5-1-2014

THE PERCEPTION OF ENGLISH SYLLABLE-FINAL NASALS BY SAUDI ESL LEARNERS

Turki Nafea Alharbi
Southern Illinois University Carbondale, turki1984@siu.edu

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by

Turki Nafea L Alharbi

B.A., Arab Open University, 2011

A Thesis
Submitted in Partial Fulfillment of the Requirements for the
Master of Arts Degree.

Department of Linguistics
in the Graduate School
Southern Illinois University Carbondale
May, 2014

THESIS APPROVAL

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Master of Arts

in the field of Applied Linguistics

Approved by:

Dr. Karen Baertsch, Chair

Dr. James Berry

Dr. Krassimira Charkova

Graduate School
Southern Illinois University Carbondale
03/27/2014

AN ABSTRACT OF THE THESIS OF

TURKI NAFEA ALHARBI, for the Master of Arts degree in Applied Linguistics, presented on 03/27/2014, at Southern Illinois University Carbondale.

TITLE: THE PERCEPTION OF ENGLISH SYLLABLE-FINAL NASALS BY SAUDI ESL LEARNERS

MAJOR PROFESSOR: Dr. James Berry

The present study examines Saudi ESL learner perception of three syllable-final English nasal contrasts: /n/-/m/, /m/-/ŋ/, and /n/-/ŋ/. It was based primarily on two models, the Perceptual Assimilation Model (PAM) and the Speech Learning Model (SLM), in order to determine how Saudi ESL learners categorized nasal segments in their L2, English. In addition, other models, including the Markedness Differential Hypothesis (MDH), contributed in finding the most difficult contrast. The participants, consisting of 24 Saudis studying in the US, were asked to distinguish between 40 English monosyllabic words grouped into minimal pairs. Regardless of their length of exposure, participants had greater difficulty in categorizing /n/ and /ŋ/ as separate phonemes, dealing with these sounds as a Single Category (SC). The /n/-/m/ contrast had the fewest errors among participants with more exposure in the US, who were able to distinguish between the word pairs in this contrast, while those with less exposure had more difficulty in distinguishing /n/ from /m/. This fact shows that the participants, especially after receiving more exposure, were able to categorize the /n/ and /m/ as a Two Category (TC). The contrast /m/-/ŋ/ had a number of errors somewhat similar to that found with the /n/-/m/ contrast. Therefore, participants in early stages of learning encountered more difficulties in categorizing /m/ and /ŋ/ than those who had spent a longer period of time in the US. This study concluded that the categorization between Arabic and English phonemes was highly important in learning English as an L2. Therefore, the absence of the English nasal /ŋ/ from the Arabic phonemic inventory

caused difficulties for Saudi ESL learners to categorize /ŋ/ as a separate phoneme. Additionally, markedness also played a role since the velar nasal /ŋ/ is typologically more marked than /n/ and /m/ making it more difficult to acquire in early stages of L2 learning.

Keywords: Perception task, contrasting nasal sounds, syllable-final, monosyllabic words, Saudi ESL learners, length of exposure, Perceptual Assimilation Model, Speech Learning Model, Markedness Differential Hypothesis.

DEDICATION

To my tender-hearted mother, Wadha, who for over ten years has eagerly awaited my return to her, which I have promised to do every year I've been away, although my journey seems to have taken longer than we expected.

To her, an indescribable love, a great longing, and a never-ending emotional bond as a son.

Turki

ACKNOWLEDGMENTS

I would like to show my gratitude to Allah, for his endless mercy and numerous blessings, without which I would not have been able to realize a righteous way in this life.

Because they were always with me, my family was an essential part in my journey toward completing my MA. To my late father (Allah always blesses him) who passed away a week before I started my MA program, my angelic mother, my five supportive brothers (Faisal, Sattam, Khalid, Mohammed, Fahd) and four amazing sisters (Muniera, Reem, Sameera, Maha), I will always be in their debt. Words cannot describe their place in my heart.

I would like to express my profound thanks and compliments to Dr. James Berry for his endless efforts, effective comments, and instructive suggestions, which guided me while working on this study. Thanks likewise go to Dr. Karen Baertsch and Dr. Krassimira Charkova for their guidance, comments, and helpful feedback.

I will never forget the time I spent in the Linguistics Department at SIU. Many thanks go to my colleagues, departmental staff, and friends for all the support and happiness they brought me.

Finally, thanks go to those who generously gave their time to participate in my study.

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CHAPTER 1

INTRODUCTION

Second language acquisition (SLA) is connected to other linguistic fields. Gass and Selinker (2008) pointed out that phonology is a field strongly connected to SLA, showing particular concern with how second language (L2) learners acquire a new phonological system, how that results in difficulties with the L2, and why L2 learners should take into account linguistic differences between their native language and the target language systems based on phonological universals. This means that many factors are involved in the transfer from first language (L1) to L2, particularly in terms of phonological systems. In addition, several theories on L2 acquisition, which will be discussed in the background section, have long been based on an interference between L1 and L2 sounds and have shown that L1 phonology plays a major role in the acquisition of L2 phonology. Thus, the ease or difficulty of acquiring certain L2 sounds is often attributed to the influence of L1 phonological knowledge.

Traditionally, the assumption has been that learning an L2 sound is easier when the L2 sound is more similar to an L1 sound and that learning it is more difficult when the L2 sound is more different from an L1 sound (Lado 1957). Many studies over the past four decades have indicated that sounds similar between an L1 and L2 are easier to learn, while dissimilar sounds are more difficult to learn (Oller & Ziahosseini 1970). However, these similarities used to explain how L2 learners deal with the complex relationship between L1 and L2 sounds have failed to provide explanations for all the perception and production difficulties encountered by L2 learners.

The Contrastive Analysis Hypothesis (CAH) was unable to answer many complex questions that were raised in the 1960s and 1970s in terms of L2 acquisition and how L1 sounds

transfer into L2 sounds. Major (1994) pointed out that CAH did not offer any evidence to support its claims and it was unable to bridge the gap in L2 acquisition, particularly regarding degree of difficulty in L2 sounds.

A revolutionary step in L2 phonological acquisition came with Eckman's (1977) Markedness Differential Hypothesis (MDH), which continues to play a major role in understanding the nature of the interaction between L1 and L2 sounds. Eckman argued that when a language contains a particular element that is relatively more marked, it will necessarily also contain a particular element that is less marked, although the presence of the less-marked element will not necessitate the presence of the more-marked element. MDH thus introduces a new way to evaluate and analyze the difficulties in L2 phonological acquisition.

Recently, more extensive studies have engendered a debate about whether the degree of similarity between L1 and L2 phonemes make L2 sounds easier or more difficult to acquire (see, for example, Flege 1995; Best 1995; and Best & Tyler 2007). These researchers have primarily focused on the nature of categorization in L1 and L2 sound systems. For instance, Best (1994, 1995) stated that the way L2 sounds are assimilated into L1 sound systems is based on the similarity between the L1 and L2 sounds in question. As a result, when L2 sounds are assimilated easily into L1 phonological categories, they will be easier to acquire, whereas those L2 sounds not easily assimilated into L1 phonological categories will be more difficult to acquire. In a similar fashion, Flege (1995) claimed that L2 sounds were categorized into L1 phonological categories based on the "*equivalence classification*" between L1 and L2 sounds.

Moreover, research on L2 speech perception has informed us that perceiving L2 sounds is not as simple as deciding whether an L2 sound is similar to, or different from, an L1 sound. There are many other psychological and linguistic factors that need to be taken into account. As

a result, the question of how we actually perceive the similarities and differences between native and non-native sounds remains an intriguing topic among researchers and has been the impetus for the formulation of different theories in L2 phonology.

In addition to the relationship between L1 and L2 phonemic inventories, there are non-phonemic factors that may help L2 learners overcome their difficulties in accurately perceiving L2 sounds. One of these factors is length of exposure to the L2 since length of exposure plays a fundamental role in allowing L2 learners to perceive L2 sounds with greater accuracy.

One area in the phonological study of Arabic for which there is a lack of research is the perception of the syllable-final English nasal contrasts, /m/-/n/, /n/-/ŋ/, and /m/-/ŋ/, by Saudi learners of English as a second language (ESL). Therefore, this study aims to address this issue. In order to understand the importance of this study, it is instructive to consider an observation about the Arabic and English phonemic inventories. The English phonemes /n/, /m/, and /ŋ/ can appear as nasal coda consonants. Although the phonemes /n/ and /m/ are part of the Arabic inventory as well, the phoneme /ŋ/ is not (Watson 2002).

Another relevant observation is that the English phonemes /m/ and /n/ are acoustically similar to each other in coda position (Thomas 1992). The nature of nasal sounds in the Arabic and English phonemic inventories can be seen in the tables below. Table 1 shows the absence of the nasal velar /ŋ/ from the Arabic phonemic inventory (Amayreh 2003).

TABLE 1: The Arabic nasal phonemic inventory.

