Rothman (2012) view this term, as they use "L3/Ln acquisition" (pp. 1). De Angelis (2007) prefers the term 'third or additional language acquisition' because they believe that the term 'third language acquisition' "places emphasis on the third language at the exclusion of all the other languages also in the mind" (pp. 11). This chronological view, however, becomes problematic when dealing with a learner of a language which has learned their other two languages simultaneously, as presented in Cenoz's overview by not identifying these languages by numbers, but by letters (Lx/Ly instead of L1/L2). While Cenoz still considers the third language they acquire to be an L3, others feel that they have two L1s, rather than an L1 and an L2 (see for example Hammarberg, 2009, also for an overview of the terms that have been used in this field). They believe that the term 'L3' should be used for those cases in which someone has at least one L1 and at least one L2, and the L3 would then be the language that is currently being learned. The remainder of this study will assume the last-mentioned definition, namely that of L3 as the language that is currently being studied with at least one L1 and at least one L2 already in place.

2.1.2 Problems with methodology

The discussion about the meaning of the term 'third language acquisition' is not the only problem that has arisen in the last decades in which the field of third language acquisition has gained supporters. Cabrelli Amaro, Flynn and Rothman (2012) discuss several methodological issues that still have to be resolved in order for the study of third language acquisition to advance as an academic field. They describe that standardization across the field is needed in the following areas:

> "(i) determining what inclusion and exclusion variables should be applied for subject participants in L3/Ln studies, (ii) resolving issues related to the comparative fallacy applied specifically to L3/Ln, (iii) creating independent measures of proficiency for L3/Ln acquisition and (iv) increasing focus on the specific contributions of results from

> L3/Ln acquisition research for various subfields of linguistic inquiry, from theory to practice" (Cabrelli Amaro et al., 2012, pp. 3).

With regard to the first area, they refer back to the issue described above, namely which types of learners can be seen as third language learners. Another issue related to this is language proficiency: should there be a minimum proficiency in the third language, or even in the second, before a learner can be seen as a third language learner? This is also raised by De Angelis (2007) as a reason why the field of second language acquisition was initially not interested in separating second and third languages learners: "[a]ll learners [were] labelled L2 learners – particularly when proficiency in the prior non-native language(s) [was] low – and it [was] usually up to the researcher to decide whether learners' prior knowledge [had] the potential to bias the results of a study or not" (pp. 5). This statement places the methodological remarks made by Cabrelli Amaro et al. in a different light, as it illustrates why there is a need for a consensus regarding which participants are allowed to be included in a study on third language acquisition (i.e. at what point someone is seen as an L3 learner instead of an L2 learner). The study by Hammarberg (2007) provided an interesting pointer for answering the question of proficiency, as they found that "SW's [S. Williams', IH] knowledge of Italian is mainly theoretical but even this type of knowledge appears to function as a source for L2 influence on L3" (pp. 26). This would mean that even a language for which someone has a very low proficiency can influence the acquisition of another. This provides further support for the definition of third language acquisition as described in subsection 2.1.1, because any language in which the learner has even very low proficiency can be included as one of the L1s or L2s for that learner.

The second methodological issue deals with the comparative fallacy that was already present in second language acquisition and has now also been transferred to third language acquisition. As mentioned before, Bley-Vroman described in 1989 that there is a fundamental difference between first and second language acquisition. An extension of this thought is that not only the process, but also the result is fundamentally different. A famous quote from Grosjean perfectly illustrates this issue: "the bilingual is not two monolinguals in one person" (Grosjean, 1989, pp. 3). While this was established as early as the 1980's, comparing bilinguals to monolinguals remained common practice for a long time, and this has now been extended to third language acquisition by comparing learners of a third language to native monolingual speakers of that language. This is the fallacy that is discussed and rejected by Cabrelli Amaro et

al. (2012), as third language learners should be analysed in their own right and not in relation to native speakers of the language. The third methodological issue ties in with this as well, as the best way to avoid the comparative fallacy is to use proficiency measures specifically designed for multilinguals. Cabrelli Amaro et al. state that many researches used monolingual proficiency measures in their research, which do not take into account the influence of the other languages in the mind of the learner.

The issue raised by Cabrelli Amaro et al. (2010) was introduced to illustrate that the study of third language acquisition can lead to better understanding of many linguistic fields and different areas in the field of language acquisition. As De Angelis (2007) said: "most of what we know about language acquisition does not go beyond the L2, and this means that our understanding of how non-native languages are acquired is at best partial and incomplete" (pp. 4). However, because the field of third language acquisition is "still in its infancy" (Cabrelli Amaro, Flynn, and Rothman, 2012, pp. 1), the influence of multiple languages still needs to be explored for many areas of language acquisition.

2.1.3 Models for third language acquisition

One of the areas in which research in third language acquisition has advanced already, is the study of crosslinguistic influence. Three influential models on crosslinguistic influence have been developed for third language acquisition: the Cumulative Enhancement Model (CEM), the L2 status factor and the Typological Primacy Model (TPM). The first model that was developed specifically for third language acquisition was the Cumulative Enhancement Model (CEM), developed by Flynn, Foley and Vinnitskaya (2004). Before this model was established, many believed that the L1 could be the only source of crosslinguistic influence. Flynn et al. provided a counter theory based on empirical research in the L3 acquisition of relative clauses. In this study, they compared their results of third language learners (L1: Kazakh, L2: Russian, L3: English) to the results of earlier research on L1 and L2 acquisition and found that the third language learners were influenced by their L2 rather than their L1. They proposed a model for crosslinguistic influence in third language acquisition, the Cumulative Enhancement Model, which states that the experience of acquiring multiple languages builds up and that all languages acquired can positively influence the acquisition of the third language. If the earlier acquired languages would interfere in the acquisition of the third language, then no transfer takes place. In the context

where only influence for the L1 was assumed, the CEM paved the road to research in crosslinguistic influence from the L2 to the L3.

The study by Bardel and Falk (2007) build on this and resulted in the second model for crosslinguistic influence in third language acquisition. This empirical study looked at the acquisition of the place of negation by L3 learners of Swedish and Dutch (with different L1s and L2s in each group). They found that the participants who had experience with the place of negation after the verb through their L2 outperformed those that did not, even those who had experience with this through their L1. This led to evidence for the L2 status factor, which states that an L2 is more important in crosslinguistic influence than an L1, and even leads to the possibility of an L2 negating any positive influence from an L1. Bardel and Falk (2012) later supported their model with evidence from research in psycholinguistics, specifically the theory on the declarative and procedural memory by Paradis (1994). This theory states that, because of its implicit nature, in first language acquisition "procedural memory sustains linguistic structure […] while declarative memory sustains vocabulary" (Bardel and Falk, 2012, pp. 71). In contrast, for the explicit acquisition of a second language, both grammar and vocabulary are sustained by declarative memory, as is also the case for third language acquisition. This means that the three types of languages are similarly represented in the mind with regard to vocabulary, but the L3 is more similar to L2 than L1 in terms of "phonology, morphology, syntax and the morphosyntactic properties of the lexicon" (Bardel and Falk, 2012, pp. 71). This similarity between L2 and L3 and the difference between L1 and L3 supported the L2 status factor, as it explains why the L2 is in a better position than the L1 in order to influence the L3.

The third model developed for third language acquisition was the Typological Primacy Model (TPM), which was developed by Rothman (2010). They set up an empirical study to test the extent to which the CEM and the L2 status factor could predict crosslinguistic influence, or whether the typological relation between two languages could be a better method for predicting crosslinguistic influence in third language acquisition. They found that the latter was the case and developed the Typological Primacy model. This model counters the L2 status factor, as the TPM states that both L1 and L2 can influence the L3, not only the L2 as predicted in the L2 status factor. The TPM is in line with the CEM in that all language have the potential to influence the L3 but restricts this by stating that only the language that is typologically the most similar to the L3 will influence it. Rothman made an extra note to mention that this model does

not deal with the typological relatedness of languages as a whole (through language families), but rather the typological relation on a specific aspect of the languages as it is perceived by the language learner.

These three models have been highly influential in the field of third language acquisition as they were the first models that were developed specifically for third language acquisition, rather than adapted from models for second language acquisition. Several studies have tried to provide empirical evidence to determine which of these models best described the process of crosslinguistic influence in third language acquisition. For example, the empirical study by Jaensch (2012) tested the three models with regard to their position on Universal Grammar and transfer. In second language acquisition, there are two theories on this matter, namely Full Transfer where the learner can make up for the inability to access UG by transferring "properties and features of the end-state L1 grammar" (Jaensch, 2012, pp. 166); or "Representational Deficit" where the learner can only transfer some aspects of their L1, but not "uninterpretable features" (Jaensch, 2012. pp. 166). Interpretable features are grammatical features that are required in order to understand what is being said (e.g. tenses on verbs), while this is not the case for uninterpretable features (e.g. grammatical gender). For third language acquisition, this puzzle gets more complicated as now not only transfer from the L1 needs to be taken into account, but also transfer from L2(s). Jaensch tested which languages (L1, L2, or both) could transfer uninterpretable features L3 by comparing Spanish and Japanese learners of German (L2: English for both) on the acquisition of grammatical gender and the contrast between definite and indefinite articles, which are both uninterpretable features. Spanish is similar to German on both these features; English is only similar to German with regard to the definite/indefinite contrast; and Japanese does not have either of these features.

Following the CEM, if the L1 is able to facilitate transfer to the L3 on uninterpretable features, then the Spanish would outperform the Japanese on gender, but both groups would be similar on the definite/indefinite contrast due to transfer from English. If only the L2 would be the dominant factor in transfer (following the L2 status factor), then there would be no difference between the two groups. Lastly, if the typology of the languages played a role (following the TPM), then the two groups would perform similarly, as English is more typologically related to German than either Japanese or Spanish. The L2 status factor and the TPM thus predicted the same outcome in this case. Jaensch (2012) found that the Japanese performed better on gender

but there were no significant differences with regard to the definite/indefinite contrast. This means that the L1 did not facilitate acquisition for the Spanish speakers, as was expected following the CEM. The result on the definite/indefinite contrast supported the L2 status factor and the TPM, which both predicted that there would be no difference between the two groups based on transfer from their L2. Furthermore, as the Japanese L1 group was able to acquire German grammatical gender, this research has provided evidence that uninterpretable features can be acquired, rather than transferred, as this group had no experience with gender in either their L1 or their L2.

Another empirical study that provided support for the L2 status factor was the case study by Hammarberg (2009). The subject of the case study, Sarah Williams, was a native speaker of English who came to Sweden to teach and was studying Swedish as a third language. Previously, she had learned French and German to a high proficiency and Italian to a low proficiency. During the first two years of her stay in Sweden, Williams and Hammarberg recorded her speaking in Swedish (first every two weeks, later at larger intervals), which resulted in a longitudinal record of her acquisition of Swedish as an L3. After these two years, they analysed these recordings on various linguistic domains, such as language switches and phonology.

With regard to language switches, they analysed the recording by Williams and coded the language switches based on their pragmatic purpose. For three categories, Hammarberg and Williams believed the language switches to be intentional. A fourth category of language switches was believed to be non-intentional. They found that the intentional language switches were generally in English, while the non-intentional switches were mostly in German and decreased over time. A possible explanation for the use of German as opposed to the other L2s French and Italian could be proficiency in the language, recency of use and typological relatedness of German to Swedish. They later compared these results to another case study, EE (L1: German, L2: English and Swahili, L3: Swedish), who used their L2 English for all types of language switches. Hammarberg and Williams named the L2 status of German as a possible reason for the difference between these two learners. Because EE learned English at a very young age, they could be said to be raised bilingually, and as a result have two L1. Their proficiency in Swahili was very low, so the use of English for all types of language switches is explained by the fact that EE had no L2 with a high enough proficiency, recency of use and typological relatedness to Swedish which would allow for language switches.

2.1.4 Process of third language acquisition

So far, this subsection has only dealt with the field of third language acquisition and its influential studies. As could be seen in the previous subsection, a large part of the research in third language acquisition has been on crosslinguistic influence of the first and second language(s) on the third, which seemed to be because this was the area which most clearly distinguished third language acquisition from second language acquisition. This could be seen in the statement by De Bot and Jaensch (2013), who described that "the main point [of these earlier studies] seem[ed] to be that the impact of the first language (L1) in learning or using a second language (L2) [was] fundamentally (qualitatively) different from the impact of the L1 and L2 on learning an L3" (pp. 1). The research in crosslinguistic influence was thus used as a way to establish the field of third language acquisition as a separate field of research. However, research in the difference in acquisition process between second and third language learners, especially empirical research, remains very limited. As De Bot and Jaensch stated: "the fundamental question of what makes trilingualism special compared to bilingualism […] continues to be evaded" (pp. 1).

An early study that addressed this issue was by Klein (1995), who looked at the difference between monolingual and bilingual teenagers acquiring the additional language English. They found that the latter group of learners of English "appear[ed] to have an advantage over [the second language learners] in lexical learning" (pp. 450). A more recent study by Cenoz (2003) analysed "the additive effect of bilingualism on third language acquisition" (pp. 71) by looking at cognitive benefits that had been proven for bilinguals. For example, a relation was found between bilingualism and better metalinguistic knowledge, as bilinguals could be associated with "a higher ability to reflect on language and to manipulate it" (pp. 73). When these bilinguals acquired another language (thus becoming third language learners), they were found to "obtain higher levels of proficiency in a third language" (pp. 76). On the basis of the findings from other empirical studies, Cenoz concluded that "in many cases [bilingualism could] enhance the acquisition of a third language" (pp. 80). As an explanation they proposed the general idea that, by virtue of having more experience in additional language learning, third language learners "may have developed specific learning / processing strategies when they learned a second language and they may benefit from the use of those strategies" (pp. 80) when learning an additional language. This distinction is made especially clear by the statement that

"third language learners can be considered 'expert' language learners as compared to 'novice' second language learners (pp. 80).

