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La prononciation des locuteurs français en anglais L2 en contexte de communication scientifique : entrave ou facilitation de l'intelligibilité et de la compréhensibilité du discours ?

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Résumé

Lorsqu'un chercheur français présente ses travaux en anglais dans un contexte international, sa prononciation est-elle un obstacle à l'intelligibilité et la compréhensibilité de son discours ou au contraire, une difficulté désirable qui conduit les auditeurs à focaliser davantage leur attention ? De nombreux travaux ont été menés sur les différentes variétés L2, mais peu de recherches se sont concentrées sur le discours en L2 dans un contexte académique. Pourtant, les enjeux associés à l'efficacité de la communication dans ce contexte précis sont importants à la fois pour les individus au plan social mais aussi pour le développement de la recherche française à l'international. La thèse se fonde sur une approche interdisciplinaire avec deux études : 1) un protocole sociophonologique qui permet d'examiner le système interphonologique de chercheurs français en psychologie, et 2) un protocole expérimental visant à évaluer l'impact d'une prononciation française sur l'intelligibilité et la compréhensibilité en fonction de la langue maternelle (L1) de l'interlocuteur (anglais ou français) et du degré d'accent (marqué, non-marqué ou L1).

Dans la première étude inspirée du cadre sociophonologique variationniste du programme *Phonologie de l'anglais contemporain* (PAC), treize chercheurs français en psychologie ont réalisé différentes tâches en production orale, constituant ainsi le corpus CO-LLAPSE dédié à l'analyse acoustique et descriptive. Une condition contrôle pour la deuxième étude est élaborée sur la base de ces mêmes tâches réalisées par trois locuteurs anglophones avec un accent *Southern British English* (SBE). L'analyse acoustique se concentre sur sept contrastes de vocaliques en anglais : /ɪ/ - /iː/, /æ/ - /ʌ/, /ɒ/ - /ɔː/, /ʊ/ - /uː/, /æ/ - /ɑː/, /ɜː/ - /ʌ/ et /æ/ - /e/. Les scores Pillai révèlent que les informateurs ne maintiennent pas toujours les distinctions de contraste vocalique, bien qu'il y ait une variabilité substantielle entre les informateurs. Les analyses descriptives de /h/, /θ/ et /ð/ montrent que la fricative glottale est sujette à une variabilité considérable, la moitié des participants l'omettant fréquemment,

tandis que les fricatives dentales sont plus souvent produites dans leur forme cible et les substitutions semblent varier en fonction des contraintes phonotactiques. Les échanges avec les chercheurs français attestent du fait que la prononciation est un sujet de préoccupation des chercheurs lorsqu'ils doivent communiquer en contexte académique. Il est donc important d'étudier son impact sur les auditeurs.

La deuxième étude vise à évaluer l'intelligibilité et la compréhensibilité des productions orales de chercheurs français issues du corpus constitué dans la première étude. Les stimuli choisis comprennent trois conditions d'accent : un accent français marqué, un accent français non marqué et un accent SBE. L'évaluation est conduite auprès de 162 participants francophones et anglophones dans trois tâches de perception en reconnaissance de mots isolés, de mots insérés dans des phrases, et de compréhension du discours. Au-delà des performances examinées lors de ces tâches, des échelles de Likert relatives à des jugements de certitude, d'évaluation de la charge cognitive ressentie, de compréhensibilité et du degré d'accent ont également été recueillies. Les résultats montrent que les auditeurs anglophones obtiennent de meilleures performances dans les tâches de reconnaissance de mots lorsqu'ils écoutent un accent SBE plutôt qu'un accent français, mais qu'il n'y a pas de différence significative en fonction de l'accent chez les auditeurs francophones. Cependant, lors de l'écoute du discours, les deux groupes ont obtenu de meilleurs résultats lorsqu'ils ont écouté un accent SBE. Les jugements perceptuels ont suivi une tendance similaire. Cette étude fournit les premiers résultats sur la façon dont les auditeurs perçoivent l'accent français en contexte académique.

Abstract

When French researchers present their research in English in an international context, is their accent an obstacle to speech intelligibility and comprehensibility, or on the contrary, a desirable difficulty that leads listeners to focus their attention more closely on the speech signal? Considerable work has been done on the different varieties of L2 speech, but little research has focused on L2 speech in an academic context. Yet, the implications associated with effective communication in this precise context are important, both for individuals at the social level and for the development of French research at an international level. This dissertation is based on an interdisciplinary approach with two studies: 1) a sociolinguistic protocol, which makes it possible to examine the interphonological system of French Psychology Researchers, and 2) an experiment aimed at evaluating the impact of French-accented speech on intelligibility and comprehensibility depending on both the first language (L1) of the listener (English or French) and the degree of accent (marked, unmarked or L1).

The first study is conducted within the variationist sociophonological framework of the *Phonologie de l'anglais contemporain* (PAC) programme. Thirteen French psychology researchers performed various oral production tasks, which constitute the CO-LLAPSE corpus used for acoustic and descriptive analysis. Three English speakers of *Southern British English* (SBE) carried out the same tasks to create a control condition for the second study. The acoustic analysis focuses on seven English vowel contrasts: /ɪ/ - /iː/, /æ/ - /ʌ/, /ɒ/ - /ɔː/, /ʊ/ - /uː/, /æ/ - /ɑː/, /ɜː/ - /ʌ/ and /æ/ - /e/. Pillai scores reveal that the informants do not always maintain vowel contrast distinctions, however there is substantial variability among informants. Descriptive analyses of /h/, /θ/ and /ð/ show that the glottal fricative is subject to considerable variability with half of the participants frequently omitting it, whereas the dental fricatives are more frequently produced in their target-like form and

substitutions appear to vary depending on phonotactic constraints. Discussions with French researchers show that having a French accent is a concern for researchers when they have to communicate in an academic context. As such, it is important to investigate the impact of accentedness on listeners.

The aim of the second study was to evaluate the intelligibility and comprehensibility of the French researchers' productions taken from the corpus developed in the first study. The chosen stimuli consisted of three accent conditions: a marked French accent, an unmarked French accent and an SBE accent. Three perception tasks were undertaken by 162 participants whose L1 was either French or English. They had to recognise isolated words, words in the context of sentences and understand continuous speech. In addition to performance on these tasks, Likert scales relating to judgements of certainty, evaluation of cognitive load, comprehensibility and degree of accent were also collected. Results show that English listeners perform better on word recognition tasks when listening to SBE-accented speech than French-accented speech, but French listeners' performances did not vary depending on the accent they heard. However, when listening to continuous speech both groups performed better when listening to SBE-accented speech. Perceptual ratings followed a similar pattern. This study provides the first results of how listeners perceive French-accented speech in an academic context.

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List of abbreviations

AWL Academic Word List

CV Consonant Vowel

CPH Critical Period Hypothesis

EFL English as a Foreign Language

EIL English as an International Language

ELF English as a Lingua Franca

ESL English as a Second Language

EE Estuary English

GA General American

GSL General Service List

HVPT High Variability Phonetic Training

L1 First Language

L2 Second Language

PAC Phonologie de l'anglais contemporain

PAM Perceptual Assimilation Model

RP Received Pronunciation

SBE Southern British English

SLM Speech Learning Model

SNAE Standard North American English

SOT Standard Orthographic Transcription

VOT Voice Onset Time

Introduction

With the English language being used as a lingua franca across the globe (Crystal, 2003), there are a number of situations and contexts in which it is important to be considered an intelligible and comprehensible speaker. Academia is one such context (Altbach, 2013). Researchers have precious knowledge to share with the international community and also desire to be perceived as competent and professional. However, speaking English comes with challenges, whether it be English as a Second Language (EFL) where the language serves an institutional and societal function within the community, English as a Foreign Language (EFL) where it is primarily used in the classroom (Ellis, 1994), or in the case of L2 researchers, English as an International Language (EIL) and English as a Lingua Franca (ELF) where it is used for communication with the international community (Jenkins, 2000).

One of the challenges is that speaking English, or any language for that matter, requires acquiring a new phonological system and yet despite many years of learning, second language (L2) speakers rarely attain native pronunciation norms, with Received Pronunciation (RP) and General American (GA) being the two most frequently taught pronunciation models around the world. Instead, many L2 speakers retain a foreign accent, which may not be problematic in itself unless the accent renders the speaker unintelligible and incomprehensible.