	Bilabial	**Alveolar**
Nasal	m	n

Table 2 on the other hand shows that the English phonemic inventory contains the nasal velar /ŋ/ in addition to the two nasals found in Arabic (Edwards 1992).

TABLE 2: The English nasal phonemic inventory.

	Bilabial	**Alveolar**	**Velar**
Nasal	m	n	ŋ

In order to determine how Saudi ESL learners perceive the previously-mentioned English contrasts in coda position, the following research questions will be addressed in the present study. The first is to investigate whether a particular English contrast influences the perception of English nasal codas, considering three contrasts: /m/-/n/, /m/-/ŋ/, and /n/-/ŋ/. The second is to investigate whether the lack of the English phoneme /ŋ/ in the Arabic phonemic inventory leads Saudi ESL learners to encounter difficulties in perceiving that phoneme in English words in coda position. Finally, the third is to determine whether length of exposure to English in the US plays an important role in the perception of these nasal codas. The following chapter presents an expanded theoretical background and discusses the literature most relevant to the current study.

CHAPTER 2

BACKGROUND

This section provides the theoretical and empirical background for the status of the perception of English syllable-final nasals by Saudi ESL learners. These theories include the Perceptual Assimilation Model (PAM) (Best 1994, 1995), the Speech Learning Model (SLM) (Flege 1995), the Markedness Differential Hypothesis (MDH) (Eckman 1977), the Ontogeny Model (OM) (Major 1987), and the Ontogeny Phylogeny Model (OPM) (Major 2001). Their relevance to the present study stems from the fact that they address theoretical problems in terms of the interlanguage (IL) between L1 and L2. In a similar vein, these theories also attempt to take into account the degree of interference between L1 and L2 from different standpoints.

2.1. Categorization in L1 and L2.

The Perceptual Assimilation Model (PAM) (Best 1994, 1995) and Speech Learning Model (SLM) (Flege 1995) primarily focus on the nature of categorization in L1 and L2 and how that works in terms of L2 acquisition. The PAM claims that L1 determines how learners perceive their L2. According to this theory, L2 sounds are assimilated into L1 phonological categories based on similarities between L2 and L1 sounds, positing that the difficultly of learning L2 sounds is based on their degree of perceived similarities to the L1.

This theory has been extremely important in perception tasks in phonology because it indicates how easily learners could acquire L2 phonemes with no equivalent in their L1, as well as whether L1 and L2 phonemes could be established as equivalent, which is determined by how similar or different L2 sounds are from those in the L1. Since L2 learners categorize L2 phonemes depending on the degree of similarity to the phonemes in their L1, when phonemes in the L2 are very similar to L1 phonemes, L2 learners can more easily perceive those L2

phonemes and distinguish them from those in the L1. However, if those phonemes contain features that do not exist in the L1, L2 learners may struggle to clearly perceive and distinguish them. On the other hand, there are also phonemes that are difficult to perceive, even for some native speakers.

In a similar fashion, the PAM-L2 addresses the perceptual assimilation of both phones in a contrasting L2 pair in order to predict the identification and discrimination strategies of naïve listeners when attempting to perceive L2 phonological contrasts (Best & Tyler 2007). Different patterns of contrast assimilation carry different predictions for learners' abilities to distinguish L2 sounds. A situation in which learners perceive two L2 phones as examples of distinct L2 phonemes is called Two Category (TC) assimilation, in which case good-to-excellent discrimination is anticipated. Examples of the TC include the perception of English /p/-/b/ as distinct phones by Dutch speakers and Spanish /o/-/u/ as different phones by Dutch listeners.

On the other hand, when learners consider two L2 phones as equally good or poor tokens of the same L1 phoneme, this is called Single Category (SC) assimilation, in which case poor discrimination is anticipated (Best & Tyler 2007). For example, French /p/ is unaspirated and short-lag [p], and therefore has the same features as English /b/ because it is frequently voiceless and short-lag [p] at the beginning of a word. The perception of two contrasting L2 phones as allophones of an L2 phoneme that differ in how well they fit that phoneme is called a Category Goodness (CG) difference, where intermediate abilities in discrimination are predicted.

Because of interference from their L1, naïve listeners will probably perceptually assimilate an L2 phone they have not heard before to the L1 phoneme closest in articulation to the new phone. In other words, this new phone would be perceived as a good or poor example of an L1 phoneme (referred to as well categorized), as unlike any other L1 phoneme (referred to as

uncategorized), or less commonly, as a sound not categorized as a speech sound (referred to as non-assimilated). For instance, even though the English rhotic, an approximant, is phonetically very different from the French rhotic, a voiceless uvular fricative or uvular trill, English speakers learning French as an L2 often think of these as being in the same lexical-functional category (Best & Tyler 2007).

Along the same lines, the SLM sheds light on how L1 and L2 phonemes are categorized based on deep phonological structure and how this categorization improves after more time using the L2 (Flege 1995). According to the SLM, naïve L2 learners perceive L1 and L2 sounds inside the same phonological space. Based on acoustics or perception, L1 and L2 sounds do not exist as completely distinct units, but rather can be seen as inhabiting a continuum or spectrum with sounds that are more alike on one end and those that are less alike on the other. How similar L2 sounds are to L1 phonemes influences a learner's ability to incorporate a new L2 sound into an L1 phoneme. This is determined based on finding L1 and L2 sounds that could be perceived as corresponding to one another when such sounds are perceptively close; however, when learners have a deeper understanding of the L2, they may construct L2 phonological categories distinct from those present in the L1 when the sounds in question are perceptively less close.

According to both the PAM and SLM, differentiating two L2 phonemes can be complicated when they are perceived as part of a single L1 phoneme, which would also apply to distinguishing allophones between the L1 and L2. As an example, in Flege's (1995) study, Spanish-speakers had the potential to perceive English /ɑ/ and /ʌ/ as both members of Spanish /a/, which would create problems with contrasting these sounds later on and result in a distinct non-native accent when pronouncing /ɑ/ and /ʌ/ or possibly problems with producing the Spanish sound /a/.

Exemplifying the importance of the PAM and SLM models in the nature of L2 perception, Aoyama (2003) conducted a study to investigate Korean and Japanese listeners' perception of English nasal segments in onset and coda positions. Nasal segments /m/, /n/ and /ŋ/ are found in English, Korean, and Japanese, but their phonemic categories have different representations. In English, /m/ and /n/ contrast both syllable-initially and syllable-finally. The velar nasal /ŋ/ contrasts with the other two nasals only syllable-finally. In the case of Korean, /m/ and /n/ contrast syllable-initially while /m/, /n/, and /ŋ/ contrast syllable-finally, as in English. In Japanese, on the other hand, /m/ and /n/ contrast only syllable-initially, while there are no contrasts in nasals syllable-finally. Aoyama used 50 English monosyllabic words with nasals in initial and final positions.

The results of final position found that Japanese listeners had significant difficulty distinguishing the syllable-final velar nasal /ŋ/ from the syllable-final alveolar nasal /n/, although they had no particular problems distinguishing the final bilabial nasal /m/ from either /n/ or /ŋ/. The findings for the final position supported the predictions based on PAM, where Japanese speakers of English assimilated the English phoneme /ŋ/ into their L1 as a SC, while the other English phonemes, /n/ and /m/, were assimilated as a TC.

Continuing with the same idea, Kluge and colleagues (2008) investigated Dutch and Brazilian Portuguese ESL learners' ability to accurately perceive English syllable-final and word-final nasals, given the different "phonological representations and phonetic realizations" of such nasals in these languages (199). Brazilians had greater difficulty accurately identifying English nasals than the Dutch participants. This most likely stemmed from the greater similarity between the phonological systems of English and Dutch in regard to final nasals, where /n/ and /m/ are distinguished phonemically word-finally. On the other hand, the nasals /n/ and /m/ in Brazilian

Portuguese are normally lost word-finally, resulting in the nasalization of the preceding vowel. As a result, Brazilian learners' difficulties can be explained through the SLM, which clarifies that the reason why Brazilian learners could not categorize nasal sounds as different phonemes is because their phonological representations appear similar to them.

By attempting to understand Brazilian EFL learners' problems with syllable-final English nasals, Kluge and colleagues (2009) aimed to create a solution for them and develop learning material involving visual cues in order to help Brazilian Portuguese EFL learners of English to better perceive and distinguish syllable-final nasals. The study compared participants' ability to distinguish these nasals with audio-only input and with audio input supplemented by visual cues. The findings showed that using visual cues in conjunction with audio resulted in an increased ability to perceive final /n/ and /m/, whereas the use of audio input without visual cues resulted in a somewhat reduced ability to distinguish them.

Phonological context also affected the data. When the vowel immediately preceding the final nasal was a low vowel, Brazilian participants were more likely to accurately distinguish final English /n/, while a high vowel resulted in them being less likely to distinguish final English /m/. This study supported the SLM's predictions that indicated the difficulties that Brazilian EFL learners would encounter, which led the author of the present study to assume using visual cues may encourage more accurate results in the perception of English nasal sounds in coda position.