These two studies tried to answer the question whether the acquisition processes of second and third language acquisition were fundamentally different and found evidence in its favour. However, both studies mainly focussed on simultaneous bilinguals acquiring a third language, who would not be considered third language learners under the more recent definition of third language acquisition, as mentioned in 2.1.1. Thus, more research is needed to answer this question, especially using the more recent definition of third language learners and incorporating different domains of linguistics, for example phonology.

2.1.5 Summary

All in all, it has been made clear that the field of third language acquisition is still a young field of research which only in the last few decades started developing separately from the field of second language acquisition. One of the largest issues that still remains unsolved is the lack of a consensus on the definition of the term 'third language (acquisition)'. While many still believe that the third language is the chronologically third language, i.e. that is acquired chronologically after the L1 and the L2, another definition has also been gaining ground, namely that the third language is the language that is currently being studied where at least one L1 and at least one L2 is already in place. The benefit of this definition is that it allows for multiple L1 and L2, which also incorporates the differences in proficiency that can come with having learned multiple languages.

Many areas in linguistics research still have not been dealt with in relation to third language acquisition, but one of the areas in which research in this field has already advanced is research on crosslinguistic influence. Where second language acquisition only had to deal with transfer from the L1 to the L2, third language acquisition has had to deal with the question whether both L1(s) and L2(s) could influence the L3, and if so, whether there was a way to predict which language was the main influencer. Three models have been very influential in solving this issue. The first model that was developed for the field of third language acquisition was the Cumulative Enhancement Model by Flynn, Foley and Vinnitskaya (2004), which stated that both the L1 and the L2 had to potential to positively influence the acquisition of the L3. Another model, the L2 status model by Bardel and Falk (2007), stated that the L2 would overrule

any influence from the L1, even in cases where this would lead to negative transfer. A third model, the Typological Primacy Model by Rothman (2010), reacted to both of these models by stating that both the L1 and the L2 had the potential to influence the L3, be it positive or negative, but that the typological relationship would be deciding factor on which language would influence the L3. While all three models have been supported with evidence (although the CEM to a lesser extent), most empirical studies supported the L2 status model.

The field of third language acquisition could be supported as a separate field of research by many theoretical reports, for example through the models on crosslinguistic influence. Yet few studies have been performed on the differences between second and third language learners with regard to the acquisition processes. Early empirical research that looked at this focussed on early bilinguals, who later acquired a third language (for example Klein, 1995, and Cenoz, 2003). They found that these bilinguals had an advantage over monolinguals, thus providing support for third language acquisition as a separate field of research. However, more research is still needed, especially using the more recent definition of third language acquisition and by focussing on more areas of linguistic research.

2.2 L3 phonology

Cabrelli Amaro, Flynn and Rothman (2012) mentioned that the field of third language acquisition was "still in its infancy" (pp. 1) and this is even more so for the subfield of L3 phonology. Research into acquisition of phonology in a third language only started gaining ground in the last decade, with a special issue from the International Journal of Multilingualism in 2010 being the first of its kind. In the introduction to this edition, Wrembel, Gut and Mehlborn (2010) state that much of the research up until then had been on the negative influence of previously learned languages on the L3. This is also repeated in Cabrelli Amaro's article which is aptly named "L3 phonology: An understudied domain" (Cabrelli Amaro, 2012, pp. 33). This article outlined some methodological issues with regard to L3 phonology research that still needed to be addressed, namely that the majority of the research up until then had focussed on production data rather than perception data and on specific sounds (segmental research) rather than combinations of sounds (suprasegmental research). The same issues that have been mentioned for the field of third language acquisition as a whole also apply here, namely that there should be more longitudinal studies to balance the large number of cross-sectional studies

and that researchers should not compare third language learners to monolingual native speakers of that language. Cabrelli Amaro stated that, until a consensus has been reached about which participants should be included in third language acquisition research, studies need to provide more proficiency data for all languages involved. Later Cabrelli Amaro and Wrembel (2016) added to this by naming four key questions in the field that still needed to be addressed further, namely:

> "(1) Are bilinguals (early and late) better equipped linguistically and/or cognitively than monolinguals for the task of continued phonological acquisition? […] (2) When exposed to a third language, which existing language system does a learner transfer to the third language? Is it (a) the native or dominant language, (b) the second language, (c) the language that is most structurally similar to the third language, or (d) a combination of both systems? […] (3) What is the developmental path of acquisition of an L3 sound system? […] (4) How does the addition of a third sound system affect existing sound systems? Are early-acquired systems less vulnerable to L3 influence than late-acquired systems, and if so, why?" (pp. 399-403).

Most of these questions still stand, but the second question, with regard to crosslinguistic influence, can be related to the three models on crosslinguistic influence (the Cumulative Enhancement Model, the L2 status factor and the Typological Primacy Model). Llama, Cardoso and Collins (2010), for example, found evidence that supported the L2 status factor. They set out to answer whether the L2 status factor or typology would be the determining factor in crosslinguistic influence in the L3 by comparing two groups of L3 Spanish learners, one group with L1 French and L2 English, and the other group with L1 English and L2 French. If the L2 would be the most influential factor, the two groups would differ in their acquisition of voice onset time (VOT, the time before a sound is produced) in L3 Spanish. If typology would be the most influential factor, both groups would use their knowledge of the typologically related French in their acquisition of VOT in L3 Spanish. Llama et al. found that there was a stronger influence from the L2 than from typology, as both groups relied more on English that on French in the acquisition of VOT in L3 Spanish, which would not have been the case if they had relied on the typological relation between French and Spanish.

Another empirical study in L3 phonology which supported the L2 status factor is the case study by Hammarberg (2009, already mentioned before in subsection 2.1.3). This case study

described the acquisition of L3 Swedish of an L1 English speaker with L2 German, French and Italian, who was recorded at regular intervals for two years. Hammarberg and Williams analysed the recordings with regard to phonology in two ways. For the first analysis they recorded Williams twice reading the same story, once at the start of the project and once after several months when her proficiency in Swedish was higher. They played both recordings to participants and asked them to determine the accent of the speaker in the recording. Most participants believed the early recording to be "spoken by a German" (Hammarberg, 2009, pp. 78), while for the second recording the results were more ambiguous, but "the majority choice was English" (Hammarberg, 2009, pp. 78). The data for the second analysis consisted of recordings by Hammarberg and Williams commenting on the story recordings directly after they had been made, with the purpose to elicit introspective data from Williams. During these recordings, Williams mentioned repeatedly that she "did not want to sound English […] but would rather prefer to approach the sound of Swedish from the basis of another foreign language such as German" (Hammarberg, 2009, pp. 25). This implies that Williams actively suppressed the English articulatory settings in favour of the German settings, especially at the beginning of process of acquiring Swedish. As can be seen from the later recording, over time the pattern changed back to the English articulatory settings. As a possible explanation, Hammarberg (2009) states: "[t]hrough increased input and usage of L3 and consequent refining and strengthening of the phonological filter, the insufficiency of using L2 as a phonological strategy is noticed by the learner, and this strategy is gradually dropped; more attention is now paid to the direct production of L3, without going through the agency of L2" (pp. 27). This active suppression of the L1 is seen as clear evidence for the L2 status factor in L3 phonology.

Research in L3 phonology has also provided evidence for the CEM and TPM, for example the study by Wrembel (2012). This study explored the three models for crosslinguistic influence in third language acquisition with regard to foreign accentedness in the L3 as perceived by native speakers of that language. Native speakers of English listened to recordings from 9 L3 speakers of English (L1: Polish, L2: French) were asked to identify the speakers' L1. Wrembel found that Polish was most often named as the L1 of the speakers, meaning that their speech was more influenced by their L1 than by their L2. This finding provided counterevidence for the L2 status factor and supported the idea of influence from multiple languages following the CEM and the importance of the typological relation between languages following the TPM, as English is

typologically more similar to Polish than to French with regard to the prosodic structure. All in all, it seems that the L2 status factor is, in general and for L3 phonology, the most supported model at the moment. However, new models which counter this might be developed, as it is still a young field of research.

All in all, L3 phonology is still an "understudied domain" (Cabrelli Amaro, 2012, pp. 33). Again, most research that has been done has focussed on crosslinguistic influence, specifically in relation to the major models (the CEM, L2 status factor and TPM). Suggestions for further research include studies in suprasegmental aspects of phonology and in perception data rather than production data. Three large questions that remain in the field of L3 phonology are: do L3 leaners have an advantage over L2 learners with regard to acquisition of phonology, what does the acquisition process of L3 phonology look like, and what is the effect of L3 phonology on the existing sound systems.

2.3 Consonant clusters

As mentioned before, the focus of research in L3 phonology had been on segmental rather than suprasegmental properties (Cabrelli Amaro, 2012). Escudero (2007) cites many studies that focussed on segmental research. One of the main observations in this research is the difficulty that second and third language learners have with acquiring new phonological knowledge. This can be explained by the role of perception in the acquisition of new phonological knowledge. Escudero claims that, when a new language is encountered, learners may perceive the sounds with the sound system of the native language of the learner, and the learner may not perceive that the new sounds are different from their own (see also research on the Perception Assimilation Model and the Speech Learning Model, for example Best & Tyler, 2007). Because this difficulty in acquiring new segments has been established, and to balance the number of studies on segmental phonology, the current study focussed on a suprasegmental aspect of phonology, namely phonotactics, with a specific focus on consonant clusters in word-initial position. It did so by looking at Italian voiced consonant clusters in word-initial position that start with /z/. This subsection first outlines research that had already been done in the acquisition of consonant clusters, followed by a description of the specific consonant clusters in Italian that were the topic of this study and the existence of these consonant clusters in other languages.

With regard to the acquisition of consonant clusters in first language acquisition, Lleó and Prinz (1996) stated that early child language development only allows for one segment in onset, nucleus and coda. Later this structure is then expanded to clusters; first in onset, then in the rhyme. This means that, at first, the cluster needs to be simplified by deleting one of the consonants. An example of this would be /tiːl/ instead of /stiːl/ for 'steal'. Zanobini, Viterbori and Saraceno (2012) also pointed to deletion by saying that "processes to simplify syllable structure are generally characteristic of earlier stages of phonological development, whereas substitution patterns are characteristic of later stages of phonological development" (pp. 17). Which of the two consonants gets deleted is "not arbitrary, but dependent upon universal conditions of feature markedness or sonority" (Lleó & Prinz, 1996, pp. 33). Fikkert and Freitas (2004) stated that "[a] frequently attested simplification strategy is to select the least sonorous element of the target cluster for production" (pp. 58). However, in their own research they found that, although the two languages that were being studied had "similar onset clusters on the surface, children [did] not necessarily show the same learning paths" (pp. 67). This meant that the simplification strategy of deleting the least sonorous element was not universal, neither for children acquiring different languages nor for different children acquiring the same language. Other strategies that were found in this article were changing one or both of the consonants (what Zanobini et al. call substitution) or inserting a schwa (unstressed vowel) between the two consonants of the cluster.

Davidson (2006) looked at the types of strategies that second languages learners use when acquiring consonant clusters in the onset. They asked native speakers of English to produce pseudo-Czech words with a consonant cluster starting with /s/, /z/, /f/ or /v/. The productions were coded depending on which strategy was used to cope with the unknown consonant clusters, represented here in table 1.

Table 1.

Strategies to cope with unknown consonant clusters, as presented in Davidson, 2006, pp. 111.

Response type	Definition	Example
Correct	Target is produced with no changes or simplifications	/zvabu/ → [zvabu]
Insertion	Target is produced with a schwa between the consonants in the cluster	/zvabu/ → [zəvabu]
Deletion	Target is produced with either the first or second member deleted	/zvabu/ → [zabu] /zvabu/ → [vabu]
Prothesis	Target is produced with a schwa before the cluster	/zvabu/ → [əzvabu]
Segment change	Target is produced with two segments, but one differs from the original	/zvabu/ → [svabu]
Other	Target is not produced, has more than one error, or is completely unrecognizable	/zvabu/ → Ø /zvabu/ → [vəvabu] /zvabu/ → [spada]

Davidson found that the speakers of English best produced the targets starting with /s/, followed by those starting with /f/, then /z/ and were least accurate on those targets starting with /v/. Voicing also seemed to be playing a role, as the participants were more accurate on the clusters starting with a voiceless consonant (/s/, /f/) than on those starting with a voiced consonant (/z/, /v/). For the second consonant of the cluster all participants were more accurate on clusters with nasals (e.g. /m/, /n/) than clusters with obstruents in the second position (e.g. /p/, /d/). With regard to the strategies that were used to cope with unknown consonant clusters, Davidson found that across all clusters, insertion was the most used strategy. For most clusters, there were no or small numbers of cases for the other strategies, but for the /z/-clusters there was also a peak in prothesis. A second experiment was performed to check whether the inserted sound between the two consonants of the cluster was an existing vowel, but it was found that it was merely a matter of "gestural mistiming" (Davidson, 2006, pp.128). This meant that the participants did not intentionally produced a schwa, but merely failed to produce to consonant cluster correctly and

left a gap between moving from the position of one consonant to the other, thus producing a sound between the two consonants.

A theory which has been used to explain the differences in accuracy on the acquisition of different consonant clusters and to explain which of the two consonants in a cluster is more likely to be deleted or changed, is the sonority sequencing principle. McCrary Kambourakis (2007) explained that, following the sonority sequencing principle, "sonority should be highest at the syllable peak [vowel] and become progressively lower toward the syllable margins" (pp. 13). They name a sonority scale of least to most sonorous starting with voiceless stops, followed by voiced stops, non-coronal fricatives, coronal fricatives, nasals, liquids, and most sonorous are the vowels. Following this principle, if the first segment of a consonant cluster is /z/, which is a coronal fricative, it can only be followed by /n/, /m/ or liquids (/l/ and /r/). Davidson (2006) tested the clusters /zm/, /zn/, /zv/, /zb/, /zd/ and /zg/. Out of these, only those clusters in which /z/ is followed by a nasal (/m/ or /n/) follow the principle and they found that these consonant clusters were indeed produced more accurately than when the /z/ was followed by an obstruent (including fricatives /zv/ and stops /zb/, /zd/ and /zg/).