The desirability of adhering to native norms has also been called into question. Research has shown that L2 speakers' ability to acquire native-like pronunciation decreases with age, making it a difficult goal to achieve (Flege et al., 1995; Hakuta et al., 2003). In addition, in a world where the majority of English users are now L2 speakers, it can be viewed as an unnecessary goal for learners (Morley, 1991; Jenkins, 2000), many of whom simply wish to be understood. For this reason, research has turned to what makes speech intelligible and comprehensible rather than how to make learners sound like native speakers (Jenkins, 2000; Levis, 2005, 2022; Munro & Derwing, 2015).

One of the difficulties for researchers and teachers of English, however, is to ascertain which production variants cause intelligibility and comprehensibility breakdowns. After years of teaching EFL in France to children and adults alike, this dissertation is motivated by a desire to help French learners become intelligible communicators of English. In addition, as a member of the CLLE research laboratory, I have witnessed the issues at stake for L2 researchers who must use English for research. Questions of identity, professionalism or negative perceptions of foreign accents often arise, but a desire to be understood is a crucial objective.

Knowing the causes of communication breakdowns is not an easy task. They can stem from both production and perception difficulties (Cutler et al., 1986; Derwing & Munro, 1997; Jenkins, 2000) and even environmental and attitudinal factors can contribute to reducing or enhancing the effectiveness of communication (Chiu & Neel, 2020; Munro, 1998; Pélissier & Ferragne, 2022). The first language (L1) of the speakers/listeners also has a significant impact on intelligibility and comprehensibility since sharing the same L1 or being familiar with the L2 accent presented has been shown to be a great facilitator (Bent & Bradlow, 2003; Gass & Varonis, 1984; Matsuura, 2007; Smith & Bisazza, 1982). The role of accentedness, in other words, speech that differs markedly from L1 norms (Bradlow & Bent, 2008), is not fully understood. For this reason, the relationship between accentedness and L1 merits investigation.

It is possible that even when utterances are intelligible, they may require considerable effort in terms of cognitive resources (Van Engen & Peelle, 2014). For example, by increasing processing times (Munro & Derwing, 1995b) or by affecting listeners ability to judge the truth value of statements (Lev-Ari & Keysar, 2010). Alternatively, accentedness could act as a desirable difficulty (Bjork, 1994; Bjork & Bjork, 2011) that would encourage listeners to pay closer attention and, thus, favour comprehension. Furthermore, the cognitive resources required may depend on the degree of accentedness of the speech in question.

In terms of French-accentedness, numerous pronunciation difficulties are cited in the literature (Capliez, 2011; Kenworthy, 1987; Mees & Collins, 2013; Rouaud et al., 2022) but it is unclear which difficulties may cause communication to break down. That is why it is important to investigate this phenomenon. Recording the realisations of French Psychology

researchers helps to contribute to the description of the French interphonological system. In addition, few studies have focused solely on the intelligibility of French speakers of English. Therefore, the aim of the present dissertation is to explore the relationship between French-accentedness, intelligibility, comprehensibility and cognitive load in a context of scientific communication. In order to do this, it proposes a combination of acoustic analysis and perceptual tests.

The outline of the dissertation is as follows. Part I (*From Perception to Production: Exploring the Intelligibility and Comprehensibility of Speech*) provides the theoretical considerations underpinning this research. Chapter 1 discusses the context in which L2 researchers use English and the issues involved in choosing pronunciation goals. It also reviews different definitions and empirical studies of intelligibility and comprehensibility and highlights trends found in different studies. Chapter 2 examines the cognitive processes involved in speech perception and how they interact with intelligibility and comprehensibility. It also concerns how speech is perceived and acquired both from an L1 and an L2 perspective, looking at differences between the two and then focuses on perception difficulties for L2 listeners. In chapter 3, we discuss the different pronunciation models used in the classroom and examine the notion of error. We then consider the methods used in the field of pronunciation teaching and review previous studies comparing the impact of segmental and suprasegmental features on intelligibility and comprehensibility. Finally, we discuss production difficulties that have been observed in L1 French speakers.

Part II (*Corpus of L2 Academic Psychology English: CO-LLAPSE*) concerns the corpus of French Psychology researchers created for this dissertation. Chapter 4 provides the methodology used for our fieldwork and data collection. The protocol is described in detail and the methodological framework is discussed. This dissertation follows the *Phonologie de l'anglais contemporain* (PAC) framework, but our protocol has been adapted to incorporate elements that emulate an academic context. Chapter 5 gives detailed descriptions of data extraction methods and acoustic and descriptive analyses and Chapter 6 discusses the results of the analyses, along with their limitations and perspectives for future work.

Part III (*Processing French-Accented Speech: From Isolated Words to Speech*) presents the perceptual experiment used to evaluate the intelligibility and comprehensibility of the French

Psychology researchers. In Chapter 7, the methodology involved in creating the perception tests is presented. A description of the protocol and participant profiles is also provided as well as decisions pertaining to the data preparation. Chapter 8 presents the results of the experiment and discusses the relationship between intelligibility, comprehensibility, French-accentedness and cognitive load in light of the findings.

Publications and Presentations

The research carried out for this dissertation and in collaboration with the *PICL!* research project[1] resulted in the following publications and presentations:

- O'Callaghan, V., Przewozny-Desriaux, A., & Lemarié, J. (2025). The Intelligibility and Comprehensibility of French-accented English in an Academic Context: from Isolated Words to Speech Comprehension, *Journal of Second Language Pronunciation*.
- O'Callaghan, V. (in creation) Corpus of L2 Academic Psychology English (CO-LLAPSE). COCOON - https://cocoon.huma-num.fr (Huma-Num - CNRS).
- O'Callaghan, V., Przewozny-Desriaux, A., & Lemarié, J. Comment des interlocuteurs ayant des langues maternelles et des accents différents se comprennent-ils lorsqu'ils doivent parler anglais en contexte académique ? Des mots isolés au discours. *Journée d'étude au laboratoire CLLE*. Université de Toulouse-Jean Jaurès, July 2024, Toulouse, France.
- O'Callaghan, V., Przewozny-Desriaux, A., & Lemarié, J. The intelligibility of French-accented speech in an academic context: an experimental method with implications for pronunciation teaching. *ARDAA 2024 Teaching and Learning English as a Foreign Language in educational settings: Issues and specificities*, Université Paris-Sorbonne Nouvelle, June 2024, Paris, France.
- O'Callaghan, V., Przewozny-Desriaux, A., & Lemarié, J. The Intelligibility and Comprehensibility of French-accented English in an academic context: how do L2 productions

[1] *Phonologie Incarnée de l'anglais au Collège Labitrie!*, described in 3.1.2.

affect recognition? *Embodied and Ecolinguistic Approaches to Cognitive Linguistics - 9e conférence internationale de l'Association française de linguistique cognitive (AFLiCo)*, May 2024, Lyon, France.

- Rouaud, J., O'Callaghan, V., Przewozny-Desriaux, A., Huet, N., & Hana Younan, M-H. Méthode de phonologie incarnée dans l'enseignement/apprentissage de l'anglais au collège : Le projet *PICL!, Journée de didactique L'apprentissage incarné - Prismes-SeSyLIA*, Apr 2024, Paris Université-Sorbonne Nouvelle, France.

- Huet, N., Przewozny-Desriaux, A., Hana Younan, M-H., O'Callaghan, V., & Rouaud, J. Non-native pupil motivation in spoken English: learning English with an embodied phonology method. *Education as a hope in uncertain times*, 20th Biennal EARLI, Aug 2023, Aristotle University of Thessaloniki, Greece.

- O'Callaghan, V., Przewozny-Desriaux, A., & Lemarié, J. Sorry, could you say that again? The Intelligibility of French-accented English in an Academic Context. *16th International Conference on Native and Nonnative Accents of English*, University of Lodz, Nov 2023, Lodz, Poland.

- O'Callaghan, V., Rouaud, J., Przewozny-Desriaux, A., Huet, N., & Hana Younan, M-H. The value of embodied methods in Teaching/Learning spoken English: assessment of phonetic performance and motivation in a longitudinal study among French learners. *Spoken English varieties: interfaces and multidimensional approaches*, PAC 2023, Apr 2023, Université de Paris-Nanterre, France.

Part I

From Perception to Production: Exploring the Intelligibility and Comprehensibility of Speech

Chapter 1

Intelligibility and Comprehensibility in an Academic Context

Using English for research has socio-professional implications because it is important for researchers to be seen as credible, competent and professional. However, not all French researchers, or other L2 researchers for that matter, feel comfortable expressing themselves in English. Despite this, they need to mobilise their language skills and the knowledge of their domain in order to publish and present their work to the academic community. In this chapter, we discuss how researchers use English for academic communication, in particular the format of conference presentations. We also discuss striking a balance between a desire to improve one's pronunciation and acknowledging that eliminating a foreign accent entirely is unlikely. The notions of intelligibility and comprehensibility are then reviewed and discussed in light of empirical studies.