As further evidence regarding the categorization problem between L1 and L2, Bradlow (2008) pointed out that the case of Japanese speakers' perception of the English /ɹ/–/l/ contrast illustrated how languages can be compared to analyze how individuals learn L2 phonemes. Although research has indicated that Japanese listeners usually have problems distinguishing

English /ɹ/ from /l/, different participants and stimuli displayed different findings in regards to how accurately they were able to perceive this contrast. This process, explained by PAM, clearly shows contrasts such as this one, a SC contrast, to be the hardest type of contrast for L2 learners.

In a TC contrast, on the other hand, L2 listeners group two phones from two different phonemes into two distinct L1 categories, and in CG contrasts, such phones are assimilated into a single L1 category with varying degrees of how well they fit. PAM suggests that these TC and CG contrasts are easier to perceive than SC contrasts. Therefore, Japanese learners of English have to categorize two sounds that are difficult to discriminate as part of two distinct phonemes to learn English phonology (Bradlow 2008).

The sections discussing the PAM, SLM, and various related studies are strongly connected to the present study which examines the perception of English nasal consonants by Saudi ESL learners in coda position in three contrasts, /m/-/n/, /m/-/ŋ/, and /n/-/ŋ/. The SLM and PAM explain exactly how L2 sounds are perceived based on degree of similarity and dissimilarity between L1 and L2 sounds and the assimilation of L1 sounds into L2 ones. As represented in the studies mentioned above, these theories reveal that degree of difficulty in L2 perception requires more than a comparison of L1 and L2 phonemic inventories. Thus, how Saudi ESL learners are likely to categorize Arabic and English phonemes is significant in determining the type of difficulties they will encounter in L2 phonemic perception.

2.2. Acquisition of marked and more marked L2 sounds in coda position.

The Markedness Differential Hypothesis (MDH) (Eckman 1977) was based on the concept of typological markedness as originated by Greenberg (1976), which argued that when the typology of an element X in a language was more marked than element Y, a language possessing X would necessarily contain Y; however, if a language had Y, that would not mean it would also contain

X. Based on this assumption, MDH aims to measure areas of difficulty in L2 learning, in association with the CAH, and presents three expected areas of difficulty in L2 learning (Eckman 2008). First, the L2 elements different from, and displaying greater markedness than, the L1 would be more difficult to acquire. Second, there would be a correspondence between how marked an element was and how difficult it was to acquire. Third, L2 elements different from, but not displaying greater markedness than, the L1 would be easier to acquire.

Several types of evidence in favor of the MDH have shown that differences alone between L1 and L2 could not explain the errors of learners, meaning that typological markedness had to be taken into account (Eckman 2008). The first type of evidence, directionality of difficulty, claims that when speakers of two different languages are attempting to acquire each other's language, it could be harder for one speaker than for the other. Degree of difficulty, based on the L1, is another piece of evidence that could be explained by markedness and is related to how hard it is for different learners with different L1s when learning the same L2. Also supporting the MDH is the relative degree of difficulty in learning L2 structures, which could be determined through markedness (see Eckman 2008, for a more detailed discussion on L2 difficulties in terms of markedness).

A large number of studies explored the role of markedness in L2 acquisition. For example, Hsu (2013) examined the influence of unmarkedness and transfer in producing nasal sounds in coda position by Taiwanese EFL learners. The author used two groups of participants in order to determine the phonemic distribution of nasals in Mandarin vs. Min. The first group consisted of Mandarin native speakers and the second Southern Min speakers. The results revealed that Southern Min speakers did not encounter difficulty in producing /m/ and that this reflected an occurrence of positive transfer from their L1 to the L2 (English). Interestingly, both

Mandarin and Min speakers had a higher tendency to use the English phoneme /n/ rather than other nasal phonemes. Since there is no phonological explanation in their L1 to support this preference, this means that markedness rules play a crucial role in IL (interlanguage) production where they preferred to produce the less marked /n/ instead of the more marked /m/ and /ŋ/.

In addition, Hsu (2011) conducted a study to determine whether markedness influenced Mandarin slips of the tongue in their production of L1 nasal codas. The author asked thirty-five participants to read 346 items. The results showed a higher tendency to prefer unmarked /n/ than marked /ŋ/ in coda position. This preference occurred because of the effects of unmarkedness, which appeared in coda position in this study and caused the emergence of syllable-final unmarked sounds as more preferred sounds. Although it did not address L2 acquisition, this study still supported the importance and influence of markedness universals, where even in their L1, speakers were shown to prefer less marked sounds over more marked sounds in coda position.

To sum up, markedness as framed above could be used to provide more facts about which English nasal sounds are more typologically marked in coda position. It suggests that the acquisition of L2 sounds in coda position will be more difficult than L2 sounds in onset position. The English phoneme /ŋ/ has been shown to be more marked than the other English nasals /n/ and /m/. As a result, Saudi ESL learners in initial stages of English acquisition may only perceive /n/ and /m/, with the ability to perceive /ŋ/ appearing in more advanced stages. This scenario shows that a markedness role in the acquisition of L2 sounds must be taken into account in the present study.

2.3. Transfer of L1 features to L2.

The Ontogeny Model (OM) (Major 1987) and the Ontogeny Phylogeny Model (OPM) (Major 2001) take into consideration that transfer plays a significant role in L2 phonology. Basically, the OM postulates that transfer is the first process that affects the acquisition of L2 phonology, but over time its influence lessens while developmental processes increase. On the other hand, in the OPM, an updated version of the OM, transfer is still considered a primary influence in early stages of acquisition. Even so, transfer shows a greater influence on unmarked L2 features than marked ones.

As already mentioned, the OM and OPM attempt to understand the interaction between transfer and developmental processes during L2 acquisition. In the case of the OM, transfer influences the beginning period of learning the L2. The importance of transfer eventually declines due to the increasing importance of developmental processes. On the other hand, the OPM identifies transfer and universal rules, such as markedness, as both playing a major role in the acquisition of the L2 phonological system. However, transfer influences the unmarked L2 features more than marked ones. As with the OM, transfer is a primary factor in the initial period of learning the L2, while the influence of markedness becomes more dominant due to decreasing transfer influences, before eventually declining (Major 2001).

A great deal of research has shown that similar sounds between L1 and L2 overall appear to be more difficult to acquire than dissimilar ones. For example, Major (2008) postulated that the reason seemed to be that sounds with greater differences were noticed by learners, while sounds with only minor differences went unnoticed more often. In addition, the sound's features are significant for transfer to occur because when the two sounds are more different, there is very little that can be transferred.

Along the same lines, Wode (1978, 1980) also pointed out that degree of similarity between phonemes was a significant concern. Wode (1980) also claimed that L1 transfer only took place if there was a strong similarity between the features of the L1 and L2 phonemes. Flege (1995) introduced his concept of *equivalence classification* in the SLM as a new norm for understanding the relationship between L1 and L2 sounds. SLM indicates that similar sounds are difficult to acquire because L2 listeners may perceive them as equivalent to sounds in the L1, whereas dissimilar L2 sounds are easier to perceive. Thus, OPM states that L2 acquisition increases over time, which leads L1 transfer to lessen, and universal rules increase in initial stages and then lessen in later stages.

To explain the importance of OM and OPM in the theoretical framework of the current study, the Arabic phonemic inventory has only two nasal phonemes, /n/ and /m/. The [ŋ] phone occurs in Arabic but only as an allophone of /n/ that occurs before velar consonants. Therefore, in word-final position, Arabic speakers initially have two categories to transfer: /n/ and /m/. They will thus have to create a new category for English /ŋ/.

Building on the basic functions of OM and OPM on the one hand and complex processes that have occurred in universal rules in various stages of L2 acquisition on the other, several studies have aimed to examine the relationship between length of exposure to L2 (English, in case of Saudi learners in the present study) and the ability to perceive L2 sounds in different stages of L2 acquisition. For instance, Flege and colleagues (1997) tested the influence of ESL learners' amount of exposure to and experience with English on their ability to accurately perceive and produce English vowels. The results revealed that L2 learners with more English experience had a greater accuracy in vowel perception and production than those with less

experience. Furthermore, their facility with English vowels was also related to how closely they perceived their L1's vowel inventory to that of English.

To gauge the importance of native-speaker input in how adult learners acquire their L2, Flege and Liu (2001) looked at adult Chinese speakers who had been residents of the US for different amounts of time. They analyzed how well English consonants appearing word-finally were identified by the participants. The results supported earlier studies that suggested that length of residence influenced L2 learners. The results showed that the adult participants were able to do better with more exposure to L2 native speakers.

All of these studies showed a high probability of length of exposure influencing L2 acquisition. The ability of L2 adult learners exposed to L2 from a later age to be native-like was based on length of exposure and other individual differences. As a result, L2 learners start in early stages to perceive/produce L2 sounds by transferring L1 characteristics to be able to deal with L2 sounds. In advanced stages, markedness effects expand due to the developmental process L2 learners undergo, which shows L2 leaners' ability to reduce L1 effects.