The consonant clusters starting with /z/ that were studied by Davidson (2006) was also studied in the current study, although instead of Czech this study looked at Italian. Krämer (2009) provided a chart with an overview of the Italian consonants, shown here as table 2. With regard to /z/ in consonant clusters in word initial position, Saltarelli (1970) stated that "[s] and [z] are in complementary distribution. […] [z] occurs only before voiced consonants, e.g. *sdentato* [zdentáto] 'toothless', and [s] elsewhere, e.g. *stentato* [stentáto] 'forced'" (pp. 21). Italian is one of the few languages which allow for these word initial consonant clusters in which /z/ is followed by a nasal or obstruent. Czech is also one of these languages, as well as other Slavic languages. Germanic languages and the other Romance languages (aside from Italian) allow for clusters in initial position that start with /z/, but not when it is followed by a nasal or obstruent. As Davidson points out, combinations of /z/ and a nasal or obstruent exist in other languages, but not in word initial position. In English, for example, /zb/ can occur in the middle of a word, as in 'husband' ("hu[zb]and" (Davidson, 2006, pp. 130)), which means that English speakers have been exposed to the combination of the two sounds. However, in these cases there is no real consonant cluster as the two consonants do not belong to the same syllable.

Table 2.

Consonants of Italian, as presented in Krämer, 2009, pp. 50.

	Labial	Dental	Alveolar	Palatal	Velar
stop	p, b	t, d	ts, dz	ʧ, ʤ	k, g
fricative	f, v		s, (z)	(ʃ)	
nasal	m		n	ɲ	
lateral			l	ʎ	
rhotic			ɾ		
glide	w			j	

As could be seen earlier, several steps are generally taken in the acquisition of consonant clusters. In first language acquisition, children first go through a phase in which they delete one of the consonants of the cluster and later they change one (or both of them). Since second language learners have already gained the ability to produce consonant clusters, they do not follow these phases. As could be seen from the data by Davidson, if the consonant clusters exist in the L1, then they were produced without much trouble. If the consonant clusters do not exist in the L1, however, the production was less accurate, and several strategies have been used to cope with the unknown consonant clusters. Data on the acquisition of consonant clusters by third language learners was not yet available, which is why the current study aimed to fill that gap.

2.4 Current study

As mentioned in subsection 2.1.4, research in crosslinguistic influence was used to establish the field of third language acquisition as a separate field of research, separate from second language learning, but few studies looked at the difference in the acquisition process. More research in this area still needed to be done, especially using the more recent definition of third language learners. Another aspect that is underrepresented in the field of third language acquisition is research in (suprasegmental) phonology (see subsection 2.2). The current study combined these two factors by addressing the general question mentioned by Cabrelli Amaro and Wrembel (2016) whether bilinguals are in general "better equipped linguistically and/or cognitively than monolinguals for the task of continued phonological acquisition" (pp. 399). It also incorporated the suprasegmental aspect of the phonology research, resulting in the final research question: are

third language learners are better at acquiring phonotactic knowledge than second language learners? As a lot of earlier research in the field of third language acquisition focussed on crosslinguistic influence from the L1(s) and the L2(s) on the L3, this study specifically opted for a phonotactic feature that did not occur in either the L1 or the L2s of the participants, namely consonant clusters in Italian that started with the voiced fricative /z/ and were followed by a nasal or obstruent. This feature occurs in very few languages, specifically Italian (but not in other Romance languages) and Slavic languages.

The methodology for this study was derived from a study by Altenberg (2005): an empirical study that looked at the acquisition of onset clusters by Spanish learners of English. These second language learners of English generally produce a schwa before consonant clusters starting with /s/ (for example, they pronounce 'school' as /ɛskul/ instead of /skul/). In order to see what could be the cause of this phenomenon, Altenberg performed three tests: a grammatical judgement task, a perception task and a production task. The conclusion after all three tests was that Spanish learners of English could have a difficulty merely in the articulatory setting that is required for the correct production of these consonant clusters, and not in the perception or judgement as was earlier posited. As seen before in subsection 2.2, perception data was still lacking in the field of L3 phonology, therefore this study was adapted from the perception task by Altenberg. In this second task, the participants were asked to write down the first syllable of each non-word that was given as auditory stimuli. The auditory stimuli for the current study consisted of non-words that followed Italian phonotactics and started with a consonant cluster (target items started with /zb/, /zm/ and /zv/).

Since this study was interested in new knowledge that did not occur in either the L1 or the L2, there was no crosslinguistic influence predicted. Instead, the hypotheses were drawn up on the basis of the general idea by Cenoz (2003) that third language learners have access to language learning strategies that are not available for second language learners. They made this distinction clear by labelling second language learners as "novice" and third language learners as "expert" (pp. 80). They stated that "third language learners [may] use more efficient strategies than second language learners" and could thus have an advantage over L2 learners in the acquisition of the additional language. As said before, since this study did not expect crosslinguistic influence, none of the three models (CEM, L2 status factor, TPM) were fully applicable for this scenario. However, the hypothesis described above still tied in with the

underlying principle of the CEM in that the knowledge from acquiring multiple languages builds up and has the potential to positively influence the acquisition of the additional language. Specifically, the hypothesis for this study was, then, that the third language learners would be more accurate at acquiring new phonotactic knowledge than the second language learners, by virtue of having more experience with acquiring languages aside from their L1.

In addition to this hypothesis with regard to the overall accuracy, another hypothesis was made with regard to the accuracy on the specific consonant clusters of the target items. This hypothesis was formulated following the sonority sequencing principle, which "maintains that sonority should be highest at the syllable peak [vowel] and become progressively lower toward the syllable margins" (McCrary Kambourakis, 2007, pp. 13). In Italian, the sonority scale of consonants from least to most sonorous is: voiceless stops (/p/, /t/, /ts/, /tʃ/, /k/), voiced stops (/b/, /d/, /dz/, /dʒ/, /g/), non-coronal fricatives (/f/, /v/), coronal fricatives (/s/, /z/, /ʃ/), nasals (/m/, /n/, /ɲ/) and the most sonorous consonants are liquids (/l/, /ʎ/, /ɾ/, /w/, /j/) (see table 2 for an overview of Italian consonants). Following this principle, it was expected that both groups of learners of Italian would be most accurate in the acquisition of /zm/ clusters, followed by /zv/ and least accurate in /zb/ clusters. Only the /zm/ cluster follows the sonority sequencing principle, as the coronal fricative /z/ is followed by the more sonorous nasal /m/. In the /zv/ cluster the coronal fricative /z/ is followed by the less sonorous non-coronal fricative /v/. This is, however, still closer in terms of sonority than the /zb/ cluster, where the coronal fricative /z/ is followed by the voiced stop /b/, which belongs to the category of second least sonorous consonants. While it was predicted that the second language learners will be less accurate than the third language learners in terms of overall accuracy, there was no difference predicted in terms of accuracy order on the consonant clusters as described above (i.e. both groups would follow the sonority sequencing principle, resulting in the order of most accurate on /zm/, followed by /zv/ and least accurate on /zb/).

Lastly, the current study looked at the distribution of strategies used to cope with the unknown consonant clusters, as described by Davidson (2006). However, there were two large differences between the study by Davidson and the current study, namely the former looked at production data from naïve participants, while the current study looked at perception data from participants who were already in the process of acquiring the language. This means that the participants in the study by Davidson did not have any experience with the language of the task

(or even any other language apart from their L1), while the participants in the current study already had experience with the phonotactics of the language of the task. Therefore, the part of the study related to the use of strategies was rather explorative. Despite the differences, the hypothesis was that the distribution of strategies would be similar to the one found by Davidson. For /z/ clusters, they found that Insertion was the most used strategy, followed by Prothesis and Segment change. The hypothesis was, then, that the most used strategy would be Insertion, followed by Prothesis and Segment change, while the other strategies would not occur as often. As no research had been done with regard to the use of strategies for second or third language learners, the null hypothesis presumed no difference between the two groups of second with regard to distribution of the strategies. Additionally as Davidson did not provide data on the strategies for each cluster (only categorised based on the first consonant), a null hypothesis was formulated that presumed that the use of strategies would be similar across the three target cluster types, i.e. the use of strategies would be independent of whether the stimulus started with /zm/, /zb/ or /zv/.

In summary, the current study tested the difference between second and third language learners in the acquisition of Italian consonant clusters that start with /z/. It did so by asking participants to write down the first syllable of auditory stimuli which consisted of Italian non-words. Target clusters started with either /zb/, /zm/, or /zv/. In addition to overall accuracy scores and accuracy scores per target cluster, the study looked at the strategies that were used to cope with the unknown consonant clusters. With regard to the overall accuracy scores, the hypothesis was that third language learners would be more accurate in the acquisition of unknown consonant clusters than second language learners. With regard to the accuracy scores per target cluster, it was predicted that both groups would be most accurate on /zm/ clusters, followed by /zv/ clusters and would be least accurate on /zb/ clusters. With regard to the use of strategies, the hypothesis was that both groups would most often use Insertion, followed by Prothesis and Segment change, while the strategies Deletion and Other would be very infrequent.

3 Methodology

This thesis aimed to answer the question: To what extent is there a difference between second and third language learners with regard to the acquisition of phonotactics? More specifically, it compared second and third language learners with regard to the acquisition of voiced consonant clusters of Italian. It did so by analysing the results of an online task which provided information on the perception of these voiced consonant clusters in the onset of words in Italian. Ultimately, this task determined whether there is a difference in the accuracy with which second or third language learners have acquired the voiced consonant clusters.

3.1 Participants

The survey was distributed among speakers of American English who were in the process of acquiring Italian as a second or third language. All participants were between 18 and 30 years old and had American English as their first language. The participants were recruited via emails sent to Italian Studies programmes at various universities across the United States. All participants were currently studying Italian at the time of testing and were given the same survey. The group division was made after the results had been gathered based on the number of languages for which they provided the linguistic background information. Those participants who were grouped as second language learners had no knowledge of any other language aside from American English and Italian. Those participants who were grouped as third language learners had learned at least one other language after puberty. There was no restriction on the amount of languages that had been learned, which languages had been learned, or how proficient they were in each language (as Hammarberg (2007) showed that even a low proficiency could influence the acquisition of the L3 phonology).

In total 57 participants were tested, 36 of whom were second language learners and 21 were third language learners. In total 8 participants in the group of third language learners were discarded: one was discarded because they were aware of the research set-up and thus their answers could not be seen as reliable, 7 others were discarded because they had acquired their second language before the age of 6, which meant that they were raised bilingually and differed from the intended target group. This meant that 13 participants were analysed in the group of third language acquisition. The total number of participants that was analysed was 49, consisting of 36 L2 learners and 13 L3 learners.

3.2 Materials

All materials were recorded under supervision of the researcher by a male native speaker of Italian using the program Audacity. This native speaker was a student at the Radboud University in the same age group as the participants. This speaker had a hint of the regional accent of Naples but could still be considered an average speaker of Italian. Before recording, the native speaker checked all items and concluded none were actual words in Italian and all followed the phonological rules of Italian.

The materials for the task consisted of 75 non-words which were based on Italian phonotactics. All non-words started with a word-initial consonant cluster. Of the 75 non-words, 30% (23 items) were target items, which started with a voiced sibilant (/z/) and were followed by a voiced consonant (either a /b/, /m/ or /v/). There were 48 non-target items which started with consonant clusters which had either a voiced consonant (/b/ or /g/), or a voiceless consonant (/p/, /t/, /k/ or /f/) as the first segment. These consonants were followed by a liquid (/l/ or /r/). See appendix A for a full list of all items. 4 extra non-target items were included which started with a voiceless sibilant (/s/) and a voiceless consonant (either /p/ or /k/). These items were included to ensure that the participants could perceive the difference between a voiced and voiceless sibilant, although the number was kept low in order not to disturb the balance between items which started with a sibilant and those which do not. The total amount of non-target items (4 starting with /s/, 48 others) formed 70% of the total items.

The reason for using non-words, instead of real Italian words, had to do with Italian orthographic rules. One of the biggest hurdles of the current study was that, while there is a difference in pronunciation, in Italian there is no difference in spelling between the voiced and voiceless sibilant at the beginning of a word. For example: the voiced sibilant in ‘sdentato’ (translation: toothless) is written as ‘s’, while it is pronounced as /z/. This means that the Italian way of spelling these words would give no insight in whether the participants heard a voiced or voiceless sibilant. If real Italian words had been used there would have been a risk that the participants would recognise the word, remembered the way it was spelled and adhere to the orthographic rules of Italian rather than the instruction to the task to write down what they heard as closely as possible. Care was taken to make sure that the non-words resembled Italian closely enough to give an accurate rating to the acquisition of phonotactics. This was also another reason why several filler items which started with /s/ were included in the task. Aside from ensuring

participants knew the difference between /s/ and /z/, it was believed that including these filler items made the participants subconsciously aware of the difference between /s/ and /z/ in the items (i.e. if they heard /s/ and wrote down ‘s’, they would be more likely to write down ‘z’ if they heard /z/). Finally, this issue was addressed by including extra instructions and example questions at the start of the test which explicitly stated that participants should take care to write down what they heard as closely as possible, and for example to “mind the difference between z and s”. More information on the instructions and questions of the survey can be found in Appendix B.

3.3 Procedure

The participants were asked to fill in an online task in the form of a survey, which was set up using the program Qualtrics. The instructions for the task were presented in the survey, for which an anonymous link was distributed via email. The participants could complete online survey on their own device and there was no set time limit in which the survey had to be completed. After reading the instructions for the survey and consenting to the use of the data, the participants could continue to the first part of the survey. The first part of the consisted of the task, which included a combination of audio files and open questions. The participants would first listen to an audio fragment, which consisted of a non-word with a consonant cluster in word-initial position. These fragments were presented using an embedded player from the online music streaming service SoundCloud (https://soundcloud.com/). After listening to the fragment, the participants were asked to fill in the first syllable, writing down what they heard as closely as possible. The following syllables of the word were given. The participants were prompted to ignore any rules they had learned about Italian spelling. In order to ensure they all knew what was expected of them, there were two example questions in which the answers were already given. The audio fragments for the examples were ‘zbaro’ and ‘prentare’. The format of the example questions can be found in (1), the format for the task items can be found in (2).