1.1 Using English for Scientific Communication

In the academic world, English has become the principal international language of communication (Altbach, 2013; Banks, 1999). This has implications for French researchers, who not only need to be experts in their domain but also proficient in English. The *Ministère de l'enseignement supérieur, de la recherche et de l'innovation*[2] (2025) recommends that those working as *enseignant-chercheurs* (university lecturers/professors) speak and write in another language, although it does not say which. It also suggests that they should

[2]Ministry of Higher Education, Research and Innovation

communicate high-level results within their community, both nationally and internationally. In fact, when the *Haut Conseil de l'évaluation de la recherche et de l'enseignement supérieur*[3] (2025) evaluates research laboratories, or when *enseignant-chercheurs* are evaluated for competitive positions, publishing and communicating internationally is one of the evaluation criteria. As a result, French researchers are under considerable pressure to publish and communicate their work in English. International conferences are of particular interest to this dissertation as they involve speakers and listeners from around the world communicating in English. Since speaking in public is a daunting task as it is, French researchers who do not feel confident speaking English or who feel they have a strong foreign accent, may be discouraged from presenting their work in an international context. For this reason, French researchers need to be intelligible and comprehensible communicators of English in a domain-specific context.

1.1.1 Psychology: a Specialist Discourse

Academic communication requires the use of specialist discourse, which is characterised by technical vocabulary, complex structures, and domain-specific conventions shared by a particular community (Gotti, 2008). This allows researchers to convey complex ideas with precision and communicate effectively with their peers. Unlike general language use, specialist discourse demands a high degree of familiarity with domain-specific terminology and conventions, which can pose challenges for those new to a field or working in their L2. While all researchers need to master specialist discourse when writing and publishing articles and presenting at conferences, L2 researchers also need to master English and may face difficulties linked to language use. For example, they may struggle with the high cognitive load associated with listening to or producing specialist discourse or have issues with pronunciation and intelligibility when speaking at conferences.

From a sociolinguistic perspective, specialist discourse involves individual characteristics being neutralised in favour of conventions specific to the socio-professional group to which the speaker belongs (Condamines, 1997). This means that researchers must conform to the norms of their academic community to ensure clarity and credibility. Belonging to a discourse

[3]High Council for the Evaluation of Research and Higher Education

community allows researchers to adopt formalised conventions, expectations and practices that define their discipline, making academic communication highly normative (Hyland & Bondi, 2006). As such, understanding and mastering specialist discourse is not only essential for effective communication among experts, but also crucial for contributing to the domain in question.

One of the most commonly cited or perhaps the most noticeable features of specialist discourse is the vocabulary or jargon that is specific to each domain. Indeed, there are many cases where jargon is only understood by members of the discourse community (Condamines, 2021). In an academic text, vocabulary can be organised into the four following categories: high frequency words, which make up 80% of most texts; academic words, which account for approximately 9%; technical words at 5% and low frequency words, which tend to amount to 5% (Nation, 2001). Coxhead's (2000; 2011) Academic Word List (AWL) compiles 570 word families from academic texts from across four disciplines; arts, commerce, law and science. It suggests that there is a common academic vocabulary that is used across genres. The word list excludes the 2000 most frequent word families in West's (1953) General Service List of English Words (GSL) since those high frequency words are used in non-academic language as well. Updated versions of the GSL have modernised the list but overall coverage is similar to the original (Brezina & Gablasova, 2015; Browne et al., 2013). In specialist discourse, therefore, one would expect to find that roughly 14% of the words would be different to those used in an everyday context with the combination of domain-specific and general academic vocabulary.

Xodabande and Xodabande (2020) created a corpus of Psychology research articles totalling 74 million words in order to examine the frequency and coverage of GSL and AWL tokens compared with non-GSL/AWL tokens. The authors found that GSL word families constituted 72.08% of the corpus and AWL word families accounted for 13.12%, whereas non-GSL/AWL tokens comprised 14.8% of the corpus. This is somewhat higher than what was indicated by Nation (2001) since AWL and non-GSL/AWL items together cover 27.92%. The ten most frequent non-GSL/AWL word types were *stimuli, non, scores, patients, stimulus, cognitive, emotional, score, correlation,* and *emotion.* Since technical vocabulary, which represents a high proportion of items in Psychology articles, differs depending on the discipline

in question, expertise and familiarity are particularly important in specialist discourse. They not only influence written comprehension but also facilitate the intelligibility and comprehensibility of speech.

1.1.2 Communicating at a Conference

Conferences include both spontaneous interactional language and highly normed formal language (Henderson, 2008). As such, conference presentations are difficult to classify on the continuum between written and spoken discourse since "they are highly integrated and planned, like written text, and yet they are spoken" (Henderson, 2008, p.3). It is important to consider the impact of style and register since it can affect intelligibility and comprehensibility by facilitating or impeding communication.

One of the main distinctions between written and spoken discourse is time. Spoken discourse occurs at a rapid pace and ideas may not always be fully formed before they are uttered, requiring listeners to deal with pronunciation, vocabulary, grammar, and potential incoherence in terms of structural organisation all at once. For this reason, "[s]poken text, and especially conversation, tends to be lexically lighter because interlocutors have less time to pack and unpack dense information during 'real-time'communicative events." (Nesi & Basturkmen, 2006, p.5). In contrast, written discourse affords the writer and the reader the time to organise their ideas. The writer has the opportunity to thoughtfully connect concepts and adjust the language to fit the suitable context, whereas the reader can revisit the text, look up difficult terms, jargon, or grammatical forms in a dictionary, and take breaks to allow the information to sink in. As such, written discourse tends to be dense in comparison with speech.

Since conference presentations lack the negotiation of meaning that exists in conversation, they must be prepared in advance and require more rigorous structuring devices (Nesi & Basturkmen, 2006). In that sense, presentations and lectures are closer to academic writing than conversation as they are less interactive and more rehearsed. When investigating the British Academic Spoken English (BASE) and the Michigan Corpus of Academic Spoken English (MICASE) corpora, Nesi and Basturkmen (2006) found that four word lexical bundles served the function of discourse signalling in lectures given by L1 English speakers

but were not widely used by L2 speakers. Research has also shown that while L1 speakers differ considerably in their written and spoken discourse, L2 speakers tend "to differentiate far less between written and spoken modes of communication" (Rowley-Jolivet & Carter-Thomas, 2005, p.60). If a conference presentation is extremely dense and lacks discourse signalling, it may contribute to difficulties in processing and understanding for listeners.

Another difference is that with written discourse, the writer and the reader have no immediate interaction, whereas spoken communication requires at least two people interacting at the same time. Conference presentations, on the other hand, involve partially delayed interaction. The audience may react, by laughing for example, during the presentation, but must wait until the end of the presentation to ask questions. As a result, ideas must be well structured and coherent like written discourse to maximise understanding. Unlike written communication though, researchers presenting at an international conference are likely to adapt their speech in order to be understood and appreciated by their audience. They may include humour related to their domain or famous examples of certain phenomena, and while some presentations are vulgarised for a wider audience, most research is presented to the specific discourse community in question. This means that presentations are likely to be more difficult to understand for novices in the field.

L2 researchers have the additional difficulty of having to produce and perceive spoken discourse in their L2. Speaking requires a degree of phonological, grammatical and lexical mastery and allows no time for checking. Conversely, speech processing requires word recognition and parsing, which also implies phonological, grammatical and lexical knowledge. For this reason, L2 researchers who feel less confident speaking English may be tempted to read a pre-prepared text to their audience. Banks (1999) distributed a questionnaire to French researchers and found that over 25% prefer to read a prepared text when presenting in English. While he notes that reading a prepared text is not the most effective way to communicate a message to the audience, he also acknowledges that this "gives the nonnative speaker a sense of security in a situation which he may well find daunting" (Banks, 1999, p.6). In addition, when asked to rate how difficult it is to present in English, 66% of respondents answered *very difficult* or *quite difficult*. Those responding *very difficult* almost doubled when asked how difficult it is to take part in debates and discussion. This indicates that

many French researchers lack confidence when communicating in English at conferences.

While conference presentations share many characteristics with written discourse, L2 researchers may consider trying not to read and making their presentations less dense to facilitate understanding. By rehearsing and making use of useful tools such as visual aids and notes, which help to alleviate the cost of speech processing for the listener, L2 researchers can gain confidence and be intelligible and comprehensible communicators. One factor that might undermine their confidence could be feeling self-conscious about speaking with a foreign accent. As such, it is important to adjust one's goals to find a harmonious balance between the desire to improve one's pronunciation and recognising that completely eradicating a foreign accent is improbable.