The section above revealed that in the perception of English final nasals it was necessary to take into account how the target phoneme was going to be perceived and whether or not it was available in both L1 and L2 phonemic inventories. Furthermore, these studies indicated that even when the environment of the target phoneme consisted of one syllable, the more marked segments would be acquired in later stages, while less marked segments would be acquired in early stages. However, there were other factors in addition to phonology that also had a role in the perception of English final nasals, such as those mentioned by Aoyama (2003), including L1 background and length of exposure. As already mentioned, these theories and studies showed different perspectives that address the problem of the present study.

Before moving to the next chapter, it must be mentioned that chapter 4 will present the results, which will be discussed based on the theoretical and empirical literature introduced in chapter 2. Chapter 3 describes the methodology followed by the present study and includes the study problem, research questions, participants, variables, instrumentation, procedure, data collection, and the way the data were analyzed.

CHAPTER 3

METHODOLOGY

The present study was conducted within a quantitative framework that drew from a sample of Saudi ESL learners. It used both descriptive and inferential statistics to analyze the data and address the research questions. The study problem, research questions, participants, variables, instrumentation, procedure, data collection, and analysis are presented below.

3.1. Research problem.

As mentioned previously, this study's aim is to examine whether Saudi ESL learners have the ability to perceive syllable-final nasals in English. This work focuses on three areas: 1) to investigate which of the three English contrasts, /m/-/n/, /m/-/ŋ/, and /n/-/ŋ/, in coda position are easier or more difficult to perceive; 2) to investigate whether the lack of the English phoneme /ŋ/ in the Arabic inventory leads Saudi ESL learners to encounter difficulties in perceiving /ŋ/ in the coda position of English words; and 3) to determine whether length of exposure to English in the US has a major role in the perception of English nasal codas. The research questions are stated in the following section.

3.2. Research questions.

The present study was organized around the following three questions.

1. Which of the English phonemic contrasts, /n/-/m/, /m/-/ŋ/, and /n/-/ŋ/, are Saudi ESL learners able to perceive more accurately?

2. Given that Arabic lacks phonemic /ŋ/, do Saudi ESL learners have difficulty in perceiving English final /ŋ/?

3. Is there a significant relationship between participants' length of exposure in the US and their accuracy of perceiving English nasal codas?

3.3. Participants.

To conduct this study, 24 Saudi ESL learners from Southern Illinois University at Carbondale (SIU) and the Center for English as a Second Language (CESL) in SIU were recruited. The participants consisted of 24 Saudi students, 12 men and 12 women, whose ages ranged from 18 to 35, with an average age of 24 years and 8 months. In addition, they represented three academic degrees since 13 of them were in the US to pursue their bachelor's degrees, whereas nine of them were pursuing master's degrees in different areas. Only two of the participants were pursuing a PhD. Most of them only spoke Arabic and English with the exception of three who were also able to speak Spanish and one who spoke German.

Furthermore, they were chosen from among Saudi ESL learners who had lived in the US for between 6 and 36 months, and their length of exposure to English in the US on average was 17 months. The researcher grouped participants' length of exposure into two categories. The first category included the 10 participants who had been in the US for between 22 and 36 months. On the other hand, the second category included the 14 participants who had been in the US for between 6 and 18 months (see Appendix A for further information about participants' length of exposure to English in the US).

The participants' proficiency was controlled for by only selecting students between levels 4 and 5 (intermediate proficiency) with regard to those enrolling in the university's intensive English program. For those enrolled in the university, their selection was based on their having Test of English as a Foreign Language (TOEFL) scores that were at least 500 to 550 in the paper-based exam, which is the minimum score necessary to enter SIU as an undergraduate or graduate student, respectively. Students studying Linguistics and TESOL were excluded from

the sample because of their awareness of linguistics, which could have influenced their responses.

3.4. Variables.

The dependent variable in this study was calculated as the score of incorrect perceptions of nasal coda contrasts. A separate mean score was calculated for errors in each nasal coda contrast since error was given a score of 1, whereas 0 was assigned for correct perceptions of nasal coda contrasts. Three groups of contrasts (/m/-/n/, /m/-/ŋ/, and /n/ -/ŋ/) served as the independent variables. On the other hand, the role of the non-phonemic variable, length of exposure in the US, was examined through Pearson's correlation analysis.

3.5. Instrumentation.

The instrument was divided into two subsections. First, participants' demographic information was collected through a questionnaire, which included age, gender, academic status, languages spoken besides Arabic and English, length of exposure to English in Saudi Arabia, and length of time spent in the US (see Appendix B).

The second subsection consisted of a list of 40 English words taken from Aoyama (2003). For written permission, the researcher has sent three emails to the author, but unfortunately the researcher has not yet received a response. These words were monosyllabic only, in order to maximize participant familiarity with lexical items. Minimal pairs were used to elicit three different contrasts: syllable-final /n/-/m/, syllable-final /m/-/ŋ/, and syllable-final /n/-/ŋ/ (see Table 3). These contrasts were represented by 10 tokens each, which were divided between five correct tokens and five incorrect ones. Ten irrelevant pairs were also selected as distracters. A female native English speaker from Carbondale, Illinois was recruited to produce these 40 English words (30 target words and 10 distracters).

The words were recorded using Speech Analyzer Version 2.5 (www.sil.org). The native speaker pronounced each pair of words twice with a pause between each pair. The participants were tested individually, with each participant listening to each word twice. Then the participants were asked to choose one of two words in an answer sheet taken from Aoyama (2003) that is given in Appendix C. Thus, participants heard a word (repeated twice) and were asked to identify the word they just heard from two choices on their response sheet. For example, they heard "scene" and were asked to choose between "scene" and "seem" as the options.

TABLE 3: The word pairs used in this study.

Final /n/-/m/		**Final /m/-/ŋ/**		**Final /n/-/ŋ/**	
Scene	Seem	swim	swing	sin	sing
Hen	Hem	rim	ring	lawn	long
Line	Lime	some	sung	kin	king
Sane	Same	brim	bring	son	sung
Worn	Warm	slim	sling	thin	thing

3.6. Procedure.

Before receiving participants' agreement in this study, the researcher informed participants that this study was not meant to evaluate their English proficiency but rather to analyze their perception in English, without more information about the nature of the study being given (see Appendix D). This was done to hide the real goal of the study. At this point, those who agreed to participate were asked to either go to the Linguistics Department lab on the third floor of Faner Hall on the SIU campus or to Morris Library to complete the study.

When each participant came to the previously agreed-upon place and time, the researcher explained the nature of the two tasks, the first recording their demographic information and the second consisting of the list of 40 English monosyllabic words. For the second task, the participant understood that he or she needed to listen twice to each word and then choose one of the given options in the answer sheet. In this fashion, each participant completed the questionnaire and then completed the perception task.

The data were collected over a period of six days. No one besides the researcher was allowed to look at the data as per a promise to the participants that their answers would be kept private and that the data would be destroyed after completing the objective of the study.

3.7. Data analysis.

The native speakers' utterances were recorded using Speech Analyzer. The task used in this study was based on a categorical identification task, that is, the participants heard one word and had to choose a matching word from two possibilities (see Strange & Shafer 2008 for a more extensive discussion of this task). Thus, the participants listened to the correct words twice to test whether or not they perceived nasal coda contrasts correctly. Their results were calculated with the errors in their perception of each contrast as the primary focus. The data were coded as one point if the participant chooses a given word incorrectly and zero points for correct perceptions.

The distribution of errors in each contrast were analyzed via three dependent *t-tests* in order to determine the contrast that caused the most problems. All descriptive and statistical analyses were performed through SPSS. Correlation analyses were used to examine potential relationships between participants' length of exposure in the US and the accuracy of perceiving the three English nasal contrasts. In addition to the above analyses, the types of perception errors

were also examined in order to identify error patterns and their frequencies in each of the different contrasts found in the minimal pairs.

The next chapter introduces the results of the current study and then discusses them based on the theoretical background presented in chapter 2.

CHAPTER 4

RESULTS

The aim of the present study was to investigate the perception of three English nasal contrasts, /n/-/m/, /m/-/ŋ/, and /n/-/ŋ/, in coda position by Saudi ESL learners. More specifically, this study sought to determine which of these English nasal contrasts is more difficult to perceive in coda position. Along the same lines, the study also questioned whether the length of exposure to English in the United States has a role in the accurate perception of these contrasts.

Based on the experiment that was conducted with Saudi ESL learners, the results showed a higher degree of difficulty in perceiving the contrast /n/-/ŋ/. Research question three asked whether the length of exposure to English caused Saudi ESL learners to be more accurate in perceiving nasal codas. Surprisingly, length of exposure to English was not found to be a factor influencing the number of errors in this contrast. For example, some participants who had been in the US for over 22 months were unable to perceive the /n/-/ŋ/ minimal pairs more accurately than those who had been in the US for approximately a year or less.