(1) Listen once to the audio fragment and fill in the first syllable. Write down what you hear as closely as possible.
<fragment 1>
zbaro

(2) Listen once to the audio fragment and fill in the first syllable. Write down what you hear as closely as possible.
<audio fragment>
____tire

After the two example questions, the participants could continue to the task, which consisted of 75 items divided over 5 pages of 15 items. The items were semi-randomly chosen so that only 5 or 6 target items were included per set of 15 items and they were accompanied by 9 or 10 filler items. The items within each set of 15 were automatically randomised. Following the online task, there were some questions regarding the linguistic background of the participants. The participants were asked which other languages they knew and to state for each of their languages: their age when they first started learning this language and their (self-rated) proficiency in this language at the moment of testing. Most of this data was only intended for group division, only the data for Italian was used for additional analyses. Care was taken not to include any questions that could link the answers to the survey to individuals and all responses were numbered to ensure anonymity. Only if a participant wished to take part in a prize draw as a reward for taking the effort to fill in the task, were they asked to submit their email address.

3.4 Analysis

The responses from the online task were analysed using several quantitative analyses. First the responses were rated on whether or not they were correct, i.e. corresponded with the intended spelling. This data was used to calculate accuracy scores (a dependent variable) for each of the two group (the independent variable). These accuracy scores were tested statistically using an ANOVA. The background information was used to see whether proficiency of Italian and time of studying Italian influenced the accuracy score.

The responses that differed from the intended answer were coded based on the strategy that was adopted to deal with the unknown phonotactics, following the outline by Davidson (2006). Within the category Segment change, the codes S1, S2 and S12 were used, based on whether the first, second or both of the consonants in the cluster was changed. The category Deletion distinguished between D1 or D2, in which D1 stands for deletion of the first consonant

of the cluster and D2 for the second consonant in the cluster. The category Insertion (coded I) was used when a character was placed between the two consonants of the cluster. Davidson used Prothesis when a learner produced a segment before the consonant cluster. As the current study dealt with perception rather than production, a response was included in this category if the participant wrote another character before the consonant cluster (coded P). Finally, it was possible that a response did not conform to the intended spelling, yet it did not fall into any of the other categories. These answers were placed in the category Other (coded O), which either meant that two strategies were used or that the response did not resemble the intended answer. Only the information on the first two consonants was taken into account, any deviations from the intended spelling in the vowels and consonants following the consonant cluster were ignored. These codes were used to calculate the frequency of each strategy (a dependent variable) for each group (the independent variable). This led to a distribution for the use of strategies for each group, i.e. the order of which strategy was used the most to the one that was used the least. The difference between the two groups with regard to the distribution of strategies was tested statistically using a chi-square test.

The difference between the groups was not the only independent variable that was used. Both dependent variables (the accuracy scores and the distribution of strategies) were also analysed based on the three consonant clusters that were used for the target items, i.e. /zb/, /zm/ and /zv/. This resulted in a mean accuracy score for each cluster, which was then also analysed based on the group division. These differences in accuracy scores were analysed using ANOVAs to see if there was a difference in the accuracy across each cluster (within a group) and between the groups. The distribution of the strategies for each consonant cluster was analysed per group to see if they followed the same order.

3.5 Pre-testing

Several measures had been taken to ensure that the testing and scoring were valid and reliable. Firstly, the audio materials, consisting of non-words resembling Italian, were rated based on the quality of the audio and the strength of the voicing of the word-initial consonants. Two independent raters, who had a background in phonology but not in Italian, as well as the present researcher individually rated the first two consonants of each item for voicing on a 5-point scale, in which 1 is voiceless and 5 is voiced. The consonants which were intended to be voiced (which

included all target items) scored on average 4 or above. The consonants which were intended to be voiceless (included in filler items) were rated as 1.7 or below. A summary of the ratings can be found in Appendix A. There were 8 consonants for which the raters did not all agree on the status of voice, which led to a score of 3.7 for these consonants, but only one occured in a target item. This target item was not deleted from the materials, as close analysis of the results showed that the participants did not have a problem with the voicing of this consonant.

Secondly, a pilot group was asked to complete the task to check the quality of the survey, which enabled the researcher to solve some technical problems before distributing the survey to the test group. The participants of the pilot group were learners of Italian as a third language, who had Dutch as their L1 and at least English as their L2. The data from the pilot group was also used to control for the reliability of the coding performed by the researcher. Two independent coders (not the same as the raters as for the level of voice, but with a similar background) coded the data from the pilot group on the same criteria as mentioned in subsection 3.4. A close analysis of the data showed that the only area in which the researcher differed from the other raters was on the use of ‘c’ instead of ‘k’. For example, the researcher coded ‘scarato’ as correct, while the other raters coded it as change of the second consonant, because it differed from the intended ‘skarato’. The reason for coding this as correct stemmed from personal communication with a native speaker of American English who wrote that, for an American, there would be no mistake that ‘c’ represented the sound /k/ in the items, as it was followed by a vowel. The reliability of the present researcher was determined using the Intraclass Correlation Coefficient, which was significant with an average measures *ICC* of .91, with a 95% confidence interval from .55 to .99 ($F(3,6) = 14.70$, $p < 0.01$). This meant that the independent raters did not differ much from the present researcher, which shows an excellent reliability of the coding.

4 Results

This section describes the analyses of the data as were outlined in section 3.4. As described in section 3.2, the groups were divided unevenly with 36 participants in the group of second language learners and 13 participants who were learning Italian as a third language. For this reason, the data was additionally analysed with equal samples of 13 participants. In these analyses, the group of third language learners was compared to a subset of the second language learners, which was randomly selected using the 'select random sample of cases' function in the statistics programme SPSS. Subsection 4.1 describes the overall results of the survey, with 4.1.1 describing the results of the background part of the survey, 4.1.2 outlining the data and variables, and 4.1.3 describing the results on the filler items. Subsection 4.2 provides analyses for the overall accuracy scores per group, followed by subsection 4.3 which describes the distribution of strategies per group. Lastly, subsection 4.4 describes the accuracy scores and use of strategies separately for each consonant cluster.

4.1 Data

4.1.1 Background data

Participants were asked to fill in some background information at the end of the survey. The main purpose of this data was to determine whether a participant was studying Italian as a second or as a third language. However, participants were also asked to fill in some data on their study of Italian, namely for how long they had been studying Italian and to rate their proficiency of Italian on a scale of 1 – 5. The data on how long they had been studying Italian was divided into four categories: less than 6 months, between 6 months and 1 year, between 1 and 2 years, and more than 2 years. These categories were coded as 1 – 4 respectively. Answers on the background part of the survey were not obligatory. For the groups of L2 learners, only 25 out of the 36 participants provided information on their proficiency in Italian, and 32 specified how long they had been studying Italian. All L3 learners provided answers for all of the background questions, including the number of and which other languages they knew.

The L2 learners who rated their proficiency in Italian (N = 23) had a mean proficiency of 2.61 (SD = 1.03) and those who provided information on how long they had been studying Italian (N = 32) had an average of more than 1 year (M = 3.30, SD = 1.06). The L3 learners (N =

13) had a proficiency of Italian with a mean of 1.92 (*SD* = .95) and had been studying Italian on average for less than a year (*M* = 1.92, *SD* = 1.26). For this group the number of languages they knew (aside from American English and Italian) ranged from 1 to 3 (*M* = 1.39, *SD* = .65) and included two other Romance languages: French (*N* = 6) and Spanish (*N* = 7), two Germanic languages: German (*N* = 1) and Swedish (*N* = 1), a Slavic language: Russian (*N* = 1), and an Austroasiatic language: Vietnamese (*N* = 1). The randomly selected sample of L2 learners had mean proficiency of Italian of 2.38 (*SD* = 1.30) and had on average been studying Italian between 1 and 2 years (*M* = 3.00, *SD* = 1.16).

4.1.2 Data outline

In the survey participants were asked to write down the first syllable of auditory stimuli in the form of Italian non-words starting with a consonant cluster. There were in total 75 stimuli, out of which there were 23 target items, which started with a voiced sibilant (/z/) and were followed by a voiced consonant (either /b/, /m/ or /v/). Of the remaining 52 items, there were 4 non-target items which started with /s/ and 48 non-target items which started with either a voiced consonant (/b/ or /g/), or a voiceless consonant (/p/, /t/, /k/ or /f/) as the first segment and a liquid (/l/ or /r/) as the second segment. The responses of the participants were coded based on which strategy they used to cope with the new phonotactic information. There were 9 codes: C, S1, S2, S12, D1, D2, I, P, and O (see subsection 3.4 for more information). The independent variables in all analyses was the group division between second and third language learners. For the first analysis, the dependent variable was the accuracy score per participant or per item (described in subsection 4.2). For the second analysis, the dependent variable was the number of times a strategy was used (described in subsection 4.3). These analyses were also performed using the independent variable consonant cluster, which stood for the three target clusters /zb/, /zm/ and /zv/ (described in subsection 4.4).

4.1.3 Filler items

There were 48 non-target items, which started with either /b/, /g/, /p/, /t/, /k/ or /f/ and were followed by either /l/ or /r/ (with the exception of /tl/). All these clusters exist also in the L1 of the participants, so it was expected that both groups performed equally well on these items. There were no missing items in the non-target items. The accuracy scores presented here are the

percentages of responses that corresponded with the intended answer on the auditory stimuli. On average, the group of second language learners had an accuracy score of 84.32% (*SD* = 0.36) and the group of third language learners had an average accuracy score of 86.38% (*SD* = 0.34). The difference between these scores was statistically tested using an ANOVA. The outcome was not significant: F_1 (1,47) = .47, *MSE* = .01, *p* = .50, η^2 = .01; F_2 (1,94) = .36, *MSE* = .03, *p* = .55, $\eta^2 < .01$, meaning that both groups did not differ significantly with respect to the accuracy on non-target items, as was expected.

Table 3 shows the distribution per group of the strategies that were used to when the cluster was not perceived correctly, and the distribution is presented in percentages in figure 1. It can be seen that S1 was clearly preferred, and although most other strategies were also used by both groups, with the exception of the strategy changing both segments (S12), which was not used for non-target items. A chi square test was performed to test whether the groups showed a similar distribution of strategies. The outcome of this test was not significant: X^2 (6, *N* = 356) = 8.58, *p* = .20, which meant that the two groups did not differ in the pattern of strategies that was used to cope with known consonant clusters. As mentioned before, these consonant clusters also exist in the L1 (and L2) of the participants, so no differences between the groups were expected.

A separate analysis was performed on the 4 non-target items which started with /s/, which were included to ensure that the participants could perceive the difference between /z/ and /s/. Again, all these clusters also exist in the L1 of the participants, so it was expected that both groups performed equally well on these items. There were no missing items in these non-target items either. Four participants differed from the intended response, one of them by changing the second element for one item (‘sbe’ instead of ‘spe’ for ‘spetarsi’), another by deleting the second element in one item (‘sa’ instead of ‘ska’ for ‘skarato’) and a third by deleting the first element in one item (‘ka’ instead of ‘ska’ for ‘skarato’). A fourth participant differed on two of the non-target items who started with /s/ (‘sqa’ instead of ‘spe’ for ‘spetarsi’ and ‘scra’ instead of ‘ska’ for ‘skarato’). All other participants responded correctly to these non-target items which started with /s/ and were followed by either /p/, /t/ or /k/.

Table 3.

Use of strategies per group for non-target items

Code	L2	L3	Total
S1	198	66	264
S2	15	8	23
D1	14	5	19
D2	2	1	3
I	20	1	21
P	1	1	2
O	21	3	24
Total	271	85	356

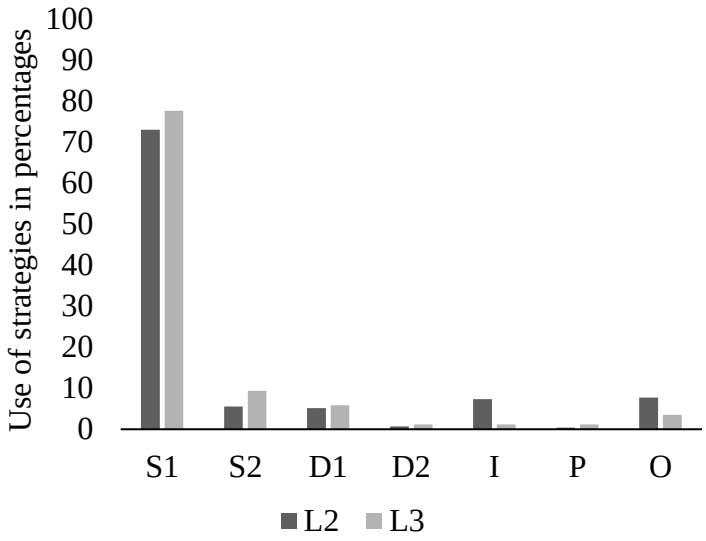

Figure 1. Overview of strategies per group for non-target items in percentages

Both the accuracy scores and the use of strategies were also analysed using equal samples of 13 participants. On average, the group of second language learners had an accuracy score of 80.01% (*SD* = 0.40) and the group of third language learners had an average accuracy score of 86.38% (*SD* = 0.34). The difference between these scores was statistically tested using an ANOVA. Again, the outcome was not significant: F_1 (1,24) = 2.74, *MSE* = .01, *p* = .11, η^2 = .01; F_2 (1,94) = 2.90, *MSE* = .03, *p* = .09, η^2 = .03. Table 4 shows the distribution of the strategies that were used per group using equal samples, and figure 2 visualises this by portraying the data in percentages. A chi square test was performed to test whether the groups showed a similar distribution of strategies. The outcome of this test was also not significant: X^2 (6, *N* = 209) = 6.37, *p* = .038, which meant that there was still no difference between the second

and third language learners in accuracy and use of strategies, even when the sample sizes were equal.