1.2 Finding the Balance

For a long time, and even today, L2 speakers were strongly discouraged from having a foreign accent and compelled to strive for native-like pronunciation of English. However, in L2 pronunciation research at least, there have been calls to focus on achieving intelligible pronunciation (Levis, 2005, 2022). One of the main reasons for this is because acquiring L1 pronunciation norms is difficult to accomplish, but also because in our ever-changing global world, it has become more acceptable to retain one's foreign-accent. Additionally, since accents are strongly tied to identity, L2 speakers may feel that modifying their accent distances them from their identity. On the other hand, researchers may wish to project a confident, professional and competent image to their interlocutors and feel that their foreign accent is an impediment to this goal. For this reason, it is important to find the right balance. While reducing a foreign accent might improve intelligibility, attaining completely native-like pronunciation is not always necessary or achievable.

1.2.1 The Repercussions of Having a Foreign Accent

Having a foreign accent can have social and professional consequences since it may lead to bias, misperceptions of competence, or discrimination in professional and social settings. That is why it is important to take into account how foreign accents are perceived by different

interlocutors. Everyone has an accent and as humans we make judgements about a person based on their accent and voice quality (Lippi-Green, 1994). We can gain a great deal of information when we listen to someone speak. We can usually infer the approximate age and gender of the speaker, sometimes the country or the region they come from and even their socio-economic background (Pélissier & Ferragne, 2022). Our accents are revealing and this can have positive or negative implications. Accents, either regional or foreign, are always associated with stereotypes. In some situations these stereotypes can be harmless, for instance, accents may be teased or praised by different interlocuteurs in the social sphere, however, at a job interview it is possible that an accent could affect the speaker's chances of obtaining work (Grogger et al., 2020; Kalin et al., 1980). Therefore, the repercussions of having a foreign accent are not negligible and, while this is an unfortunate truth, it needs to be considered. That is not to say that L2 speakers should strictly adhere to the L1 speaker norms at all costs, but should be aware of this phenomenon. As a society we should work towards eliminating these kinds of prejudices, but of course, progress can be slow. As discussed, it is important for researchers to be taken seriously as they use English in a professional academic context, hence the need to consider how foreign accents can be perceived.

Having a foreign accent can be disadvantageous when looking for work. Schmaus and Kristen (2021) investigated the impact of having a foreign accent in the early hiring process. Applicants had to inquire about a recently advertised job over the phone. Names (Turkish/ German) and accents (Turkish accent/standard German accent) were manipulated to compare whether they had an impact on the hiring process. Results showed that applicants who telephoned with a German-sounding name and standard German accent or those that called with a Turkish-sounding name and standard German accent had the same chance of being told the position was not yet filled. However, applicants with a Turkish accent were more often told that the position had been filled. Sadly, this shows that accent discrimination is alive and well.

A study by Lev-Ari and Keysar (2010), also found that L2 speakers were perceived to be less credible because of the difficulty in processing their foreign accent. Participants were asked to judge the truth value of trivia statements written by an L1 speaker and read

aloud by L1 and L2 speakers. The participants were divided into two groups: the first group was asked to rate the truthfulness of the statements and the second to rate not only truthfulness but also the difficulty of understanding. The idea being that the second group of listeners would be more tolerant of the L2 speakers, but this was only partially true. The first group judged mild and heavy L2 accents as less true than L1 accents and the second group judged heavy L2 accents as less true but mild L2 and L1 accents similarly. It appears, therefore, that foreign-accented speech can indeed affect how the speaker is perceived and not always in a positive light. The authors attribute this to processing difficulties rather than stereotypes since in the subsequent questionnaire, the participants were not able to identify the accents they heard. This falls in line with the concept of cognitive fluency, in other words, the ease with which individuals are able to process information (Oppenheimer, 2008). Cognitively fluent speech and text are processed more easily and, thus, tend to be judged more favourably.

Similarly, Jenkins (2009) conducted a questionnaire on attitudes and identity in the English as a Lingua Franca (ELF) community. Three hundred and sixty English teachers, who were mainly L2 speakers, responded to a questionnaire in which they had to rank different accents around the world and comment on them. Firstly, they had to select 5 accents that they considered to be 'the best' from around the world including their own. The accents that were consistently ranked the highest were L1 accents, with accents from the UK or the US usually coming in first or second position. The second task consisted in rating 10 specific accents for correctness, acceptability, pleasantness and familiarity. Once again the L1 accents received the highest ratings on all four variables. In the final task the respondents had to comment on the 10 accents that they had rated and responses revealed preferences for native or native-like accents (Jenkins, 2009, p.27):

> UK (RP) English accent, typical labels: "normal, traditional, authentic, proper, classical, clear, very easy to understand, perfect, beautiful, elegant, lovely to listen to..."
>
> US English accent, typical labels: "pleasant, beautiful, relaxed, laid back, informal, clear, easy to understand, correct, comfortable" and less often "careless, sloppy" by those who preferred UK English

Accents perceived as nativelike, especially Swedish English, were also described positively, and often in terms of their nativelike-ness:

Swedish English accent, typical labels: "almost mother-tongue like, quite natural like native speakers, near-British, well-mastered, precise, clear, fluent, accurate, a very good accent, excellent pronunciation...

On the other hand, L2 accents perceived as being more distant from L1 accents were described negatively, and the more distant, generally the more negative the description:

Russian English accent, typical labels: "harsh, unfriendly, heavy, sharp, aggressive..."

China English accent, typical labels: "choppy, incomprehensible, short and abrupt (ping pong), broken, appalling, quarrel-like..."

Japanese English accent, typical labels: "difficult to understand, funny, strange melody, flat, bad, menacing, torture...

This indicates that even L2 speakers can be harsh judges of their own, or other L2 accents. This type of judgement can be triggered almost instantly. Pélissier and Ferragne (2022) compared listeners' reactions to sentences produced with a Parisian upper-class accent and a *banlieue* accent. Sentences were either congruent or incongruent with social stereotypes of the accent. For example, "I love playing golf with my associates" would be congruent with an upper-class accent and "I always listen to rap music in my car" would be congruent with a *banlieue* accent (2022, p.4). Incongruent sentences almost immediately elicited an event-related potential (ERP) referred to as the N400. This suggests that stereotypes are quickly activated when listening to socially marked accents. This applies to L1 accents, but one can imagine that similar prejudices exist in relation to L2 speech.

French psychology researchers would surely not wish to be perceived as less credible or less intelligent, but more importantly, they would not want to be considered unintelligible or incomprehensible. Therefore, it is important to consider the impact of foreign-accented speech on the speaker in a variety of different contexts and ways to overcome possible intelligibility problems. It is important to remember that a foreign accent is not incompatible with intelligible speech.

1.2.2 Nativeness: an Unrealistic Goal

Although L2 speakers may wish to completely acquire L1 pronunciation norms to avoid bias or simply because they desire to sound like L1 speakers, it is a difficult goal to accomplish. A considerable body of research has demonstrated that even the most proficient L2 speakers often retain a foreign accent.

The Critical Period Hypothesis (CPH) suggests that there is a period of time after which an L2 learner will no longer be able to fully acquire and emulate L1 norms whether they be phonological, morphological, syntactic or lexical. Phonologically speaking, this implies losing the perceptual acuity to easily discriminate phonemic/phonetic distinctions and, as a consequence, not being able to produce them. Research has endeavoured to investigate the veracity of this hypothesis, identify the onset and offset and understand its origins.

The CPH was first posited by Penfield and Roberts in (1959) and is based on the observation that language proficiency levels seem to decline as the age of L2 acquisition increases. However, it is difficult to interpret findings since different factors can influence language acquisition such as the duration of exposure to the target language or social and linguistic differences. In addition to this, not everyone agrees when the critical period occurs. Singleton (2005) reviewed the literature and found a huge discrepancy in the ages cited, ranging from a critical period that ends shortly after birth to one that ends around the age of twelve. Some argue that the age depends on different aspects of language and the critical period for phonology is often cited as being earlier.

Flege et al. (1995) tested the CPH on L1 Italian individuals who acquired L2 English at different ages. Those who had learnt English after turning 15 were consistently viewed as having a foreign accent. This study seems to suggest a later offset of critical period for phonological acquisition. On the other hand, Hakuta et al. (2003) stated that when comparing age of immigration to the USA and English proficiency test scores they "found no evidence of such discontinuity in language learning potential. Instead, the most compelling finding was that the degree of success in second language acquisition steadily declines throughout the life span" (p.37).