This result might be explained by the absence of /ŋ/ from the Arabic phonemic inventory, which causes challenges in differentiating /ŋ/ from /n/. As a result, the participants distributed /n/ and /ŋ/ as a single phoneme. For example, when the participants were asked to identify whether they heard a recording of *sin* or *sing*, they always chose the correct word when it was *sin*, which contained /n/. On the other hand, they showed a greater tendency to choose the word containing /n/ when the correct phoneme was /ŋ/. A possible explanation for this phenomenon could be that the phoneme /ŋ/ is more marked than /n/, and as a result /ŋ/ may be acquired in more advanced stages in terms of L2 acquisition, although the results for this contrast showed that /ŋ/ was still difficult to acquire for learners in advanced stages as well.

Regarding the nasal contrast /m/-/ŋ/, a negative correlation was found in participants' ability to distinguish these two phonemes. The results revealed difficulties in distinguishing between the English phonemes /m/ and /ŋ/ in early stages of English acquisition. However, after receiving heavy exposure to English, some participants were able to differentiate between /m/ and /ŋ/ and perceive them more accurately as separate phonemes. The results for this contrast displayed that the English /ŋ/ could be acquired in advanced stages by taking into consideration the ability of Saudi ESL learners to categorize /ŋ/ as a separate phoneme in their own English inventory.

In contrast, some participants with less exposure to English were unable to accurately categorize /m/ and /ŋ/ as two phonemes. This issue could be related to their dependency on the Arabic nasal phonemic distinctions to categorize English nasal sounds. As previously mentioned, the Arabic nasal system does not have the nasal velar /ŋ/. Therefore, they need to receive more exposure to English to be able to create the /ŋ/ as a separate phoneme.

The results for the /n/-/m/ contrast displayed the least number of errors. It showed Saudi ESL learners had no difficulties in perceiving these phonemes, /n/ and /m/, as separate phonemes, particularly some of those who received more exposure. These results could be explained by understanding that the English nasal phonemes /n/ and /m/ exist in the Arabic phonemic inventory. Even though differentiating between them in coda position is more difficult because the coda is more marked than other environments, some participants displayed a high ability to perceive /n/ and /m/ as two separate phonemes. Additionally, length of exposure to English was an important factor in this contrast since some participants in advanced stages were able to show a greater accuracy in categorizing the nasal /n/ and /m/ as separate phonemes.

To give a more detailed explanation, Tables 4 and 5 illustrate each group of participant's percentage of their perception errors based on their length of exposure. The participants are broken down in the left column into the number of months each spent in the US. The right column contains the raw percentages for the error rates of each participant.

Table 4 below shows the percentages of errors of participants who had more English exposure.

TABLE 4: Perception error percentages for experienced participants.

Participants with 22 Months of Exposure or More	**Perception Error Percentages for the Three Contrasts**
1 (36 months)	4.17%
2 (30 months)	8.33%
3 (24 months)	12.5%
4 (24 months)	16.7%
5 (24 months)	20.8%
6 (24 months)	25%
7 (24 months)	29.2%
8 (24 months)	33.3%
9 (24 months)	37.5%
10 (22 months)	41.7%

Table 5 shows the percentages of errors of participants who had less English exposure.

TABLE 5: Perception error percentages for less-experienced participants.

Participants with 18 Months of Exposure or Less	**Perception Error Percentages for the Three Contrasts**
11 (18 months)	45.8%
12 (18 months)	50%
13 (12 months)	54.2%
14 (12 months)	58.3%
15 (12 months)	62.5%
16 (12 months)	64.7%
17 (10 months)	29.2%
18 (9 months)	70.8%
19 (8 months)	75%
20 (6 months)	79.2%
21 (6 months)	83.3%
22 (6 months)	91.7%
23 (6 months)	95.8%
24 (6 months)	100%

On the other hand, the results of the 3 dependent t-tests revealed that the participants showed significant differences in the accuracy of perceiving the English nasal contrasts in coda position. In particular, the results showed that the participants had significantly more perception errors in the contrast /n/-/ŋ/ than the contrast /n/-/m/. In other words, the contrast /n/-/ŋ/ had the largest number of errors in coda position, t (23) = 7.020, p < .001. Table 4 shows a 10% error rate in the contrast /n/-/m/, and the contrast /m/-/ŋ/ had a similar error rate, 11.25%, whereas the

nasal contrast /n/-/ŋ/ had the highest error rate, 30.8%. The percentage of errors was calculated by dividing the group error means by a total possible score of 10.

TABLE 6. 3 Dependent t-tests for errors in perceiving three nasal contrasts in coda position.

Pair	Number of Participants	Mean	Standard Deviation	t (23)	Significant Two-Tailed	Percentage of Errors
Contrast /n/-/m/ Contrast /n/-/ŋ/	24	1.00	1.44	-5.94	.000*	10%
Contrast /n/-/ŋ/ Contrast /m/-/ŋ/	24	3.08	1.44	7.020	.000*	30.8%
Contrast /m/-/ŋ/ Contrast /n/-/m/	24	1.12	1.22	-.65	.524	11.25%

The next part of this chapter will present and discuss a detailed description of the nature of the results. They are presented in three sections which are the /n/-/m/ contrast, the /n/-/ŋ/ contrast, and the /m/-/ŋ/ contrast. In addition, the discussion of the results will be connected with the theories and the empirical studies presented in chapter 2.

4.1. The /n/-/m/ contrast.

Among the three nasal contrasts, the results for the /n/-/m/ contrast were revealed to have the fewest errors. To illustrate this, the numbers of errors and their distributions among the ten pairs of words are summarized in Table 7. The underlined words are ones that were actually recorded.

TABLE 7. Number of errors and their distribution in word pairs with the contrast /n/-/m/.

Pairs	Number of Participants	Mean	Standard Deviation	Percentage of Errors
line **lime**	24	.25	.44	6%
hen **hem**	24	.12	.34	3%
scene **seem**	24	.12	.34	3%
worn **warm**	24	.08	.28	2%
sane **same**	24	.00	.00	0%
scene seem	24	.16	.38	4%
worn warm	24	.08	.28	2%
sane same	24	.08	.28	2%
hen hem	24	.04	.20	1%
line lime	24	.04	.20	1%

As can be seen in Table 7 above, the participants in general showed no difficulties in perceiving English /n/ and /m/ as two separate phonemes. The ten words used in this contrast produced a similar error rate. The highest number of errors in this contrast occurred in the pair *line-lime* where participants displayed an error rate of 6%. In a similar vein to the number of errors in this contrast, which had high number of errors among others, the participants in the pair *seem-scene* had an error rate of 4%.

The words pairs *same-sane*, *worn-warm*, and *warm-worn* had the same number of errors with an error rate of 2%. Interestingly, all the participants' responses in the word pair *same-sane* revealed no errors, even though some participants committed errors in the word pair *same-sane*.

The rest of the word pairs, particularly *hen-hem* and *seem-scene*, had an error rate of 3%, while *hem-hen* and *lime-line* had an error rate of only 1%, respectively.

When taking the influence of length of exposure to English into consideration in the contrast /n/-/m/, differences in the number of errors can be seen in Table 8, which reflected an improvement among the participants over time in perceiving the English /n/-/m/ contrast in coda position.

TABLE 8. The influence of length of exposure in the nasal contrast /n/-/m/.

Pair	**Number of Participants**	**Pearson Correlation**	**Significant (2-tailed)**
The contrast /n/-/m/	24	- .620	.001*

Based on these results, the number of errors were negatively correlated with length of exposure. This means that participants with a longer length of exposure were better able to categorize /n/ and /m/ as different phonemes. For instance, some participants with 12 months exposure or less committed a higher error rate in the pair *line-lime* (6%), but some participants with 24 months exposure or more were able to categorize the pair *lime-line* as different phones with an error rate of only 1%. Therefore, some participants with less exposure to English needed more time in the US to develop their perceptual skills in differentiating the English nasal bilabial /m/ from the English nasal alveolar /n/ and categorize them as two separate phonemes.

Categorization could be considered a primary explanation for the results for the contrast /n/-/m/. The Arabic and English phonemic inventories contain /n/ and /m/ as separate phonemes, and they are treated as two separate phonemes, particularly by some participants who had a greater length of exposure to English (see Flege 1995; Best 1995; and Best & Tyler 2007). Therefore, [m] is a good example of the Arabic /m/ phonemic category, and English [n] is a good

example of the Arabic /n/ phonemic category. Based on this, we expect these sounds to be treated as two separate phonemes. For example, the participants categorized /n/ and /m/ in the word pair ***same***-*sane* as distinct phonemes without errors in their responses. Therefore, Saudi ESL learners categorizing /n/ and /m/ separately was logical in terms of the tendencies of categorization in L1 and L2.

In sense of PAM, some participants perceived the nasal /n/ and /m/ in their own inventory as a Two Category (TC) assimilation. In other words, some participants who had spent more than 18 months in the US were successful in distinguishing /n/ from /m/ as distinct phonemes. For instance, these participants perceived /n/ and /m/ in the word pair ***lime***-*line* as a TC assimilation. On the other hand, some participants with limited exposure to English in the US discriminated the /m/ and /n/ as a Category Goodness (CG) difference, since they perceived the phoneme based on their intermediate abilities (Best & Tyler 2007). For example, they assimilated /n/ and /m/ as a CG difference where they were goodness-to-fit. On the other hand, some participants who had only 6 months in the US perceived /n/ and /m/ as a Single Category (SC) assimilation, where they were not able to distinguish between them as separate phonemes. For instance, they were not able to assimilate the /n/ and /m/ in the word pair *line*-***lime*** as distinct phonemes.