Table 4.

Distribution of strategies per group for non-target items using equal samples

Code	L2	L3	Total
S1	89	66	155
S2	11	8	19
D1	6	5	11
D2	0	1	1
I	8	1	9
P	1	1	2
O	9	3	12
Total	124	85	209

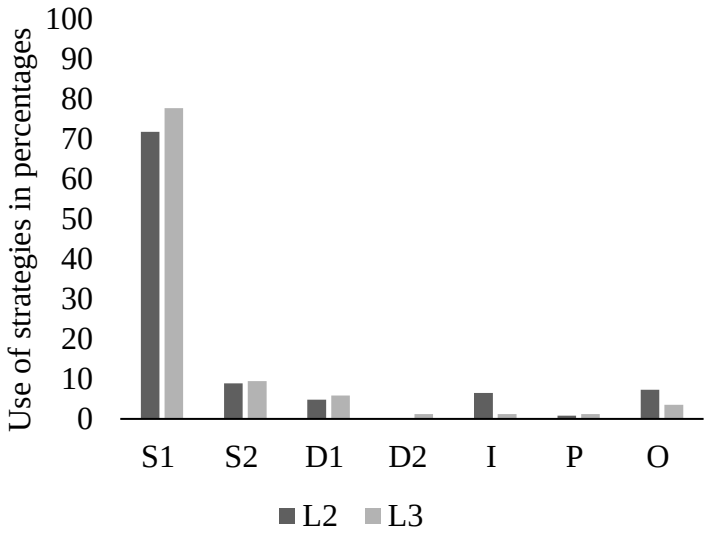

Figure 2. Overview of strategies per group for non-target items in percentages using equal samples

4.2 Target accuracy scores

There were 23 target items, which started with a voiced sibilant (/z/) and were followed by a voiced consonant (either /b/, /m/ or /v/). These clusters do not exist in American English (L1 for both groups of participants) or in the L2s of the group of third language learners (except for the one L3 learner who also spoke Russian, this case is analysed further in section 5). As this

was all new information, transfer from other languages was not expected. However, based on Cenoz's (2003) account of 'novice' second language learners and 'expert' third language learners (Cenoz, 2003, pp. 80), it was expected that the group of third language learners would be more accurate on the acquisition of new phonotactic knowledge than second language learners.

On average, the group of second language learners had an accuracy score of 25.39% (*SD* = 0.44) and the group of third language learners had an average accuracy score of 37.79% (*SD* = 0.49). The difference between these scores was statistically tested using an ANOVA, which was only significant in the analysis by items: F_1 (1,47) = 1.75, *MSE* = .08, p = .19, η^2 = .04; F_2 (1,44) = 9.91, *MSE* = .02, p < .01, η^2 = .18. This meant that no statistically significant difference between the groups of second and third language learners was found based on the accuracy scores of the target items. An additional test was performed to see whether there was a correlation between the proficiency, time spend studying Italian and the number of correctly perceived consonant clusters. There were no correlations found between proficiency of Italian and percentage of correct responses: r = -.08, p = .62, and length of studying Italian and percentage of correct responses: r = -.18, p = .24.

The analyses were also performed using equal samples of 13 participants. On average, the group of second language learners had an accuracy score of 26.42% (*SD* = 0.44) and the group of third language learners had an average accuracy score of 37.79% (*SD* = 0.49). The difference between these scores was statistically tested using an ANOVA, ad again only the outcome of in the analysis by items was significant: F_1 (1,24) = 1.06, *MSE* = .08, p = .31, η^2 = .04; F_2 (1,44) = 7.02, *MSE* = .02, p = .01, η^2 = .138. An additional test was performed to see whether there was a correlation between the proficiency, time spend studying Italian and the number of correctly perceived consonant clusters. Again, there was no correlation found between proficiency in Italian and percentage of correct responses: r = -.08, p = .74. Analysing equal samples suggested a different pattern with regard to length of studying Italian, as now there was a moderate negative correlation between length of studying Italian and percentage of correct responses. However, this result missed significance: r = -.31, p = .15.

4.3 Target strategies

The responses of the participants were coded based on which strategy they used to cope when they did not perceive the consonant cluster correctly. A null hypothesis presumed no difference between the group of second and the group of third language learners. There were 9 codes: C for correct (which was used only to calculate the accuracy scores and was left out in these analyses), S1, S2 or S12 for segment change of either the first or second segment or both, D1 or D2 for deletion of the first or second element respectively, I for insertion, P for prothesis, O for other. The division of these strategies for the target items can be found in table 5 and is visualised in percentages in figure 3. It shows that all strategies were used by both groups of participants. A chi square test was performed to test whether the groups showed a similar distribution of strategies. The outcome of this test was not significant, X^2 (6, N = 766) = 4.10, p = .66, which meant that the two groups did not differ in the pattern of strategies that were used to cope with unknown consonant clusters, which provided evidence for the null hypothesis.

Table 5.

Distribution of strategies per group for target items.

Code	L2	L3	Total
S1	447	149	596
S2	11	2	13
S12	58	15	73
D1	34	9	43
D2	12	3	15
I	11	2	13
P	12	1	13
O	32	5	37
Total	617	186	803

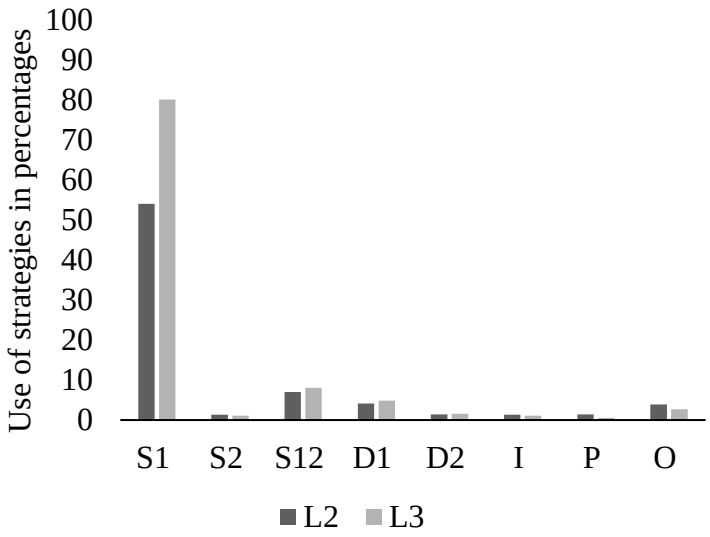

Figure 3. Overview of strategies per group for target items in percentages

The distribution of the strategies for the equal samples can be found in table 6 and visualised in percentages in figure 4. The chi-square analysis was also performed using equal samples for both groups, but the outcome was not significant, X^2 (6, N = 387) = 12.33, p = .06, which meant that the two groups did not differ in the pattern of strategies that were used to cope with unknown consonant clusters. This meant that the data supported the null hypothesis, even when equal samples were used.

Table 6.

Distribution of strategies per group for target items using equal samples.

Code	**L2**	**L3**	**Total**
S1	140	149	289
S2	3	2	5
S12	22	15	37
D1	24	9	33
D2	8	3	11
I	6	2	8
P	3	1	4
O	14	5	19
Total	220	186	406

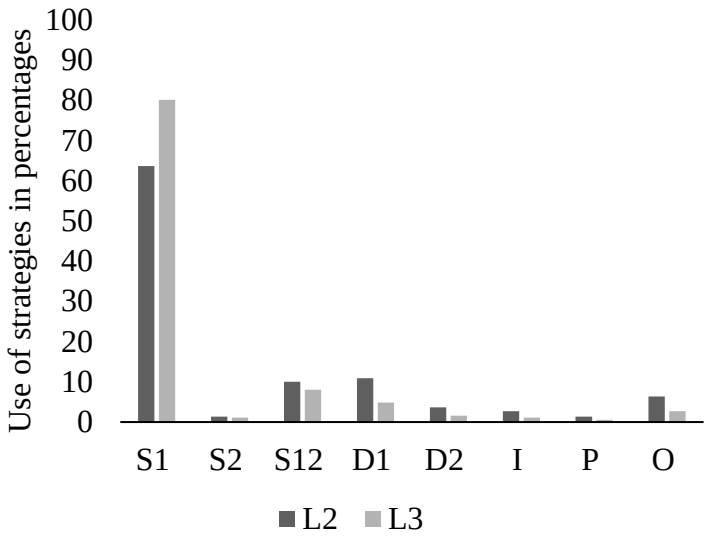

Figure 4. Overview of strategies per group in percentages using equal samples

4.4 Target consonant clusters

There were three consonant clusters used for the target items: /zb/, /zm/ and /zv/. Following the sonority sequencing principle, it was hypothesised that both groups of participants would be most accurate on /zm/ clusters, followed by /zv/ clusters and would be least accurate on /zb/ clusters. A null hypothesis predicted that there would be no difference between groups and that the use of strategies would show the same pattern across all three consonant clusters.

On average, the group of L2 learners had an accuracy score of 28.47% (*ST* = 0.45) for the /zb/ clusters, 32.14% (*ST* = 0.47) for the /zm/ clusters, and 16.38% (*ST* = 0.37) for the /zv/ clusters. On average, the group of L3 learners had an accuracy score of 35.58% (*ST* = 0.48) for the /zb/ clusters, 52.75% (*ST* = 0.50) for the /zm/ clusters, and 26.92% (*ST* = 0.45) for the /zv/ clusters. An ANOVA was performed to statistically analyse the differences in accuracy scores between the three consonant clusters within the group of L2 learners. The outcome was only significant in the by item analysis: F_1 (2,105) = 2.389, *MSE* = .10, *p* = .10, F_2 (2,20) = 6.00, *MSE* = .01, *p* < .01. The same was done for the differences between the consonant clusters within the group of L3 learners, which was also only significant in the by item analysis: F_1 (2,36) = 1.840, *MSE* = .12, *p* = .17, F_2 (2,20) = 10.09, *MSE* = .01, *p* < .01. ANOVAs were also performed for each individual consonant cluster to compare the difference in accuracy between the group of second and third language learners. Most of the outcomes were not significant, only the by item analyses for the /zm/ and /zv/ clusters: for /zb/ F_1 (1,47) = 0.385, *MSE* = .13, *p* = .54,

F_2 (1,14) = 1.28, *MSE* = .02, p = 0.28, for /zm/ F_1 (1,47) = 3.491, *MSE* = .12, p = .07, F_2 (1,12) = 24.51, *MSE* = .01, $p < .01$, and for /zv/ F_1 (1,47) = 1.296, *MSE* = .08, p = .26, F_2 (1,14) = 4.70, *MSE* = .01, $p < .05$.

The distribution of strategies per consonant cluster for the L2 learners can be found in table 7 and visually in percentages in figure 5. It shows that all strategies were used, as was also seen in subsection 4.3, but not all strategies were used for all consonant clusters. In /zb/ clusters, participants never deleted the second segment (D1), and in /zv/ clusters participants never inserted a segment between or before the two consonants of the cluster (I or P). It can also be seen that the use of S1 is high for all three consonant clusters, especially for /zv/ clusters, and the use of S12 is very low for /zm/ and /zv/, but relatively high for /zb/. The most used strategy for all consonant clusters is change of the first consonant and the use of all other strategies is relatively low, with the exception of change of both consonants for /zb/ clusters.

Table 7.
Distribution of strategies per consonant cluster for the L2 learners

Code	**/zb/**	**/zm/**	**/zv/**	**Total**
S1	127	126	194	447
S2	3	1	7	11
S12	53	3	2	58
D1	4	10	20	34
D2	0	5	7	12
I	5	6	0	11
P	2	10	0	12
O	12	10	10	32
Total	206	171	240	617

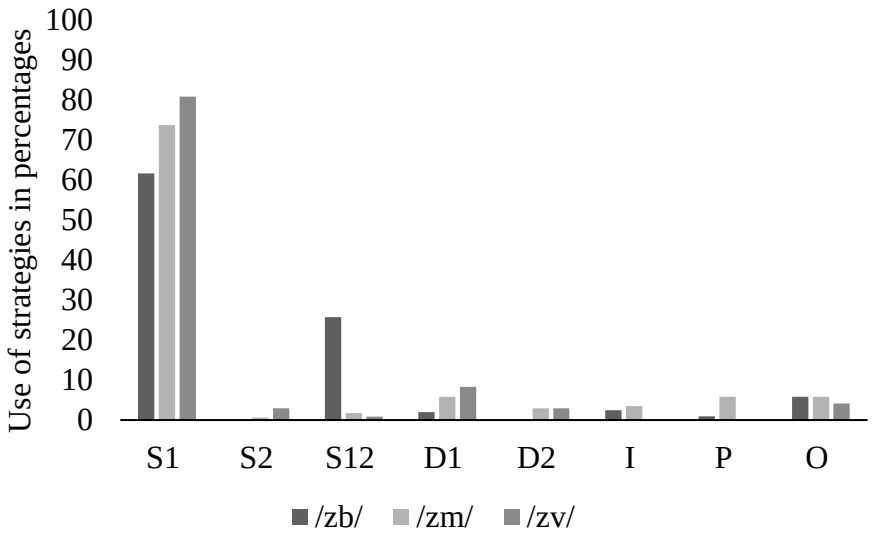

Figure 5. Overview of strategies per consonant cluster in percentages for the L2 learners

Table 8 describes the distribution of strategies per consonant cluster for the L3 learners, which can be found in percentages in figure 6. Again, all strategies were used, but not all strategies were used for all consonant clusters. The use of S1 was high for all clusters. All other strategies occurred only 2 times or less, with the exception of S12 for /zb/ and D1 and O for /zv/.

Table 8.