The causes of such a decline in language acquisition have been attributed to a variety of sources such as neurobiological, cognitive-developmental and affective-motivational factors

(Singleton, 2005). The main point of contention being whether this phenomenon is biological or not. Scovel (1969) has argued that there is a critical period but only in phonology because of the neuro-motor connection involved in producing speech. Speech is the only part of language that engages our motor functions and thus might be influenced by physical phenomena that we do not fully understand. He suggests that the difference between children and adults arises from biological factors instead of environmental influences. Hyltenstam and Abrahamsson (2003) are also in favour of biological maturational constraints. They tested near-native speakers of Swedish from different L1s and found that none of the L2 speakers performed as well as native speakers on all three tests, even those who had started learning Swedish from four years old.

Birdsong (2014), on the other hand, does not believe that a lack of neural plasticity leads to a decline in phonological acquisition since the L1 can be influenced by the L2 in adulthood. He argues that immigrants are sometimes told that their accents have changed when they visit their home country or even those who have moved to a different region of the same country. He argues that "[s]uch permeability of the L1 would not be possible if the neural systems underlying phonetic perception and production were not plastic" (2014, p.46). In 2003, Birdsong investigated the authenticity of L1 English speakers' productions of L2 French. He compared acoustic analyses and L1 French speaker judgements and found that two out of 22 speakers achieved native-like productions. Both of the speakers had started learning French relatively late, after the age of 14, and started living in France at the ages of 20 and 21 respectively. Instead, their successful acquisition of phonological patterns seems to be due to high levels of motivation and some phonetic instruction. For him, these findings indicate that late acquisition of an L2 can be successful and even native-like. They also suggest that the constraints on L2 acquisition may not be biological.

There are certain aspects of early language acquisition that promote better levels of attainment and proficiency. Infants and children receive input differently to the way adults do. They are also less influenced by their L1, which is still being fine-tuned, and are more malleable in a social and psychological sense. According to Ioup (1995), child and adult language acquisition differ in two main ways: "The first is ultimate attainment: children succeed in becoming bona fide native speakers, adults by and large don't. The second relates

to what has been referred to as input enhancement" (p.95). In other words, it refers to the extent of explicit explanation on form. Children get minimal to no guidance on form, while adults frequently receive input and corrections via rules. Infants and young children get phonological input by hearing their parents and caregivers daily, yet they seldom receive any explicit instruction on phonetic units, or when to stress syllables or words within a sentence. Yet, despite the lack of formal instruction they manage to acquire L1 phonological norms. The same does not apply to the majority of adults, even when immersed in the country of the L2. The differences in input and instruction could offer an environmental explanation for the success of early learners.

Though the reasons for this phenomenon are unclear, evidence seems to point towards a decline in phonological acquisition capacities for a majority of speakers. Taking this research into account, it becomes evident that the focus should be on achieving intelligible pronunciation rather than attaining L1 norms. In this way, teachers are able to concentrate on reducing the phonological variations that impede intelligibility instead of eliminating variation altogether. However, this does not mean that successful phonological acquisition is impossible for L2 learners. By working on both perception and production, L2 learners can aim to be highly intelligible and, in some cases perhaps even native-like if this is the speaker's goal. It is important to foster both intelligible communication and self-confidence in L2 speakers. However, it is not yet clear what constitutes intelligible and comprehensible communication.

1.3 Intelligibility and Comprehensibility

Intelligibility and comprehensibility involve complex cognitive and linguistic processes requiring two or more speakers to activate their perceptual and productive skills. Speech processing is inherently interactive and may be facilitated or impeded at different levels. In order for successful communication to take place, the sound signal must be produced in such a way that the listener is able to recognise and decode it, therefore, both the speaker and listener have a role to play. For this reason, it is often challenging to ascertain the precise reason for unsuccessful communication as a variety of factors could be the cause. The speaker's

pronunciation may be difficult to decode or disfluent, the listener may be unfamiliar with the speaker's accent, lack concentration or be biased towards foreign accents and there could even be environmental factors such as external noise.

1.3.1 Notions and Definitions

The terms "intelligibility" and "comprehensibility" have been used in the literature in a variety of ways and there is little consensus as to the strict definition of these two concepts, but there are certain similarities in the different definitions. As Didelot et al. (2019) suggest, the term intelligibility seems self-evident so it gives the illusion of not needing an explicit definition yet it is in need of being elucidated. According to Munro (2010, p.8), intelligibility has been a linguistic notion in pronunciation teaching since at least 1900 when used by Sweet in his book on practical language study and later when Abercrombie published famous article in 1949, expressing for the first time the idea that second language learners ought to strive for 'comfortably intelligible' pronunciation instead of a native-like accent. Although it has been discussed and debated in the literature for a long time, it is not fully understood what makes speech intelligible. This is undoubtedly due to its multifaceted nature and the numerous factors that can have an impact on its success. Phonetic or prosodic variation can impede intelligibility as well as environmental factors such as noise or distortions of the sound signal. In addition, the speaker is not always the cause of an intelligibility breakdown. Speech processing problems also come into play as L2 listeners may have speech recognition or comprehension difficulties and L1 speakers may infer the wrong meaning due to the misinterpretation of top-down strategies or an intolerant attitude to a foreign accent.

Cruz (2007) points out that a total of ten different terms have been proposed in the literature between 1950 and 2003 with intelligibility being the most popular, closely followed by comprehensibility. Broadly speaking, all of these terms refer to understanding and successful communication between speakers, but different nuances have been highlighted by different researchers. Catford (1950) proposes the terms intelligibility and effectiveness. For him, speech can be considered intelligible if "the hearer understands the words" (p.8) and effectiveness refers to whether the hearer responds appropriately to the speaker's intentions, if this happens the utterance "may be said to be completely effective" (p.7). For example, a

listener may recognise the word but misinterpret its meaning in a certain context and give an inappropriate response. This can happen with two L1 speakers, for example, an American might ask a British person to show off their new pants. The American has in mind a pair of trousers or jeans whereas a British person with little knowledge of American English might understand a pair of underpants and probably refuse. This utterance would be considered ineffective and could potentially surprise the interlocutor in either a humorous or upsetting way, even if the word pants had been correctly recognised by the listener. The opposite, however, is not possible for Catford as an utterance needs to be intelligible in order to be effective.

Smith and Rafiqzad (1979) speak of intelligibility and comprehension. Intelligibility is the "capacity for understanding a word or words when spoken/read in the context of a sentence being spoken/read at natural speed" (p.371). They do not give an explicit definition of comprehension but acknowledge the fact that "the greater the comprehension of content material, the more likely intelligibility will occur" (p.371). Decoding the acoustic signal seems to be the principle tenet of intelligibility and the second term, this time comprehension, relates to understanding the meaning. Unlike Catford though, the authors highlight the influence of top-down factors on intelligibility.

From a cognitive perspective, Dijk and Kintsch (1983) provide a definition of comprehension within a situation model. Different levels of information (semantic, contextual, etc) interact intricately and, as a result, the listener must be able to create a mental representation of the situation being evoked by combining semantic and experiential knowledge with incoming information. Although the authors are principally concerned with understanding texts, understanding speech requires similar interaction between stored knowledge and the speech signal.

Smith and Nelson's (1985) definitions are some of the most cited, particularly by those who ascribe to the World Englishes paradigm. They suggest using three different terms, intelligibility, comprehensibility and interpretability, which work on a rising scale of difficulty. Intelligibility refers to word/utterance recognition; comprehensibility refers to word/utterance meaning (locutionary force); and interpretability is the meaning behind word/utterance (illocutionary force). They believe these three levels help clarify the confusion between

terms that have been used interchangeably in the past. The complexity of the three levels increases as they argue that word recognition is easier than understanding the meaning of an utterance (1985, p.334).

> For some time, word recognition was the sole criterion used in testing the understanding of different varieties of English, so we have limited word intelligibility to the recognition of words. Since we believe more serious problems of miscommunication occur when people fail to understand the meaning of a word or an utterance (comprehensibility), or the meaning behind the word or utterance (interpretability), we believe separate research categories need to be established for each of these.

While it may be true that not understanding the meaning of an utterance can hinder communication more drastically, a certain degree of intelligibility is still essential in order to understand an utterance. That being said, one or two unintelligible words may be compensated for by understanding the overall meaning and context of the utterance, thus it is perhaps more accurate to view intelligibility as a continuum rather than a binary concept. For example, Lindblom (1990) proposed the model of mutuality, which is based on the idea that the interaction between the speaker and the listener is highly adaptive. He argues that listeners use signal-dependent information (acoustic signal) and signal-independent information (related to the listener's knowledge and experience) to decode speech. When signal-dependent information is impaired, listeners rely more heavily on signal-independent information. This distinction is interesting since it can help to explain the interactions between the two constructs.