It is important to mention that English /n/ and /m/ are ranked as the most similar sounds among all other English consonant phonemes acoustically. Thomas (1992) made a similarity index among 40 English phonemes, in which he ranked phoneme pairs from most to least similar. Thomas's similarity index suggested that /m/ and /n/ were more similar to each other than either /n/ and /ŋ/ or /m/ and /ŋ/ were. Therefore, a higher degree of similarity between /m/ and /n/ in English codas may cause difficulties for L2 learners, especially in earlier stages of L2 learning.

In other words, Saudi ESL learners who committed errors in the contrast /n/-/m/ did so because they were unable to categorize the phonemes as different phonemes. They found /n/ and /m/ to be very similar, which might have led them to encounter perceptual difficulties in choosing the word with the correct recorded phoneme. The learners with greater exposure to English were able to perceive them differently. The results for this contrast were consistent with Aoyama's (2003) results, which found that the English nasal contrast /n/-/m/ in coda position was not very difficult for Japanese perceivers who had more exposure to English.

Another piece of evidence is that sounds in coda position are more marked than those in onset or medial positions, which indicates that acquisition of L2 sounds in coda position should be acquired in more advanced stages of L2 acquisition (Eckman 2008). Therefore, Saudi learners of English encountered difficulties in categorizing English sounds in coda position, in particular those who were not familiar with English sounds even when those sounds exist in the Arabic phonemic inventory.

4.2. The contrast /n/-/ŋ/.

Dissimilar results were noticed in the contrast /n/-/ŋ/. More specifically, most participants had significant errors in the majority of the word pairs. In addition, the influence of length of exposure had no effect since the participants who were in the US for over 22 months made significant errors as well as the participants who were in the US for only 6 months. The numbers and percentages of errors for the contrast /n/-/ŋ/ are shown in Table 9. The underlined words were those that actually appeared on the recording.

TABLE 9. Number of errors and their distribution in word pairs with the contrast /n/-/ŋ/.

Pairs	Number of Participants	Mean	Standard Deviation	Percentage of Errors
thin **thing**	24	.79	.41	19%
lawn **long**	24	.62	.49	15%
kin **king**	24	.54	.50	13%
sin **sing**	24	.46	.51	11%
son **sung**	24	.42	.50	10%
lawn long	24	.12	.33	3%
son sung	24	.04	.20	1%
kin king	24	.04	.20	1%
thin thing	24	.04	.20	1%
sin sing	24	.00	.00	0%

In regard to how the participants perceived the word pairs in this contrast, the most participants encountered challenges in discriminating between /n/ and /ŋ/. For example, in the word pair ***thing*-*thin***, the participants were unable to choose the correct recorded phoneme with almost an error rate of 19%. This revealed the degree of difficulty in perceiving /n/ and /ŋ/ as two separate phonemes. In a similar fashion, the participants in the word pair *lawn-**long*** had an error rate of 15%. Additionally, the word pair ***king*-*kin*** indicated that the participants had a problematic categorization in this contrast because they perceived the wrong phoneme with an error rate of 13%. The error rate in the word pair *sin-**sing*** was 11%, whereas in ***sung*-*son*** it was 10% .

Interestingly, the word pairs ***thin***-*thing*, ***kin***-*king*, and *sung*-***son*** had the same percentage of errors, 1%. Furthermore, these pairs of words had the smallest number of errors compared to other word pairs ending with /ŋ/ in this contrast. The participant responses for the word pair *sing*-***sin*** contained no errors. Finally, the participants' responses for the word pair *long*-***lawn*** show less difficulty since it had an error rate of only 3%.

No influence from length of exposure to English in the contrast /n/-/ŋ/ can be seen since the participants had errors in perceiving the /n/ and /ŋ/ as distinct phones regardless of their length of exposure. Table 10 shows the nature of the influence of length of exposure for this contrast.

TABLE 10. The influence of length of exposure in the nasal contrast /n/-/ŋ/.

Pair	**Number of Participants**	**Pearson Correlation**	**Significant (2-Tailed)**
The contrast /n/-/ŋ/	24	- .349	.095

Although a negative correlation was also found in relation to error rate in distinguishing /n/ from /ŋ/, the correlation was not significant. This implies that length of exposure is not as an important factor as in the contrast /n/-/m/. That is, some participants with longer length of exposure had a substantial number of errors in perceiving the difference between /n/ and /ŋ/. In other words, these results did not support the hypothesis that length of exposure would always be a positive influence on perceiving this contrast more accurately.

The fundamental reason why Saudi ESL learners were not able to categorize the English nasal phonemes /n/ and /ŋ/ as two distinct phonemes was because they were not aware of their allophonic distribution. Specifically, they categorized /n/ more accurately than /ŋ/ because it already existed in their perceptual inventory as a separate phoneme. On the other hand, they were

not aware of /ŋ/ as a separate phoneme because /ŋ/ is absent from their native perceptual inventory. As a result, they transferred /n/ as a single phoneme for the two different phonemes, /n/ and /ŋ/, when they attempted to perceive these English phonemes.

Along the same lines, English [n] is a good example of Arabic /n/. So, goodness of fit would suggest that English [ŋ] would be hard for Arabic speakers to discriminate. On the other hand, single category with a goodness of fit distinction as [n] is easily identified. For example, the participants had an error rate of only 1% in the word pair ***thin****-thing*, whereas they had an error rate of 19% in the word pair ***thing****-thin*, which clearly demonstrates their difficulties in perceiving the English nasal allophonic distribution (see Flege 1995; and Best 1995).

The same results were found by Aoyama (2003) with Japanese listeners of English, which showed that Japanese listeners were not able to categorize English /n/ and /ŋ/ as different phonemes. Aoyama attributed this to the absence of the velar nasal /ŋ/ from the Japanese phonemic inventory. Based on that, the influence of L1 perceptual dominance is highly important in the perception of L2 sounds, particularly in the case of L2 phonemes that are absent from the L1. To support this conclusion, Aoyama (2003) also stated that Korean listeners of English displayed fewer errors than Japanese listeners in the nasal contrast /n/-/ŋ/ probably because of the availability of /ŋ/ in the Korean phonemic inventory and its absence in the Japanese phonemic inventory.

Additionally, PAM provided another explanation for the nature of the results for the contrast /n/-/ŋ/ in the present study. The most participants assimilated /n/ and /ŋ/ into their own inventory as an SC assimilation. In other words, the most participants were not accurately successful to discriminate between the /n/ and /ŋ/ as distinct phones regardless of their different lengths of exposure. For example, the most participants did not assimilate /n/ and /ŋ/ as distinct

phones in the word pair *lawn-long* since they committed errors by choosing /n/ as an allophone for /ŋ/ (see Best 1995; and Best & Tyler 2007).

Therefore, Saudi ESL learners perceived the /n/ and /ŋ/ as an SC assimilation because they relied on the degree of similarity between the phonemes in their Arabic and English phonemic inventories. Thus, they found that /n/ could be assimilated as a phoneme for the English phoneme /ŋ/. The same results were found in Bradlow (2008) with Japanese speakers' perception of the English /ɹ/–/l/ contrast, which revealed that Japanese learners of English assimilated /ɹ/ and /l/ as an SC assimilation because the Japanese phonemic inventory contains only two contrasting approximants, /j, w/, while the English phonemic inventory contains four contrasting approximants, /ɹ, j, w, l/. Therefore, the Japanese learners of English encounter difficultly in perceiving /ɹ/ and /l/ as a TC assimilation.

Furthermore, the nature of markedness in L2 acquisition may explain why English /ŋ/ represented such a challenge for Saudi ESL learners. Eckman (2008) indicated that the more marked a sound is, the more difficult it is to acquire, while the less marked a sound is, the easier it is to acquire. In terms of nasal sounds in the typology of markedness, the velar nasal /ŋ/ is typologically more marked than the alveolar nasal /n/. Therefore, the English alveolar /n/ is easier to acquire than the English velar /ŋ/. Based on this principle, Saudi ESL learners may acquire /ŋ/ in later stages, while the other nasals, /n/ and /m/, may be acquired in early stages because they are less marked.

To exemplify this from the participants' responses, in the word pair ***thing-thin***, the error rate was 19%, which indicated that the /ŋ/ was not easier to acquire because it is typologically more marked, particularly if it is available in an L2 phonemic inventory and not an L1 phonemic

inventory. On the other hand, the word pair *sung-**son*** displayed an error rate of only 1%, which means the alveolar nasal /n/ was easier to acquire because /n/ is less typologically marked.