Distribution of strategies per consonant cluster for the L3 learners

Code	**/zb/**	**/zm/**	**/zv/**	**Total**
S1	49	37	63	149
S2	1	0	1	2
S12	14	1	0	15
D1	2	1	6	9
D2	0	1	2	3
I	0	2	0	2
P	0	0	1	1
O	1	1	3	5
Total	67	43	76	186

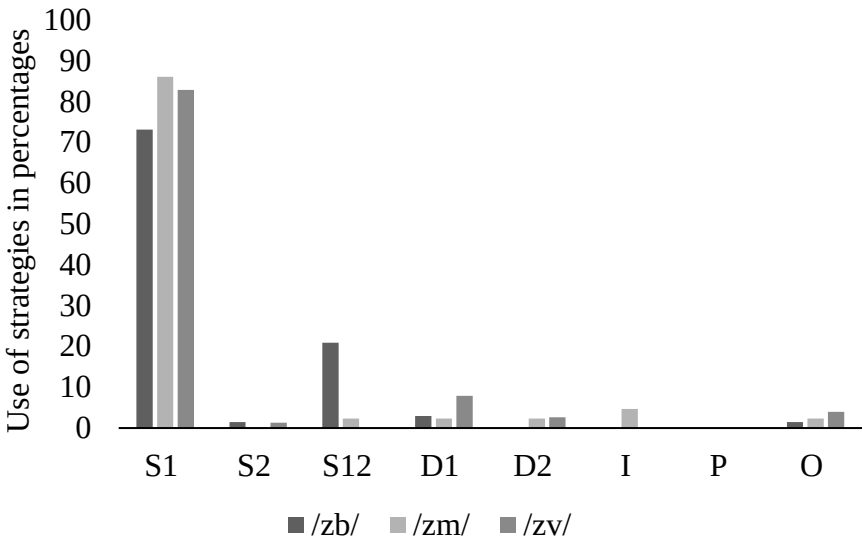

Figure 6. Overview of strategies per consonant cluster in percentages for the L3 learners

As was the case for all analyses described in this section, the analyses per consonant cluster were also performed using equal samples of 13 participants for both groups. The randomly selected sample of L2 learners had a mean accuracy score of 32.69% (*ST* = 0.47) for the /zb/ clusters, 43.41% (*ST* = 0.50) for the /zm/ clusters, and 21.63% (*ST* = 0.41) for the /zv/ clusters. The same data was used for the L3 learners with a mean accuracy score of 35.58% (*ST* = 0.48) for the /zb/ clusters, 52.75% (*ST* = 0.50) for the /zm/ clusters and 26.92% (*ST* = 0.45) for the /zv/ clusters. An ANOVA was performed to statistically analyse the differences in accuracy scores between the three consonant clusters within the randomly selected sample of L2 learners. The outcome was again only significant for the by items analysis: F_1 (2,36) = 1.14, *MSE* = .10, p = .33, F_2 (2,20) = 4.49, *MSE* = .02, $p < .05$. As seen earlier, the same was the case for the L3 learners: F_1 (2,36) = 1.840, *MSE* = .12, p = .17, F_2 (2,20) = 10.09, *MSE* = .01, $p < .01$. The ANOVAs for each individual consonant cluster were repeated using the data from the equal samples to compare the difference in accuracy between the group of second and third language learners. Which led to roughly the same outcome as for the complete groups: for /zb/ F_1 (1,24) = 0.161, *MSE* = .14, p = .69, F_2 (1,14) = .65, *MSE* = .02, p = .44, for /zm/ F_1 (1,24) = 2.02, *MSE* = .11, p = .17, F_2 (1,12) = 14.95, *MSE* = .01, $p < .01$, and for /zv/ F_1 (1,24) = .88, *MSE* = .08, p = .36, F_2 (1,14) = 3.94, *MSE* = .01, p = .07.

The use of strategies per consonant cluster for the randomly selected sample of L2 learners can be found in table 9 and represented visually and in percentages in figure 7. The overall distribution of the strategies was relatively similar, although there were more cases of a strategy not being used for a certain consonant cluster. This can be explained by the smaller number of participants in this sample. There was one strategy that showed a different pattern for this randomly selected sample compared to the data of the complete group of L2 leaners, which was deletion of the first consonant. While the spread of this strategy was relatively similar in the complete group of L2 learners, here the differences between the clusters were more pronounced. Another difference was that, percentage-wise, it was used the most for /zm/ cluster here, while this was for /zv/ clusters in the data of the complete group of L2 learners.

Table 9.

Distribution of strategies per consonant cluster for the L2 learners using equalsamples

Code	**/zb/**	**/zm/**	**/zv/**	**Total**
S1	40	39	61	140
S2	0	0	3	3
S12	20	1	1	22
D1	4	10	10	24
D2	0	3	5	8
I	5	1	0	6
P	0	3	0	3
O	4	3	7	14
Total	73	60	87	220

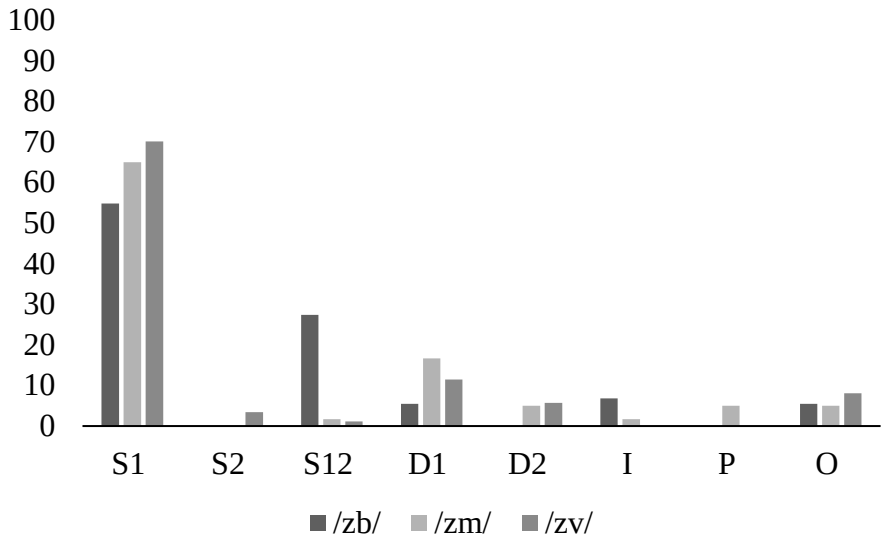

Figure 7. Overview of strategies per consonant cluster in percentages for the L2 learners using equal samples

In summary, the data was analysed based on the overall accuracy scores, the accuracy scores per consonant cluster, the overall distribution of strategies used to cope with the unknown consonant clusters, and the distribution of these strategies per consonant cluster. ANOVAs were used to compare the second and third language learners based on the overall accuracy scores and the accuracy scores per consonant cluster. However, most outcomes were not significant, with the exception of some in the by items analysis. A chi-square test was performed to compare the overall distribution of strategies per group, but again the outcome was not significant. As the sample sizes differed per group (for L2 $N = 36$, for L3 $N = 13$), a randomly selected sample ($N = 13$) of the data of the L2 leaners was taken and compared to the data of the L3 learners. The same analyses were performed, but this did not change the outcomes of the ANOVAs with regard to significance. The influence of proficiency in Italian and time spend studying Italian was tested, but no significant correlations were found between these factors and the overall accuracy scores.

5 Discussion

This study looked at the accuracy of the acquisition of consonant clusters by second and third language learners of Italian. Participants were asked to perform a task in which they first listened to non-words (target items started with the clusters /zb/, /zm/ or /zv/), after which they were asked to write down the first syllable of that non-word. The results of this task were described in section 4. The current section discusses the implications of the results, starting with subsection 5.1 in which the accuracy scores are described, and which provides possible explanations for the non-significant results, followed by subsection 5.2 which summarises the results on the use of strategies to cope with unknown consonant clusters. Subsection 5.3 gives a qualitative analysis of these strategies by describing which the types of responses were found for each strategy. Finally, subsection 5.4 discusses some problems with the current study and provides suggestions for further research.

5.1 Comparison of accuracy scores for L2 and L3 learners

This study aimed to answer the question whether there was a difference between second and third language learners in the accuracy with which they acquired consonant clusters that were not present in their L1 (and L2s). The clusters were taken from Italian. Specifically, this study looked at word-initial consonant clusters that started with the voiced fricative /z/ and were followed by the voiced consonants /b/, /m/, and /v/. It could be seen in section 4 that the accuracy scores on these target clusters were relatively low, with a mean accuracy score of 25.39% for the L2 learners and 37.79% for the L3 learners. This means that both groups gave a correct response on less than half of the target items. As the participants were already in the process of acquiring Italian, higher accuracy scores were expected, although it was expected that the participants would make some mistakes on these clusters, as they did not have any experience with them through their other language(s). On comparison, the L2 learners had a mean accuracy score of 84.32% on the filler items, which started with consonant clusters that exist in their L1 (for example /bl/) and the L3 learners had a mean accuracy score on the filler items of 86.38%. This shows that there was a large difference in accuracy scores on the acquisition of consonant clusters that were known through the L1 (and L2s) and those that were not, as both groups clearly performed worse on the new consonant clusters than on the known consonant clusters.

As mentioned before, the current study dealt with a phonotactic feature that does not occur in the L1 or L2(s) of the participant (with the exception of one L3 learner who also acquired Russian, who will be discussed later in subsection 5.4). This meant that a large portion of the existing literature could not be used for any predictions for this study. Instead, the hypothesis for the overall accuracy scores was based on the general idea that "expert" third language learners have access to more explicit learning strategies than "novice" second language learners (Cenoz, 2003, pp. 80). It was thus predicted that the group of third language learners would be more accurate in the acquisition of the Italian phonotactic knowledge than second language learners. This idea can be linked to one of the models of crosslinguistic influence, namely the Cumulative Enhancement Model (Flynn, Foley, & Vinnitskaya, 2004). Although of course the current study did not expect any transfer to occur, the hypothesis ties in with the fundamental idea of the CEM that the experience of acquiring languages builds up, and can lead to an advantage over those who have not learned an additional language aside from their L1.

As said before, the hypothesis stated that the group of third language learners would be more accurate in the acquisition of the Italian phonotactic knowledge than second language learners. The average accuracy scores showed a difference of more than 10 percent in favour of the third language learners, which would support the hypothesis. However, the difference between the two groups was tested statistically using an ANOVA, and the outcome was not significant. This means that the data in this study showed a trend in the direction that was predicted in the hypothesis, but did not fully support it, i.e. there was no significant difference found between second and third language learners with regard to the accuracy of acquisition of new phonotactic knowledge.

The mean accuracy scores were also analysed with regard to the three consonant clusters. The hypothesis for this analysis was made on the basis of the sonority sequencing principle, which "maintains that sonority should be highest at the syllable peak [vowel] and become progressively lower toward the syllable margins" (McCrary Kambourakis, 2007, pp. 13). Following the sonority sequencing principle, it was predicted that the two groups would be most accurate in /zm/ clusters, followed by /zv/ clusters and would be least accurate in /zb/ clusters. Since there was a difference between the two groups in overall accuracy scores, this was also the case for the scores per consonant cluster. For /zb/ clusters, the L2 learners had a mean accuracy score of 28.47% and the L3 learners had a mean accuracy score of 35.58%. For /zm/ clusters, the

L2 learners had a mean accuracy score of 32.14% and the L3 learners had a mean accuracy score of 52.75%. For the /zv/ clusters, the L2 learners had a mean accuracy score of 16.38% and the L3 learners had a mean accuracy score of 26.92%. This means that, by looking only at the mean accuracy scores, both groups were the most accurate on /zm/ clusters, as was predicted by the sonority sequencing principle. On /zv/ and /zb/ clusters, however, the hypothesis did not hold. An ANOVA was performed on the mean accuracy scores for the three consonant clusters, which did not show a significant difference, i.e. accuracy scores were similar for each consonant cluster. This was the case both the L2 and the L3 learners.

The lack of a significant difference is striking, because only the /zm/ cluster was predicted in the sonority sequencing principle. The fact that there was no significant difference between the accuracy scores for the three consonant clusters contradicts the sonority sequencing principle, as one would have expected at least a significant difference between /zm/ and the other two clusters that do not follow the sonority sequencing principle. Morelli (2003) also questioned the sonority sequencing principle, which they claimed was at that point still "fairly uncontroversial" (pp. 356). They started their article by pointing out that, on the one hand, consonant clusters that are not allowed following the sonority sequencing principle are still attested in languages (for example the /zb/ and /zv/ clusters in this study), and on the other hand the sonority sequencing principle allows for certain consonant clusters (for example "Stop + Sonorant" (Morelli, 2003, pp. 357)) that are not attested in any languages. Some of the predictions of the sonority sequencing principle, however, still hold, as the mean accuracy scores do show a difference between the /zm/ cluster which is allowed following the sonority sequencing principle and the two clusters which are not allowed. This was especially clear for the L3 learners, with 53 percent on /zm/ clusters compared to 36 and 27 percent for the /zb/ and /zv/ clusters respectively. It is therefore not too surprising that the order of /zb/ and /zv/ was reversed compared to the hypothesis, and not /zm/ with one of the other clusters. However, the fact remains that no statistically significant difference was found between the three consonant clusters, which means that the hypothesis based on the sonority sequencing principle was not supported by the data of this study.

In an additional analysis this study also took two background factors into account that could potentially have influenced the accuracy scores, namely proficiency in Italian and time spent studying Italian. The group of L2 learners had a mean proficiency of 2.61 and had been

studying Italian on average for more than 1 year. The group of L3 learners, on the other hand, had a mean proficiency of 1.92 and had been studying Italian on average for less than a year. While no correlation was found between the accuracy scores, proficiency and time spent studying Italian, the difference between the groups still left some questions to be answered. In light of the proficiency scores, it is even more striking that the accuracy scores per group were relatively low. This means that, after over two years of studying, and with an intermediate proficiency in Italian, the group of second language learners still only gave a correct response to one in four of the target items. Although the group of third language learners performed better, they gave a correct response in only less than half of the target items. The data showed, then, that there was a difference, although not significant, between the mean accuracy scores of the L2 and L3 learners in the favour of the L3 learners, but the difference in proficiency between the groups was in favour of the L2 learners. The question remains, then, whether the difference between the two groups with regard to accuracy scores would have been significant, if the two groups had had a more similar proficiency in Italian.