For Dalton and Seidlhofer (1994), the concept of intelligibility cannot be separated from identity as every accent has its own national, regional and social identity. They prefer the terms acceptability and accessibility, but argue that "they cannot be fixed or defined in any absolute way" (p.10) as they are dependent on a variety of sociolinguistic factors. Accessibility is more closely related to understanding and acceptability to the listener's attitude and tolerance of language variation. It is the listener who will determine whether an utterance is acceptable or not.

Bamgbose (1998) takes a similar view. He argues that the concept of intelligibility is complex and calls into question the linguistic authority of the native speaker: "a native speaker is not necessarily the infallible judge of what is intelligible nor is he or she even necessarily more intelligible than a non-native speaker" (p.11). He argues that the concept of intelligibility involves many complex factors including recognition, understanding, and being able to relate the meaning of an utterance to a particular sociocultural context. He thus regroups Smith and Nelson's categorisations under the term intelligibility.

Munro and Derwing (1995a; 1995b; 1997; 1998; 2006; 2015; 2015) have investigated the relationship between intelligibility, comprehensibility and accentedness of L2 English in numerous studies and their definitions are also some of the most cited. They, like Smith and Nelson, propose three terms: intelligibility, comprehensibility and accentedness. Intelligibility concerns "the extent to which an utterance is actually understood" (1995b, p.291); comprehensibility is used "to refer to listeners' perceptions of difficulty in understanding particular utterances" (1995b, p.291); and accentedness "refers to how strong the talker's foreign accent is perceived to be" (1995b, p.291). Intelligibility is measured by word recognition and scalar ratings are used to measure the listener's perception of comprehensibility and accentedness as Munro and Derwing (2015, p.15) explain.

> While intelligibility is the final perceptual product of an interaction, comprehensibility has more to do with the process of understanding. For this reason, intelligibility is often quantified as the number of the speaker's words that the listener has successfully grasped, and comprehensibility is the listener's assessment of the degree of effort exerted to understand the message.

Although they interact, these three concepts are partially independent of each other as it is possible to have a strong foreign accent, for example, and yet be highly intelligible. It is also possible to understand an utterance without having recognised each individual word.

While many linguists have focused on the listener's perception of intelligibility and comprehensibility, Jenkins' definition highlights the speaker's role as well as the listener's. She defines intelligibility as "the production and recognition of the formal properties of words and utterances and, in particular, the ability to produce and receive phonological

form" (2000, p.77). She postulates that pronunciation in the English as an International Language (EIL) context is the most important factor in order to guarantee intelligible communication. For this reason, she proposes the *Lingua Franca Core* (LFC), which is a set of phonological features that, if mastered, can ensure intelligibility between speakers of different L1s. However, as Berns (2008) suggests, Jenkins' English as a Lingua Franca (ELF) approach is more radical than Smith and Nelson's World Englishes (WE) approach as it stipulates the use of key features whereas the WE approach focuses more on sociolinguistic factors such as encouraging tolerance and cooperation between language communities. Nevertheless, more research is needed to substantiate the choices of the LFC.

Field's (2005) definition of intelligibility focuses on the listener's capacity to recognise and decode the speech signal. It is defined as "the extent to which the acoustic-phonetic content of the message is recognizable by a listener. On this analysis, intelligibility forms part of a wider construct of comprehensibility." (2005, p.401). He asserts that intelligibility is related to the properties of speech, while comprehensibility is influenced by other factors such as context and syntactic or lexical knowledge.

Didelot et al. (2019) and Rajagopalan (2010, 2011) argue that having intelligibility as a goal without defining it allows the model of the native speaker to be hidden behind a vague term. Rajagolopan even goes as far as to compare intelligibility to subjective adjectives "such as beautiful, ugly, easy, difficult, primitive, civilized" (2010, p.468). For him, intelligibility is not just a linguistic preoccupation but also a "politically charged theme" (2011, p.487) as it relies on a willingness to understand different varieties around the world. Munro (2010) totally disagrees with the idea that intelligibility is a subjective buzzword, but that it is a highly important preoccupation for many that can go from a simple misunderstanding to a tragedy. He gives the example of communication breakdowns between pilots and air traffic controllers. There are also situations in which intelligibility breakdowns can deeply impact the speakers' lives such as immigrants who wish to be integrated into a new culture and society. Although intelligibility relies to a certain extent on the listener's attitude, studies have shown strong correlations between different listeners' assessments of intelligible and comprehensible speech.

While linguists have not agreed upon a single definition of intelligibility and comprehensibility, there are similarities in the different definitions. Intelligibility is most often related to how the speech signal affects the recognition of words and utterances, whereas comprehensibility refers to a deeper level of processing and understanding speech. We consider Derwing and Munro's (1995b; 2015) definitions to be the most useful as they provide a means for quantifying intelligibility and comprehensibility and putting the constructs to the test, which we discuss in Chapter 7.

1.3.2 Experimental Perspectives

A number of empirical studies have shed light on different aspects of intelligibility and comprehensibility. Studies have looked at intelligibility from different L1s, some have compared the constructs with accentedness, acceptability or functional load, whereas others have examined the effect that noise or speech disorders can have on intelligible speech. The following explores insights and reviews the findings of empirical studies.

As previously mentioned, Derwing and Munro have conducted numerous studies on intelligibility. In one such study (Munro & Derwing, 1995a), they investigated the relationship between intelligibility, perceived comprehensibility and accentedness. Eighteen L1 English listeners heard the English speech samples of ten L1 Mandarin speakers and two L1 English speakers and were asked to transcribe the samples and rate the perceived comprehensibility and accentedness of each sample. Both the L1 English and the Mandarin-accented samples were found to be highly intelligible overall. The harshest scores were given to the L2 samples for accentedness, yet the intelligibility scores show that heavily accented speech can still be highly intelligible. The comprehensibility ratings were more indicative of intelligibility levels, whereas accentedness was not. The differences between comprehensibility ratings and intelligibility scores were likely due to processing difficulties since the Mandarin-accented speech was intelligible, but may have been understood with more difficulty than the L1 English speech. This research suggests that intelligibility, comprehensibility and accentedness are interrelated but not wholly dependent on each other.

In another study, Munro and Derwing (1995b) investigated the effect of Mandarin-accented speech on processing time. Twenty L1 English listeners assessed the truth value of

true/false statements uttered by ten L1 Mandarin speakers and ten L1 English speakers and response times were measured. Results indicated that the Mandarin-accented speech took longer to evaluate than L1 English speech. This correlated with the perceived comprehensibility ratings since utterances that were given low ratings tended to take longer to process. This suggests that foreign-accented speech may often be intelligible, but come with higher processing costs that could reduce overall comprehensibility, which is discussed later in 2.1.1.

Derwing and Munro (1997) extended their research to Cantonese, Japanese, Polish and Spanish-accented English. Intelligibility, perceived comprehensibility and accentedness ratings were obtained from 26 L1 English listeners, who also completed a language identification task in which they had to assign one of the four languages to each speaker. Familiarity with a particular accent correlated with correct identification and was associated with better understanding overall. The findings of this study closely replicated their previous studies with accent ratings being the harshest, followed by perceived comprehensibility and finally intelligibility scores, which tended to be high.

Derwing and Munro (2006) have also investigated how functional load interacts with comprehensibility and accentedness. This is a concept in which certain phonemic errors are considered to carry more weight than others. Twenty-six samples of Cantonese-accented speech that exhibited both low and high functional load errors were evaluated by 13 L1 English listeners. High functional load errors were found to have a greater impact on perceived comprehensibility and accentedness ratings than low functional load errors, even when low functional load errors were accumulated. This suggests that the nature of the error is more important than the quantity of errors, although the authors argue that more research would need to substantiate this.

Given that the participants of previous studies were L1 listeners, Munro et al. (2006) decided to include L2 listeners in their next study in order to investigate the influence of a speaker's linguistic background on intelligibility. Forty L1 Cantonese, L1 Japanese, L1 Mandarin and L1 English listeners evaluated the utterances of 48 L1 Cantonese, L1 Japanese, L1 Polish and L1 Spanish speakers in English. Results showed that scores of intelligibility, perceived comprehensibility and accentedness were significantly correlated across languages as listeners tended to agree on which speakers were the easiest to understand and which were

the most difficult. The Japanese listeners found the Japanese speakers the most intelligible as did the Cantonese listeners. Therefore, speech from the listeners' own L1 was not consistently considered the most intelligible. The L1 ratings correlated well with the L2 ratings suggesting that there was a shared response to the L2 speech.