4.3. The contrast /m/-/ŋ/.

The overall results for the nasal contrast /m/-/ŋ/ contained an error rate of 11.25%, which means it was not a major challenge for the participants to perceive the bilabial nasal /m/ and the velar nasal /ŋ/ as two distinct phonemes. The error rate for this contrast was obviously less than the /n/-/ŋ/ contrast, with an error rate of 30.8%, although it was still slightly higher than the /n/-/m/ contrast, which had an error rate of only 10%. The numbers and percentages of errors for the contrast /m/-/ŋ/ are shown in Table 11. The underlined words are those that actually appeared on the recording.

TABLE 11. Number of errors and their distribution in word pairs with the contrast /m/-/ŋ/.

Pairs	Number of Participants	Mean	Standard Deviation	Percentage of Errors
rim **ring**	24	.29	.46	7%
some **sung**	24	.25	.44	6%
swim **swing**	24	.20	.41	5%
slim **sling**	24	.20	.41	5%
brim **bring**	24	.12	.33	3%
swim swing	24	.04	.20	1%
slim sling	24	.00	.00	0%
brim bring	24	.00	.00	0%
rim ring	24	.00	.00	0%
some sung	24	.00	.00	0%

By looking carefully at the given ten word pairs containing the contrast /m/-/ŋ/, it can be seen that the word pair *rim-ring* had the highest number of errors, with a rate of 7%, compared to the other word pairs. In a similar vein, the pair *some-sung* contained a rate of 6%. The word pairs *swim-swing* and *sling-slim* had the same percentage of errors, 5%. Finally, among the word pairs displaying errors for this contrast *bring-brim* had the fewest, with a rate of only 3%. Interestingly, the participants' responses in the word pairs *slim-sling*, *brim-bring*, *ring-rim*, and *sung-some* displayed no errors. Similarly, the word pair *swing-swim* showed an error rate of only 1%.

By taking the influence of length of exposure in the contrast /m/-/ŋ/ into consideration, Table 12 shows there is a negative correlation that indicates that errors may decease with length of exposure.

TABLE 12. The influence of length of exposure in the nasal contrast /m/-/ŋ/.

Pair	**Number of Participants**	**Pearson Correlation**	**Significant (2-Tailed)**
The contrast /m/-/ŋ/	24	- .444	.03*

Those participants who had less than a year in the US showed a slightly higher rate of errors in the contrast /m/-/ŋ/, particularly in word pairs that had the word containing /ŋ/ underlined. The error rate declined as length of exposure increased. This indicated that length of exposure played a considerable role in improving participant ability to perceive the /m/-/ŋ/ contrast in coda position.

Even though the nasal velar /ŋ/ was present in both contrasts, it was mainly problematic in the perception of the /n/-/ŋ/ contrast. There are several possible reasons why the number of errors in this contrast was less than in the /n/-/ŋ/ contrast. First, in the contrast /n/-/ŋ/ Saudi ESL learners perceived /n/ as a single phoneme for two different phonemes, /n/ and /ŋ/, while in the

contrast /m/-/ŋ/ Saudi ESL learners considered /m/ as a distinct phoneme and /n/ as a phoneme of /ŋ/. Therefore, Saudi learners of English perceived the contrast /m/-/ŋ/ more accurate than the contrast /n/-/ŋ/.

Based on the above, English /m/ is a good example of Arabic /m/, whereas English [ŋ] is a bad example of Arabic /n/. Therefore, we would expect good identification of [m]. Additionally, we would expect bad identification of [ŋ]. The expectation would be that speakers would hear [ŋ] as /n/ if they could categorize it at all. /n/ was not an option in the answer sheet. Error rate was lower than it was for /n/ vs. /ŋ/ because participants rejected /m/ as an answer and chose /ŋ/ as a result.

Second, some participants, especially those who had greater exposure to English, categorized /m/ and /ŋ/ as distinct phonemes. This could be related to participants' perceptual experience in categorizing English phonemes, even those unavailable in their L1 phonemic inventory. For example, some participants in the word pair ***bring-brim*** categorized the velar /ŋ/ as a separate phoneme even though /ŋ/ does not exist in the Arabic phonemic inventory. On the other hand, those participants with less exposure to English did not categorize /ŋ/ as a separate phoneme in the word pair *rim-ring*, which could be explained by taking into account their inability to categorize L2 phonemes absent from their L1 phonemic inventory. However, they categorized the /m/ in the word pair ***rim-ring*** as a distinct phoneme and therefore realized the L2 allophonic distribution of /m/. This means they encountered a problematic perception in terms of L2 categorization (see Flege 1995; and Best 1995).

Another piece of evidence can be seen from the standpoint of the PAM. Some participants, in their early stages of perceiving English phonemes, perceived /m/ and /ŋ/ as a SC assimilation and treated these different phonemes as a single phoneme. For example, some less

experienced participants were not able to perceive the /ŋ/ accurately in the word pair *some-sung*. Some participants with more exposure to English displayed more accurate perceptual abilities and could perceive the /m/ and /ŋ/ as distinct phones. This was an example of a TC assimilation, which reflects a greater accuracy in categorizing English nasal phonemes separately. For instance, some participants showed fewer errors in the word pair *swim-swing*. PAM therefore could be seen to play a significant role in the perceptual abilities of the participants (see Best & Tyler 2007).

The MDH may provide another explanation for the influence of length of exposure that allowed Saudi ESL learners to perceive the /m/-/ŋ/ contrast more accurately. As previously mentioned, more marked phonemes are more difficult to acquire in an L2 than less marked phonemes (Eckman 2008). In other words, the velar /ŋ/ is typologically more marked than the bilabial /m/ in the /m/-/ŋ/ contrast. Under this analysis, some participants first acquired the English /m/ and in later stages of English learning were able to acquire /ŋ/. These findings were in keeping with those of Hsu (2013) in regard to Mandarin and Min speakers of English who preferred to use the English nasal /n/ instead of others nasals. In both cases, some participants' responses were likely influenced by the rules of markedness in IL production and perception since some participants in these studies produced and perceived less marked rather than more marked sounds in early stages of learning English.

Additionally, OM and OPM could be used to clarify how Arabic phonological features were transferred into English. OM postulates that transfer between an L1 and an L2 plays a major role in their ability to perceive L2 sounds. Over time, its impact decreases while developmental processes increase (Major 2001). Based on this principle, Saudi ESL learners transferred their Arabic phonemic features into English in the early stages of learning, and as

already stated, /ŋ/ is absent from the Arabic phonemic inventory. For instance, some participants with less exposure time transferred their Arabic phonemic features into English in the word pair *rim-ring*. As a result, this word pair had more errors than the other word pairs featuring the contrast /m/-/ŋ/.

In contrast, some participants with more exposure time were able to categorize /m/ and /ŋ/ by relying on their developmental processes in L2 phonological acquisition, such as the influence of markedness on perceiving L2 sounds. In other words, some more experienced Saudi ESL learners perceived the /ŋ/ in this contrast as a distinct phoneme because they used universal rules to perceive it instead of transferring their Arabic phonological features to do so. It was therefore observed that length of exposure allowed the participants to develop their phonological processes in the sense of L2 phonemic acquisition.

Overall, the results indicated that the error rate of 10% in perceiving the /n/-/m/ contrast was lower compared to the other two nasal contrasts. In a similar fashion, the error rate in the /m/-/ŋ/ contrast was 11.25% but was still less than the number of errors for the /n/-/ŋ/ contrast, which had an error rate of 30.8%. This showed that the /n/-/ŋ/ contrast was more challenging for the participants compared to the other two English nasal contrasts.

CHAPTER 5

CONCLUSION

The aim of the present study was to investigate the perception of three English nasal contrasts, /n/-/m/, /m/-/ŋ/, and /n/-/ŋ/, in coda position by Saudi ESL learners. It sought to determine which of these English nasal contrasts participants found more difficult to perceive in coda position. Along the same lines, the study also aimed to determine whether the length of exposure to English in the United States played a role in perceiving these contrasts more accurately.

The results revealed that Saudi ESL learners had more difficulty perceiving the contrast /n/-/ŋ/, regardless of their length of exposure. In other words, they were not able to categorize the /n/-/ŋ/ as two distinct phonemes. On the contrary, the contrast /m/-/ŋ/ showed a gradual improvement between more- and less-experienced speakers since some participants with less exposure to English encountered difficulties in discriminating /m/ and /ŋ/ as two separate phonemes. On the other hand, some participants with greater exposure to English were able to categorize /m/ and /ŋ/ as different phonemes. Finally, the /n/-/m/ contrast revealed that the participants had no notable difficulties in categorizing /n/ and /m/ as distinct phonemes with regard to their length of exposure since those with more exposure were able to categorize /n/ and /m/ as two distinct phonemes more accurately.

The findings of the present study supported the SLM and PAM since these models primarily concentrate on categorization of L1 and L2 sounds in L2 acquisition. In other words, the nature of each contrast in this study indicated that the similarity and dissimilarity of the English phonemic inventory to the Arabic phonemic inventory was highly important in the perception of English nasal sounds with greater accuracy. As a result, the absence of the English

phoneme /ŋ/ from the Arabic phonemic inventory caused difficulties for Saudi learners of English. For example, they had difficulties perceiving the word pairs with the contrast /n/-/ŋ/ as separate allophones. On the other hand, the contrast /n/-/m/ led Saudi ESL learners to accurately categorize /n/ and /m/ as distinct phonemes because the of nature of their categorization in the phonemic inventories of Arabic and English (see Flege 1995; Best 1995; and Best & Tyler 2007).