5.2 Comparison of use of strategies by L2 and L3 learners

As mentioned before, the analysis of strategies used to cope with unknown consonant clusters was taken from Davidson (2006), who found that Insertion was the most used strategy across all consonant clusters, followed by smaller peaks for Prothesis and Segment change for clusters starting with /z/. No other studies with regard to the use of strategies had been done that better suited the current study. So, although the participants and methodology of Davidson's study was not comparable to the current study, the result was still used as a null hypothesis, namely that the most used the strategy would be Insertion the most, followed by Prothesis and Segment change, with only marginal use of the rest of the strategies. As there were no studies with regard to strategies and second and third language learners, a null hypothesis presumed no difference between the groups. Lastly, as Davidson did not specify the use of strategies per consonant cluster (only grouped by the consonant in initial position), again a null hypothesis presumed no difference between the three target clusters, i.e. the order of most used strategy would be the same for all three clusters.

As could be seen in subsection 4.3, the data of this study showed a different picture with regard to the first hypothesis. The most used strategy was not Insertion but Segment change, and

specifically change of the first segment. Insertion and Prothesis were, in fact, the least used strategies: they each formed less than 5 percent of the total use of strategies per group. Figure 4 showed an overview of strategies per group in percentages (using equal samples for a more honest comparison). Segment change was clearly the most used category for strategies used to cope with unknown consonant clusters. The largest part of the use of this category was made up by change of the first segment, with 64 percent for the L2 learners and 80 percent for the L3 learners. It can thus be said that the current study showed a different distribution of strategies than the study by Davidson (2006). A possible explanation for this could be the difference between production data by Davidson and perception data in the current study. In production data, the articulatory settings influence the outcome, where this is not the case in perception data. This was also the reason why Altenberg (2005) used three tests to analyse the phenomenon that can generally be observed in the production of L2 English by native speakers of Spanish. They found that it was indeed the problem with articulatory settings that caused this phenomenon, and that this was not due to problems with grammatical judgement or perception. Davidson (2006) also performed a second analysis, aside from the analysis of the strategies, and looked closely at the sound that was most commonly inserted between the consonants of the cluster. They found that this sound was not a fully intended vowel, but rather a result of problems with the articulatory settings as the participants did not have any experience with producing these clusters and left a gap between the two consonants. These problems with articulatory settings do not play a role in perception data, which is likely the reason why Insertion was less used in the current study than in the study by Davidson.

Another area in which the current study differed from the one by Davidson (2006), is the type(s) of participants that were used. Davidson looked at “naïve non-native listeners” (Best & Tyler, 2003, pp. 7) who did not have any previous experience with the language that they were asked to produce in the task. The participants were monolingual speakers of English, who had no previous experience with Czech. The current study, on the other hand, looked at “L2 learning listeners” (Best & Tyler, 2003, pp. 9). What Best and Tyler mean by this terminology is that this latter group of listeners already has some experience with the language as they are in the process of acquiring it, while for the first group it is their first encounter with the language. Of course, the current study also looked at L3 learners rather than only L2 learners, but the distinction between the first encounter and already having experience with the language still holds.

However, as there is as of yet no other literature with regard to second and third language learners and the use of strategies for new phonotactic knowledge, more research still needs to be done before the difference in results between Davidson's study and the current study can be analysed further.

While it was predicted that the second language learners would overall make more use of strategies to cope with unknown consonant clusters than third language learners, no difference between the groups was predicted with regard to the distribution of these strategies. This meant that both groups would follow the order Insertion – Prothesis/Segment change – rest of the strategies. As described earlier, this order was not found in the data. However, both groups did follow the order Segment change – Deletion – rest of the strategies, although the peak for Deletion was stronger for the L2 learners than for the L3 learners. While the groups followed the same order, they differed in the use of specific strategies. For example, for the L2 learners the strategy S1 made up 64 percent of the total use of strategies, while this was 80 percent for the L3 learners. The differences in cases for each strategy were tested statistically using a chi-square test. The outcome of this test was, however, not significant. This means that the data in this study supported the hypothesis that there would be no difference between second and third language learners with regard to the distribution of the strategies used to cope with unknown consonant clusters.

No difference was also predicted with regard to the distribution of strategies across consonant clusters, i.e. that the order of most used strategies would be the same for /zb/, /zm/ and /zv/ clusters. The category Segment change was used most often across all consonant clusters, with for the L2 learners 87 percent of the total use of strategies for the /zb/ clusters, 76 percent for the /zm/ clusters and 85 percent for the /zv/ clusters. For the L3 learners, this category made up 96 percent of the total use of strategies for /zb/ clusters, 88 percent for the /zm/ clusters and 84 percent for the /zv/ clusters. The distribution of the strategies per group in percentages could be seen in figures 5 and 6, which showed that there were differences in the use of strategies per consonant cluster, for example the peak in S12 for /zb/ clusters. These differences were tested using an ANOVA, but the outcome was not significant. This means that the data in this study supported the hypothesis that the distribution of strategies would the same for all three consonant clusters.

5.3 Qualitative analyses of strategies

This subsection describes in detail what kind of responses were given for each strategy and how this was distributed between the two groups and across the three consonant clusters. Subsection 4.3 described the distribution of strategies per group for target items. In total, the category Other was used 37 times: 32 times for the group of L2 learners, 5 times for the L3 learners. Out of the 32 times this code was used for the L2 learners, there were 20 cases were the response that did not resemble the intended answer (for example ‘sat’ instead of ‘zbi’ for ‘zbieno’). In the other 12 cases, two strategies were used (for example ‘esma’ instead of ‘zma’ for ‘zmasto’, where both Prothesis and Segment change were used). There were 6 cases where there was a combination of Segment change (S1) and Insertion was used, where the inserted character was ‘v’ (for example in ‘svma’ instead of ‘zma’ for ‘zmatarsi’). Out of the 5 times Other was used for the L3 leaners there were two cases in which the response did not resemble the intended answer and 3 cases where two strategies were used, of which one cases was v-insertion. These cases of v-insertion are discussed later in this subsection. The use of Other was spread evenly across the three consonant clusters for the group of L2 learners, with 12 cases for /zb/, 10 cases for /zm/ and 10 cases for /zv/.

There were three codes within the category Segment change: S1 for change of the first consonant, S2 for change of the second consonant and S12 in those cases where both consonants were changed. There were in total 596 cases of S1, 13 cases of S2 and 73 cases of S12. In all cases of S1 and S12 the first segment, the voiced consonant /z/, was replaced by its voiceless counterpart /s/ (for example ‘sba’ instead of ‘zba’ for ‘zbario’). In 54 of the 73 cases of S12 the second consonant was changed into its voiceless counterpart (for example ‘spu’ instead of ‘zbu’ for ‘zbutarsi’). These cases occurred mostly for the /zb/ cluster. Out of the 13 cases of S2, there were 6 cases where the consonant was replaced by its voiceless counterpart, which were equally distributed across the /zb/ and /zv/ clusters. For the L2 learners, there were 447 cases of S1, 11 cases of S2 and 58 cases of S12. The use of Segment change was not spread evenly across the three consonant clusters, with 183 cases for /zb/ clusters, 130 cases for /zm/ clusters and 203 cases for /zv/ clusters. For the L3 learners, there were 149 cases for S1, 2 cases of S2 and 15 cases of S12. Here the use of Segment change was spread more evenly across all three consonant clusters, with 64 cases for /zb/ clusters, 38 cases for /zm/ clusters and 64 cases for /zv/ clusters.

The analyses of the responses that were coded as Deletion, Insertion and Prothesis can be found in Appendix C. This appendix describes for example which characters were inserted between or before the consonants of the clusters and how these cases were distributed across the three consonant clusters. One striking phenomenon must be named here, namely the cases of s-prothesis. In these cases, the participants inserted the voiceless sibilant ‘s’ before the voiced consonants of the clusters, which resulted in a construction where a voiceless sound was followed by a voiced consonant cluster (for example ‘szva’ instead of ‘zva’ in ‘zvato’). The same construction was found in the v-insertion cases in Other. It seems that in these cases participants perceived some form of voice in the cluster but not the intended clusters /zb/, /zm/ or /zv/. A likely reason why they opted for a construction where ‘s’ was followed by the voiced cluster is that, in many languages (including English), when there is a cluster of three characters in word-initial position, the first segment is always the voiceless sibilant /s/ (for example /str/ in ‘strike’). A similar phenomenon occurs in word-final position, where the /s/ is the last segment (for example in the plural ‘parts’). /s/ thus has the ability to appear in the outside positions of triconsonantal clusters, while this is not possible for other consonants (see also Boyd, 2006, on the structural representation of these clusters starting with /s/). It is still unclear why the participants opted for the construction of three consonants instead of a two-character cluster, for example a voiceless cluster by changing the first segment into ‘s’ or a voiced cluster as was intended. The cases of v-insertion raise even more questions, as here the character that was inserted does not resemble any of the sounds in the clusters (for example ‘svma’ instead of ‘zma’ in ‘zmatarsi’). As mentioned before, it seems likely that participants were not able to perceive the clusters correctly, but still needed a way to represent the voicing they heard. Unfortunately, on the basis of the data in this research, no further speculation can be done, and further research is needed to provide an answer for this issue.

In summary, it could be seen that, if the first consonant was changed (S1 and S12), it was always replaced by its voiceless counterpart ‘s’. Voice also played a role when the second consonant was changed (S2 and S12), as in more than half of these cases the consonant was changed into its voiceless counterpart. For Prothesis and Other, there were some striking cases where the inserted character resulted in a construction where a voiceless sibilant was followed by two voiced consonants.

5.4 Problems with this study and suggestions for further research

There were several issues in this study that require some additional attention. As mentioned in subsection 3.2, the size of the group of second language learners ended up larger (more than double) than the group of third language learners. This was likely a result of the way in which the participants were gathered. Rather than actively searching for two groups, one for learners of Italian as a second language and another for learners of Italian as a third language, participants were reached via the Italian studies programmes at various American colleges or universities. The division into the two groups was based on the information that was provided in the background part of the survey. It was felt that explicitly stating that a survey would be open to those with knowledge of additional languages would lead to active influence from these earlier acquired languages. Unfortunately, the decision led in this study to uneven groups of participants. The influence of this was reduced by also performing all analyses with a subset of the data from the second language learners, so there were two equal samples of 13 participants. However, the results from these analyses had low statistical power due to the small sample size, and ultimately also did not lead to significant results.

Because of the rather open way of selecting participants, there was also no selection based on the other languages for the group of learners of Italian as a third language. The only selection criteria that was applied on these participants was that they acquired their second language after the age of 6, i.e. that they did not grow up with two L1s. As there was no selection on which other languages this group knew, data was included of one participant who knew Russian, which is a language that also allows for the consonant clusters that were analysed in this study. This means that the consonant clusters were thus not unknown and the information could potentially be transferred from their L2, which means that this one participant could potentially have influenced the mean score of the L3 group (especially since the sample size was small). Fortunately, limited or no transfer seems to have occurred, as this participant had an accuracy score of 30.43%, which is lower than the mean accuracy score of the group of L3 learners (which was 37.79%). This participant did also not differ from the other participants in the group of L3 learners with regard to the strategies that were used, as 94% of the strategies was S1, and the other 6% was S12. If the results had been very different, i.e. if the accuracy score would have differed much from the other accuracy scores in the group of L3 learners, then this participant would have been excluded from the analyses as well. In this case, however, it was felt that there

was no need to exclude this participant, also taking into account that this group was already small before exclusion.

The largest hurdle in this research, which could in no way be avoided, was the Italian orthography of the clusters. While phonologically they all start with /z/, in the orthographic representation they start with ‘s’, as can be seen in the example that Sartarelli (1970) gives on the matter: the Italian word that is pronounced as “[zdentáto]” is orthographically represented as “sdentato” (pp. 21). Measures were taken to minimalize the influence of this difference in orthography as much as possible, with specific instruction stating that participants should “write down what they hear as closely as possible”, paying extra attention to matters such as “the difference between ‘s’ and ‘z’” and inclusion of non-target items starting with /s/ to ensure they heard the difference within the time spent on the task. However, the influence cannot be ruled out completely, especially given the outcome that, whenever the response did not conform to the intended answer, it was most often the case that the ‘z’ had been replaced with ‘s’. There is no way to find out whether a participant truly heard the voiceless /s/ (as is of course hoped), or if they heard the cluster correctly but still used the Italian orthographic representation of the sibilant.

On the one hand, the influence of orthography could have been larger than expected. Silveira (2009) looked at the influence of orthography in production by L2 learners and discussed studies that found a relation between written information in the task and pronunciation errors by participants. In their case study, Silveira collected free speech from a participant, and found that even in this context without orthographic input, the same errors could be found. As an explanation they refer to Young-Scholten and Archibald (2000) who claimed that, in a foreign language learning context, often the first contact learners have with the language is through written input. This basis in written input, and thus the orthographic representations, continued to influence the output of these learners even in contexts were no written input was present. The participants in the current study most likely experienced the same scenario, i.e. first encountered Italian mostly through written input. This could be a reason for assuming that the most used strategy (S1 from ‘z’ to ‘s’) was the result of the orthography of Italian, rather than what the participants actually heard. However, it can also be assumed that the participants were not able to perceive the voiced consonant clusters correctly. Firstly, because they were still in the process of acquiring Italian, they might not have acquired the new phonotactics correctly. The responses

given by the participants point in this direction, as the cases of v-insertion and s-prothesis make it seem more likely that they heard /s/ rather than /z/. In these cases, participants added the voiceless ‘s’ to the voiced cluster, which may mean that the participants actively looked for ways to incorporate a voiceless sound in their response. Unfortunately, at the present moment, no concluding answer to this issue can be given and further research is still needed in order to solve this issue.