A number of studies have examined cross-linguistic intelligibility with L1 and L2 listeners. Smith and Rafiqzad (1979) investigated international intelligibility by recording nine L1 speakers from Hong Kong, India, Japan, Korea, Malaysia, Nepal, the Philippines, Sri Lanka and the United States. The authors recruited 1,386 L2 listeners from the same countries as the speakers (except the US) as well as Bangladesh, the Republic of China, Indonesia and Thailand. The participants were asked to complete a cloze test. Intelligibility was measured by counting the number of correctly recognised words. Overall, the speaker from Sri Lanka was found to be the most intelligible and the speaker from Hong Kong the least intelligible. The American speaker was placed in the penultimate position, which shows that L1 speakers are not always considered the most intelligible. Speakers of the same nationality did not always find each other the most intelligible either. In fact, there was a high level of consistency between the different listeners accuracy scores regarding which speakers were the most intelligible and which were the least intelligible.

In a later study, Smith and Bisazza (1982) found that speakers of the same L1 tended to find each other more intelligible. Recordings of three L1 speakers from Japan, India and the United States were played to listeners from Hong Kong, India, the Philippines, Japan, Taiwan, Thailand and the United States. While the L1 English speaker was considered to be the most intelligible overall, the L1 Indian listeners found the L1 Indian speaker highly intelligible and the L1 Japanese listeners found the L1 Japanese speaker the most intelligible.

Bent and Bradlow (2003) found that proficiency played a key role in determining speaker intelligibility. The authors investigated the link between speakers' L1, intelligibility and proficiency. Two L1 Chinese, two L1 Korean and one L1 English speaker were recorded speaking English. The L2 speakers had either a low or a high proficiency level, one of each. The low proficiency speakers were rated the least intelligible speakers, thus highlighting the importance of language proficiency. The L1 English listeners found the L1 English speaker the most intelligible while the L1 Chinese and L1 Korean listeners found the high proficiency

L1 Korean speaker to be the most intelligible. The authors call the facilitating effect of L2 speakers sharing the same L1 the "matched interlanguage speech intelligibility benefit" and the preference for L2 speakers to find other L2 speakers more intelligible than L1 speakers the "mismatched interlanguage speech intelligibility benefit". Their findings support the idea that L1 speakers are not always the most intelligible speakers for L2 listeners. It would also seem therefore that while speakers of the same language tend to find each other easier to understand, the proficiency of the speaker is an overriding factor that can outweigh sharing the same L1.

Matsuura (2007) examined the intelligibility and comprehensibility of L1 English and Hong Kong-accented English for L1 Japanese listeners. At the same time, she analysed the impact that language anxiety can have on these constructs. The L1 Japanese listeners were asked to complete a cloze test and rate their perceived comprehensibility for each speaker. In addition, they filled out a questionnaire in order to assess each participant's language anxiety. Results suggested a strong negative correlation between intelligibility and language anxiety. This indicates that intelligibility breakdowns are also strongly associated with the listener's attitude, not only the speaker's production skills. In terms of language background, the speaker from Hong Kong was found to be more intelligible than the L1 English speaker for these L1 Japanese listeners. Once again, L1 English is not necessarily the most intelligible variety for L2 speakers.

More recent research has investigated the construct of acceptability, which has not received the same amount of attention as comprehensibility or intelligibility. It relies more heavily on the listener's tolerance of regional or L2 variation. Crowther et al. (2023) aimed to explore the relationship between comprehensibility and acceptability in an academic setting using scalar ratings. Four groups of listeners (undergraduate students, graduate students, faculty members and administrative staff) at an American University rated L2 speakers from a variety of L1s (Mandarin, Arabic, Spanish, French, Persian) who had taken the Duolingo placement test. Results showed that listeners' tended to agree with one another and ratings followed similar patterns. Interestingly, comprehensibility and acceptability ratings were almost indistinguishable from one another. This is reassuring given that comprehensible speech was also judged as acceptable.

Research investigating the effects of noise on intelligibility has also been conducted. Munro (1998) found that noise has a detrimental effect on both L1 and L2 speech. Twenty-four L1 English listeners heard true/false statements read by ten L1 Mandarin speakers and ten L1 English speakers that were presented in quiet and noisy conditions. The listeners had to orthographically transcribe the utterances and decide whether they were true, false or unknown if the statements were unintelligible. The Mandarin-accented statements were affected far more significantly by the addition of noise than the L1 English ones, although they too were adversely affected. There was also significant inter-speaker variability, particularly for the L1 Mandarin speakers with some speakers retaining good intelligibility levels and others not. Some listeners also showed greater difficulty in understanding utterances in noisy conditions than others, which makes the relationship between foreign accent and noise difficult to describe.

Another area which has been investigated is the relationship between intelligibility, speech pathologies and noise. Chiu and Neel (2020) conducted a study into the effects of Parkinson's Disease on intelligibility in noisy conditions. Ten speakers with Parkinson's Disease and five healthy controls read 56 sentences. These were transcribed orthographically by 120 participants, 60 in quiet conditions and 60 in noisy conditions. The intelligibility scores were much lower in noisy conditions, particularly for the speakers with Parkinson's Disease. In addition, 23 participants evaluated the ease of understanding, articulatory precision, prosodic accuracy, resonance balance and voice quality of the speech samples. These perceptual evaluations correlated with the intelligibility scores, thus highlighting the detrimental effects of noisy conditions and speech pathology in combination. It is important to consider the fact that while speech may be intelligible in optimal conditions, it may not be the case in noisy situations. It appears that high or low intelligibility in quiet conditions predicts a similar pattern in noisy conditions, therefore, a speaker who is difficult to understand in quiet conditions would likely become unintelligible in noisy conditions.

Keintz et al. (2007) have also explored intelligibility and speech pathologies. They argue that listeners' use three types of knowledge to decode speech: linguistic knowledge, related to features such as syntax or phonology; paralinguistic knowledge, involving gestures or expressions; and experiential knowledge, consisting of common experiences and knowledge

shared by the listener and speaker. In their study, the authors found that audio-visual information facilitated the intelligibility of disarthric speech as opposed to audio information only. This indicates that a variety of sources can play a role not just the speech signal.

Studies have also examined the role of accentedness on listeners. Gordon-Salant et al. (2015) compared age and accentedness. The authors found that participants performed better when listening to a mild Spanish accent compared with a moderate Spanish accent and that this effect was stronger in older participants. In a similar study comparing accentedness and sentence structure, Strori et al. (2020) found that sentence recognition accuracy of L1 English speech and high-intelligibility Mandarin-accented speech decreased if the sentences were more complex, whereas recognition of low-intelligibility Mandarin-accented speech remained the same. Thus, a foreign-accentedness appears to affect listeners and interacts with other factors such as age and sentence complexity.

1.4 Summary

In this chapter, we have examined the context of using English for academic communication and discussed the issues at stake for L2 researchers. They need not only to be perceived as competent and professional, but also to be understood. As such, a balance must be found between improving one's pronunciation and acknowledging the limits of achieving native-like pronunciation. This can be achieved by making intelligibility and comprehensibility the primary goal.

We then discuss how the terms "intelligibility" and "comprehensibility" have been defined in the literature. Although there are a variety of different definitions available, they share common ground. We find Derwing and Munro's (1995b; 2015) definitions to be the most beneficial since they offer a way to measure intelligibility and comprehensibility.

The findings of previous studies examining intelligibility and comprehensibility described in this chapter suggest that there are some noticeable trends. L1 speakers are not always the easiest speakers to understand for L2 listeners and L2 speakers of the same L1 often understand each other more easily. Overall though, speakers tend to agree on who is intelligible regardless of L1. This seems to be due to other important factors, such as

proficiency for example, which strongly influences intelligibility. However, some of these factors have yet to be elucidated. In Chapter 2, we will examine the different factors involved in speech perception.

Chapter 2

Into the Ear

Since speech production is frequently peppered with slips of the tongue or degraded by external factors such as noise, listeners must constantly mobilise their perceptual skills to decode and understand speech. Research on speech perception can extend our understanding of which segments and suprasegmental features are important to maintain in order to produce intelligible speech. It can also further our knowledge of how speakers of different L1s perceive the speech signal and provides insight as to why certain groups of L2 speakers produce certain pronunciation variants. This chapter examines the impact that accentedness can have on cognitive load, the cognitive processes involved in speech perception and the word recognition models that have been proposed for L1 processing. It also discusses the differences in the way that the L1 and L2 are acquired, how this can affect L2 speech processing and the models proposed for L2 perception.