Additionally, the results agreed with the MDH since the MDH claims that if a sound is more marked in an L2, it is difficult to acquire, whereas a less marked sound is less difficult to acquire (Eckman 1977). The findings in this study are therefore consistent with the principles of the MDH. To provide a more specific explanation, Saudi ESL learners encountered difficulties in acquiring the velar nasal /ŋ/ as a separate phoneme in early stages of English learning since /ŋ/ is typologically more marked than the other nasal phonemes, /n/ and /m/. The Saudi ESL learners with more exposure were able to perceive /ŋ/ as separate allophone, even though this only occurred in the contrast /m/-/ŋ/, while in the contrast /n/-/ŋ/ they were not able to perceive /ŋ/ in later stages of English learning regardless of their length of exposure.

The findings of the present study were also compatible with the OM and OPM. According to the OM and OPM, transferring L1 characteristics into an L2 is a major process in L2 phonological acquisition, especially in early stages of L2 learning. In advanced stages of L2 learning, the influence of L1 characteristics declines, whereas the influence of developmental processes, such as markedness principles and other universal rules, increases (Major 2001). In keeping with these principles, Saudi ESL learners transferred their Arabic phonemic features in the early stages of learning. By receiving more exposure to English, Saudi ESL learners relied more heavily on universal rules in order to perceive the English nasal contrasts.

Perception is a crucial factor in learning any L2, and the present study showed perceptual problems among Saudi ESL learners. As a result, it is instructive to provide pedagogical implications to help improve Saudi ESL learners' perceptual abilities. Before introducing some strategies to help overcome an L2 learner's perception problems, it must be mentioned that the degree of similarity between the L1 and L2 sounds should be taken into account because the effect of the L1 plays a major role in perceiving L2 sounds. For example, Saudi ESL learners accurately perceived English /n/ and /m/ due to the availability of those sounds in the Arabic phonemic inventory. On the other hand, Saudi ESL learners failed to accurately perceive English /ŋ/ because of its absence from the Arabic phonemic inventory.

First of all, Saudi ESL learners should spend a longer time listening to the English nasal sounds since the results of the present study revealed that the length of exposure to English played a fundamental role in improving the perception of nasal contrasts by Saudi ESL learners. It would not be enough, however to merely increase the amount of time spent listening to English. Each stage of learning has its own particular dilemmas requiring particular methods to deal with them effectively. Therefore, ESL teachers should pay attention to the nature of Saudi learners' stage of learning in order to find appropriate types of listening material to remedy their perceptual errors.

Another pedagogical implication is the presence of L2 sounds that are not available in the L1 phonemic inventory. ESL teachers should take into consideration the fact that the English velar nasal /ŋ/ does not exist in the Arabic phonemic inventory. In other words, ESL teachers should teach Saudi ESL learners to discriminate between English nasal sounds based on their representation in the English phonemic inventory instead of trying to perceive the English nasal sounds based on Saudi learners' L1 phonemic system. Saudi learners of English would learn to

perceive /ŋ/ in the words that contain it instead of perceiving it as /n/. Therefore, perception of L2 sounds based on the L2 sound system is highly important to avoid creating a problematic perception of L2 sounds.

Finally, the improvement of listening strategies should be based on discriminating between English sounds according to the different environments in which they appear. As a further explanation, the English nasal sounds are more difficult to perceive word-finally than in onset or medial environments. As a result, ESL teachers should focus on teaching Saudi ESL learners to pay more attention to sounds in word-final position in order to perceive those words with a greater accuracy. This is because the degree of similarity between the English nasal sounds makes perceiving them separately in coda position difficult.

Future directions along this line of research should address three aspects that were not included in the present study because of the limitations on the scope of the research questions. First, the perception task used in this study could also be used to conduct a study on production. The aim of such a study would be to examine how Saudi ESL learners produce the English nasal sounds in order to determine whether they encounter the same difficulties that were observed in the perception task of this study. Another point of interest would be to conduct a perception task for onset, rather than coda, position. Such a study would only include the English nasal contrast /n/-/m/ word-initially and /m/-/ŋ/ and /n/-/ŋ/ word-medially to determine the role of positional effects on perception. Finally, if disyllabic words were used instead of monosyllabic words, such an instrument could possibly result in different findings.

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APPENDICES

APPENDIX A

LENGTH OF EXPOSURE TO ENGLISH

The first category of participants, with 22 months exposure or more.

Participant	Length of exposure to English
1	36 months
2	30 months
3	24 months
4	24 months
5	24 months
6	24 months
7	24 months
8	24 months
9	24 months
10	22 months

The second category of participants, with 18 months exposure or less.

Participant	Length of exposure to English
11	18 months
12	18 months
13	12 months
14	12 months
15	12 months
16	12 months
17	10 months
18	9 months
19	8 months
20	6 months
21	6 months
22	6 months
23	6 months
24	6 months

APPENDIX B

Demographic Information

Dear participant,

I would like to thank you for participating in the present study. This study is not meant to evaluate your English proficiency or serve as any other kind of examination. Rather, it is conducted to collect information for my MA thesis. Therefore, please provide accurate responses and take your time to listen to the words you will hear and to choose the best answer.

Best regards,

Turki Alharbi

Please check the appropriate answer or fill in the relevant information.

1. What is your age and gender?

    a) Age: b) Gender:

2. What academic degree are you currently pursuing?

    a) Undergraduate

    b) Graduate MA

    c) Graduate PhD

3. Do you know any language(s) other than Arabic and English? If yes, please list them below.

_____

4. How long have you studied English in Saudi Arabia? Please provide years and months, such as 1 year and 5 months.

_____

5. How long have you lived in the US? Please provide years and months, such as 1 year and 5 months.

_____

6**.** Where have you studied English? Check the answer that best describes you.

a) In Saudi Arabia b) In the US

c) Both in Saudi Arabia and the US d) Other _____

APPENDIX C

The Word List

1. heat	hit	11. sung	son	21. seem	scene	31. sling	slim
2. sin	sing	12. slim	sling	22. swim	swing	32. sung	son
3. wig	wag	13. same	sane	23. team	tame	33. tack	tag
4. swing	swim	14. hit	hid	24. sing	sin	34. lime	line
5. seem	scene	15. kin	king	25. kit	kid	35. sung	some
6. cap	cab	16. some	sung	26. hem	hen	36. king	kin
7. thin	thing	17. line	lime	27. ring	rim	37. warm	worn
8. rim	ring	18. lawn	long	28. thing	thin	38. bring	brim
9. hen	hem	19. brim	bring	29. bit	beat	39. long	lawn
10. tin	teen	20. worn	warm	30. same	sane	40. pig	big

Note: The underlined words were recorded on a tape. The underlines, however, were not on the sheet for the participants.

APPENDIX D

CONSENT FORM

Dear participant,

My name is Turki N. Alharbi. I am a graduate student in the Department of Linguistics at Southern Illinois University at Carbondale (SIUC). I am currently developing a research study as part of my Master's Degree in Applied Linguistics. In this study, I will investigate issues related to the perception of certain English sounds by Saudi ESL learners. If you agree to participate in my study, you will be asked first to fill out demographic information (gender, academic status, age, length of exposure, etc.) about yourself. Then you will be asked to listen to 40 words and choose one of the given choices in the answer sheet. It will take about 20 minutes to complete. All your responses will be CONFIDENTIAL. Your participation in the test is VOLUNTARY. If you agree to take part in the investigation, you need to sign this form. However, if you change your mind, you may withdraw at any time without hesitation. The people who will have access to the data will be myself and the thesis advisor, Dr. James Berry. After the study is completed, the raw data sheets and their link to participants' names will be destroyed as each participant's data will be given a numerical code. All possible steps will be taken to protect your identity.

For additional information, you can contact me, Turki N. Alharbi, Project Researcher, 505 S Poplar St Apt. 4, Carbondale, IL, 62901, tel.: (618) 303-4335, email: Turki1984@siu.edu or Dr. James Berry, Research Advisor, Department of Linguistics, Faner Building 3230 SIUC, Carbondale, IL, 62901, tel.: (618) 453-3414, email: jberry@siu.edu

Please, read the statement below and check if you **agree** or **do not agree** with it. Then, sign and date this form.

- -

“I agree I do not agree to participate in the study.”

Signature _____ date _____

This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail siuhsc@siu.edu

VITA

Graduate School
Southern Illinois University

Turki Nafea L. Alharbi

Turki.Alharbi84@gmail.com

Arab Open University
Bachelor of English Language & Literature, August 2011

Thesis Title:
The Perception of English Syllable-Final Nasals by Saudi ESL Learners

Major Professor: Dr. James Berry