A suggestion for this further research, which could possibly solve the issues described above (small samples sizes, 1 case of Russian L2 and the matter of Italian orthography), would be to perform the same study but with a production task instead of a perception task. It would still look at both second and third language learners of Italian, using the same consonant clusters, but instead of asking participants to write down what they heard, they would be asked to pronounce a given non-word. If this non-word was presented as auditory stimuli as well (in a repeat-after-me task, see Hammerberg, 2009, pp. 81), this would circumvent the issue with the Italian orthography. The study could also adopt a different approach to finding participants, which would allow for equal sample sizes and more control on the L2s of the participants in the group of third language learners. To get a close comparison to this perception study, the production study could ensure that none of the third language learners knew any Slavic languages, so all participants would be dealing with unknown consonant clusters. On the other hand, it would be very interesting to see if transfer would occur (potentially in relation to one of the three models on crosslinguistic influence), which could be a reason to include Slavic languages as L2s for this group of participants.

6 Conclusion

This study dealt with the larger topic of third language acquisition and L3 phonology, a young field of research which only has been gaining ground in the last few decades. Researchers in the field all agree that there is a difference between second and third language acquisition, as third language learners have more experience in learning in language, what Cenoz (2003) described as "novice" second language learners compared to "expert" third language learners (pp. 80). There is still, however, no consensus on the definition of a third language. One approach is to label all acquired languages chronologically, which allows for an L1, L2, L3 – Ln approach. Another approach allows for multiple L1 and multiple L2, depending on at which stage in life the language is learned (generally L1 before and L2 after puberty). In this approach, the L3 is the language that is currently being studied. The latter approach was adopted in this study.

In the field of third language acquisition, a large part of the research has focussed on crosslinguistic influence, resulting in three models, however few studies looked at differences in the acquisition processes of second and third language acquisition. Another gap in the literature, specific to L3 phonology, is that previous research in L3 phonology has largely focussed on the acquisition of segments, rather than looking at suprasegmental properties. This study combined these two aspect and attempted to fill the gap by trying to answer the question to what extend there was a difference in accuracy between second and third language learners with regard to the acquisition of new phonotactic knowledge. While most studies in general have looked at transfer from earlier acquired languages, this study looked at a phonotactic feature that was not present in either the L1 or the L2(s). It did so by looking at the acquisition of word initial consonant clusters in Italian that start with /z/ and were followed by a voiced consonant. The target clusters that were used in this study were /zb/, /zm/ and /zv.

The participants were all native speakers of American English who were in the process of acquiring Italian. The second language learners did not have any experience with learning a language outside of the L1 American English and their L2 Italian. The third language learners had learnt at least one other language outside of their L1 American English and their L3 Italian. These participants were asked to listen to auditory stimuli in the form of nonwords which started with the clusters described above and to write down what they heard as closely as possible. The responses on the task were analysed based on overall accuracy (per group and per consonant cluster), and the distribution of strategies used to cope with unknown consonant clusters. The

hypothesis with regard to overall accuracy scores was that the group of (expert) third language learners would perform better than the group of (novice) second language learners, but this could not be statistically supported by the data. With regard to the distribution of strategies, it was found that the most used strategy was Segment change, specifically S1. For the L2 learners, there was also a peak in the use of Deletion that was not found for the L3 learners, but this difference was not statistically significant, which supported the hypothesis that the groups would not differ in the distribution of the strategies that were used to cope with the unknown consonant clusters.

The accuracy scores and use of strategies were not only compared for the two groups but also across the three consonant clusters. It was predicted, based on the sonority sequencing principle, that both groups would be most accurate in /zm/ clusters, followed by /zv/ and /zb/ clusters. The /zm/ clusters were found as most accurate, but the prediction did not hold for the other two clusters. This could be explained since /zm/ was the only cluster that followed the sonority sequencing principle and this did indeed have the highest accuracy score. However, the outcome of the statistical analysis for the difference in accuracy scores between the clusters was not significant, which was striking, as one would have expected at least a significant difference between the /zm/ clusters and the /zb/ and /zv/ clusters.

All in all, the results on the distribution of strategies and the order of accuracy across the consonant clusters, as well as the specific responses for each strategy have been insightful. Ultimately, this study has not been able to provide evidence in favour of the research question whether there was a difference between second and third language learners with regard to the acquisition of new phonotactic knowledge. This means that, while a difference might occur based on crosslinguistic influence (as described in the three models), based on this data it cannot be said that being a tri-/multilingual in itself has an added beneficial effect in the acquisition of the new phonotactics not present in an L1 or L2.

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Appendix A: Pre-test on Quality of Audio and Voicing of Consonants

This appendix reports the mean scores on the voicing for each consonant in the cluster of al target and non-target items. Two independent raters as well as the current researcher rated each consonant with regard to voice on a five-point-scale, in which 1 is voiceless and 5 is voiced. The raters received a table in which the first column showed the number and letter coding for the consonant. For example, for the target /zbaro/, there would be two lines in the table, the first column of the first line would say 1A and the first column of the second line would say 1B. Then followed five columns (1-5) for each point in the voice scale, and lastly there was a column which read 'the quality of the audio is too poor to make a judgement about voice'. The raters were asked to place an 'X' in the column which they felt best described what they heard in the audio files. None of the raters described any of the audio files to be of too poor quality to be judged on voice.

The table below shows the results of the pre-testing, which was performed by the researchers as well as two independent raters. The first column describes the type of item, either a target item starting with /zv/ (ZV), /zm/ (ZM), or /zb/ (ZB), an example item (EX), or a non-target item (N). The second column shows the pronunciation of the non-word. The third column shows the mean score from the three raters on the voicing of the first consonant of the cluster. The fourth column shows the mean score on the voicing of the second consonant of the cluster.

Item Code	Pronunciation	Mean score C1	Mean score C2
EX	/zbaro/	4	4,33
EX	/prentare/	1	3,67
ZV	/zvantato/	5	5
ZV	/zvatare/	5	5
ZV	/zvato/	5	5
ZV	/zventire/	5	5
ZV	/zverare/	5	5
ZV	/zvilɒto/	5	5
ZV	/zvolio/	4,67	5
ZM	/zmarare/	5	5
ZM	/zmasto/	4,33	5
ZM	/zmatarsi/	5	5
ZM	/zmelto/	5	5
ZM	/zmetare/	4,33	5
ZM	/zmodare/	5	5
ZM	/zmovato/	5	5
ZB	/zbanto/	4,67	5
ZB	/zbario/	3,67	5
ZB	/zbieno/	5	5
ZB	/zbɒko/	4,67	5
ZB	/zbɒtare/	5	4,33
ZB	/zbɒtarsi/	5	4,67
ZB	/zbortare/	4	5
ZB	/zbovare/	4,67	5
N	/brandarsi/	4,33	4,33
N	/bravare/	4,67	5
N	/bretarsi/	4,33	4,33
N	/briganto/	4	4,33

N	/brɔkio/	4	4
N	/brokio/	4,33	4,67
N	/brontare/	4	4,67
N	/flarare/	1	4,67
N	/flatare/	1,33	4,33
N	/flesare/	1	4
N	/flɔidare/	1,33	4,33
N	/flɔtarsi/	1,33	4,33
N	/frendare/	1	4,33
N	/fritare/	1	3,67
N	/frɔtanto/	1	4,33
N	/glandare/	4,67	4,33
N	/glotto/	4,67	4,33
N	/gradanto/	4,67	4
N	/grapolare/	4,67	4,33
N	/grekio/	4,67	3,67
N	/grimare/	4,67	4
N	/grɔkare/	4,33	4
N	/grondato/	4,67	4,33
N	/klamare/	1	4,33
N	/klerato/	1	4,33
N	/klimato/	1	4
N	/kratto/	1	4,33
N	/kredare/	1	4,67

N	/krimanto/	1	4,33
N	/krɔbito/	1	4,67
N	/krostare/	1	4,67
N	/plenare/	1,33	4,33
N	/pranto/	1,33	4
N	/predanto/	1	4,33
N	/prekarsi/	1	4,33
N	/prevato/	1	3,67
N	/pritzo/	1	4
N	/prɔdare/	1	4
N	/proferato/	1	4
N	/prokare/	1	3,67
N	/prosato/	1	3,67
N	/skarato/	1,33	1
N	/spetarsi/	1	1,67
N	/spɔlto/	1	1
N	/stɔpare/	1	1
N	/trakio/	1	4
N	/tramanto/	1	4,33
N	/traskato/	1	4
N	/trentare/	1	3,67
N	/trevo/	1	4,33
N	/trɔki/	1	4,33
N	/tromfare/	1	4,33

Appendix B: MA Thesis Survey I Hoendervangers

Start of Block: Info

MA Thesis survey

Thank you for taking part in this survey. My name is Ilse Hoendervangers. I am a student from the Netherlands and I am currently working on my thesis for the MA Linguistics programme at the Radboud University. The topic of my research is the acquisition of sounds in foreign language acquisition.

This survey consists of two parts and takes about 15-20 minutes to complete. The first part contains short audio fragments with non-existing words that sound similar to Italian. For each of these, you will be asked to write down what you hear. The second part contains questions about your language background (which languages you speak, at what level, etc.). As a large part of this survey includes audio, it is advised to use headphones and work in a quiet environment.

All responses to this survey will remain anonymous. The language background questions are solely for the purpose of group division for statistics. The individual results of the survey will not be made public, only the average outcomes of the analyses.

Click on the arrow to continue to the first part of the survey. By continuing you agree to the use of the data that will be collected as described above.

End of Block: Info

Start of Block: Info Audio

Audio fragments

For this part of the survey, you will need to listen to short audio fragments containing one non-existing word that sounds like Italian. For each, you will be asked to write down the first syllable, writing down what you hear as closely as possible regardless of what you might have learned about the Italian way of spelling (think for example about the difference between 's' and 'z' or 'f' and 'v').

Below you will find two examples in which the answer is already given. Please also use these examples to test your volume.

Listen once to the audio fragment below and fill in the first syllable, writing down what you hear as closely as possible.

<Fragment 1>

___ro

Answer: zbaro

Listen once to the audio fragment below and fill in the first syllable, writing down what you hear as closely as possible.

<Fragment 2>

___tare

Answer: prentare

Click on the arrow to start the experiment. There are 5 pages in total in this part of the survey, each containing 15 fragments. It might take a while before all fragments have been loaded. Please listen to each fragment only once, as we are looking for the first impression. For this reason, it is also not possible to return to a previous page once you continue to the next.

End of Block: Info Audio
Start of Block: Fragments 1

Listen once to the audio fragment below and fill in the first syllable, writing down what you hear as closely as possible.
<Fragment 3>
_____kio

In order to save trees, not all items will be written down in full. The instruction ‘listen once to the audio fragment below and fill in the first syllable, writing down what you hear as closely as possible’ is included in all items. It is followed by an embedded web-player which contains the audio fragment. Below the web-player is the space where the participant could write down their answer, with next to it the following syllables of the word.

End of Block: Fragments 5
Start of Block: Info Background

You have completed the first part of this survey. Part two consists of questions regarding your language background.
In this part of the survey you will be asked to answer some questions about your language background. These answers will not be used to link responses to individual persons but are used to divide the participants for statistical analyses.

Click on the arrow to continue.

End of Block: Info Background
Start of Block: Background

What is your first language? (multiple answers possible)

_____

Which other languages do you speak? (Please include Italian.)
Add for each language your age when you first started learning this language and your current skill level (on a scale of 1-5).

	Language 1	Language 2	Language 3	Language 4	Language 5	Language 6
Which languages do you speak?						
At what age did you start learning this language?						
What is your current skill level on a scale of 1-5?						

For how long have you been studying Italian?
_____

Do you have any questions or remarks about this survey or (the topic of) my thesis?
_____
_____

End of Block: Background

Start of Block: Thank you!

Thank you for taking part in this survey!
If you want take part in the lottery for the Amazon gift card of $10 as a reward for taking part in this survey, please send an email to ilse.hoendervangers@student.ru.nl.
You can also send an email to this address for more information about this survey or my thesis.

Click on the arrow to submit your answers and finish this survey.

End of Block: Thank you!

Appendix C: Analysis of Responses for Deletion, Insertion and Prothesis

For the L2 learners, there were 34 cases of D1, which were not distributed evenly across the three consonant clusters, with 4 cases for /zb/ clusters, 10 cases for /zm/ clusters and 20 cases for /zv/ clusters. For the L3 learners, there were 9 cases, which were distributed more evenly with 2 cases for /zb/ clusters, 1 case for /zm/ clusters and 6 cases for /zv/ clusters. There were 12 cases of D2 for the L2 learners, 5 for the /zm/ clusters and 7 for the /zv/ clusters. For the L3 learners there were 3 cases of D2, 1 for /zm/ clusters and 2 for /zv/ clusters. For both L2 and L3 learners, there were no cases of D2 for /zb/ clusters.

For the strategy Insertion, there were 11 cases for the L2 learners and 2 cases for the L3 learners. For the L2 learners, there were 5 cases for /zb/ clusters and 6 for /zm/ clusters. For the L3 learners, the 2 cases were for /zm/ clusters. For both groups there were no cases of Insertion in /zv/ clusters and for the group of L3 learners there were no cases for the /zb/ clusters either. In 9 out of the total 13 cases, a vowel was inserted between the two consonants of the cluster (5 cases of ‘a’, 2 cases of ‘e’, 1 case for both ‘i' and ‘o’), all for /zb/ clusters. In 4 cases the inserted character was the consonant ‘v’, and in the last case an ‘s’ was inserted.

The strategy Prothesis was used when a character was inserted before the consonant cluster. This strategy was used in 12 cases for L2 learners and in 1 case for L3 learners. In 1 out of the 13 cases of Prothesis in total, the vowel e was inserted before the cluster (in a /zv/ cluster). In all other cases (2 cases for /zb/, 10 for /zm/), the character s was used (for example ‘szma’ instead of ‘zma’ for ‘zmasto’). This resembles the cases of v-insertion seen for Other, as here too the voiceless sibilant /s/ was followed by two voiced consonants.