2.1 Speech Perception from a Cognitive Perspective

Although speakers and listeners communicate with apparent ease on a daily basis, recognising and understanding speech is a complex task, which can be studied by different fields of research. From a linguistic perspective, research tends to focus on how the acquisition of different languages (L1, L2, L3) can affect speech processing, whereas from a cognitive point of view, research addresses how the brain encodes, stores and retrieves information in order to process speech. This requires cognitive resources and interactions between different systems, which can be impeded or facilitated depending on a variety of internal and external factors.

2.1.1 Perception and Cognitive Load

Speech processing requires the acoustic signal to be temporarily stored in the working memory (Baddeley & Hitch, 1974, 2019), but due to its limited capacity, simultaneous processes and cognitive resources must not become too demanding. According to Cognitive Load Theory (Chandler & Sweller, 1991), which was developed for educational purposes, learners use various cognitive processes in the working memory to complete a task and must relate this to prior knowledge stored in the long-term memory. However, depending on how the task is designed and presented, learners may have to use additional cognitive processes that are not directly useful for learning (e.g. inhibiting irrelevant information present in the task). Taken together, these elements form the cognitive load, which represents the level of mental effort required to complete a given task (Chanquoy et al., 2007), and difficulties essentially arise when the cognitive load induced by the learning task exceeds working memory capacity (Tricot, 2021).

Sweller et al. (1998) identify three distinct forms of cognitive load: intrinsic (inherent to the task), extraneous (the way information is presented), and germane (involving the processing of new information through schema creation). Extraneous cognitive load is not beneficial because it involves greater demands on working memory for activities that are not directly useful for learning (Leahy & Sweller, 2011). On the other hand, germane cognitive load facilitates the integration of information processed in long-term memory, so it should be encouraged as it is what makes learning possible. In relation to speech processing, accentedness could be identified as a source of extraneous cognitive load, in the sense that accentedness relates to the way in which information is presented to the listener who has to recognise and understand it. Successful speech processing may depend on the accent of the speaker and on the listeners' familiarity with the accent in question.

According to van Engen and Peelle (2014), accented speech is a source of acoustic challenge for listeners since it can generate a mismatch between listeners' expectations and percepts. Processing accented speech requires additional cognitive resources and may increase listening effort. This need for extra processing may hinder intelligibility or comprehensibility and may even impact the listeners' memory of an interaction or reduce content acquisition (Roussel et al., 2017, 2021). Increased listening effort due to accented speech

may also slow down cognitive processing and reaction times. However, this cognitive effort may depend on the degree of accentedness and may be reduced as the listener progressively adapts to accented speech and becomes more familiar with it.

As Paas et al. (2010) suggest, previously stored and organised information is not subject to the same limitations as new information, thus familiar information is processed more easily than novel information, such as the incoming speech signal. Familiarity with a particular accent or speaker facilitates speech processing (Bradlow & Bent, 2008; Gass & Varonis, 1984) and listeners can make use of their semantic and syntactic knowledge to overcome difficulties decoding the speech signal (Janse & Ernestus, 2011), something which may be more beneficial for L1 listeners. In addition, Bjork and Bjork (1994; 2011) argue that varying learning conditions can create a desirable difficulty which facilitates learning. If this is also true of speech processing, then an unfamiliar accent could encourage listeners to engage more with the task of processing speech.

Several studies have investigated the impact of manipulating cognitive load demands on speech perception. Antoniou and Wong (2015) found that listeners with different aptitudes reacted differently when cognitive load was manipulated. English listeners had to identify Mandarin-like pitch contours. Cognitive load was varied by asking participants to maintain letters in memory during the pitch contour perception test and decide whether they matched letters presented at the end of the task. High-aptitude participants performed better than low-aptitude participants across load conditions and only low-aptitude listeners were adversely affected by high cognitive load. This suggests that in cross-linguistic contexts comparing listeners from different L1s, low-proficiency L2 listeners could be impaired more drastically by increasing cognitive load than high-proficiency L2 listeners or L1 listeners.

Another study by Mitterer and Mattys (2017) investigated how visual perception and facial recognition interfered with speech perception using a 4I-oddity task. The authors came to the conclusion that continuous scanning and encoding of visual stimuli impedes speech perception as it increases cognitive load. They also argue that speech discrimination tasks are more impacted by increasing cognitive load than categorisation tasks because the former requires listeners to store the stimuli in the working memory, whereas the latter does not. This is interesting as an unfamiliar accent might also generate discrimination difficulties

for listeners if they are expecting specific acoustic cues associated with phonemic categories.

In another study, Chiu et al. (2019) found that manipulating cognitive load demands in visual recognition and rhyming non-word tasks impacted the listeners' ability to perceive duration, intensity, and *f0* distinctions. Retaining images or words in the working memory interfered with the participants perceptual acuity. Thus, increasing cognitive load in the form of visual interference can hinder speech perception, whether this also applies to foreign-accented speech remains to be seen.

McLaughlin et al. (2024) measured how listeners adapted to Mandarin-accented speech over five days to see whether it would reduce cognitive load after exposure. The participants were assigned to three groups: the control group only listened to L1 speech during training, the exposure group heard only Mandarin-accented speech and the feedback group heard Mandarin-accented speech and received feedback on their recognition performance. On the first and last day participants had to complete a dual-task, which involved retaining an auditorily presented sentence in memory and choosing between odd and even numbers on a screen, whereas on days two, three and four they trained with speech transcription tasks. The authors found that there was an improvement for all groups, but no benefit for the groups that had been receiving exposure to Mandarin-accented speech, suggesting that either listeners are able to adapt very quickly or that short-term exposure to Mandarin-accented speech was not enough to reduce cognitive load for listeners.

On the other hand, Adank et al. (2009) found that both unfamiliar L1 and L2 accents increased cognitive load. Listeners from Greater London and Glasgow had to listen to Southern British English (SBE), Glaswegian and Spanish-accented speech. The listeners from Greater London were only familiar with SBE-accented speech, whereas the Glaswegian listeners were familiar with both SBE and Glaswegian but not Spanish-accented speech. This resulted in slower processing times and higher error rates on a transcription task for the unfamiliar accents, both regional and foreign, indicating that unfamiliar accents can have a detrimental impact on listeners. In order to better understand the factors involved in speaker and listener interactions, it is necessary to explore the mechanics of speech processing.

2.1.2 Different Models of Word Recognition

In order to process speech successfully, the sound signal must be recognised, decoded and associated with words that are retrieved from the mental lexicon (Cutler et al., 1986; Dufour & Frauenfelder, 2007; Pisoni & Luce, 1987). Since word recognition is heavily influenced by syntactic and semantic predictability, the listener can also compensate for a deterioration in the signal by using the context and their syntactic or semantic knowledge (Janse & Ernestus, 2011). However, there are many obstacles to overcome when processing speech. Unlike written language where letters can be processed simultaneously, speech is sequential (Norris, 1994). This can be problematic when a phoneme cannot be identified due to degradation in the acoustic-phonetic signal. Since phonemes are modified by co-articulation and are highly context-dependent, it means that they are articulated in different ways depending on the context, therefore it is sometimes difficult to categorise them (Luce & Pisoni, 1998). Important questions remain to be answered: is speech processed in a linear fashion from the first phoneme to the last? How do listeners overcome the acoustic variability and overlapping boundaries of speech in real-time? Which units of speech are used for processing: the phoneme, the syllable, the word or even the sentence? What role does context play? To what extent does word frequency speed up recognition? Several different speech perception models have been proposed in an attempt to answer these questions. These models can nourish our understanding of what makes speech intelligible and help explain the findings presented in Chapter 8.

Speech input is an ongoing stream of information and as such it needs to be maintained in working memory in order to be processed. According to Baddeley and Hitch's (1974; 2019) working memory model, the acoustic signal is stored in the phonological loop, which has two main components: a short-term phonological store that holds auditory memory traces before they quickly fade, and an articulatory rehearsal mechanism, also known as the articulatory loop, which can maintain and revive these memory traces. This allows the listener to process the acoustic information as it arrives but subsequently this new information needs to be connected to the semantic and syntactic knowledge stored in the long-term semantic memory, something which may be more difficult for L2 listeners. Many of the word recognition models diverge as to the nature of the interactions between these

two memory systems.

Morton's (1969; 1979) Logogen model is one of the earlier theories. He postulates that logogens store information about words and become activated when receiving bottom-up sensory information and top-down contextual information. The two systems continually exchange and interact until reaching a response threshold. When this is achieved, a word is said to be recognised. He also notes that high frequency words tend to have lower thresholds for recognition than low frequency words, indicating that the more frequent words are, the more easily they are recognised. His work inspired others to develop further theories.

Marslen-Wilson and Welsh (1978) went on to develop the Cohort model, which assumes that a lexical unit becomes active when provided with sensory input. It begins as a bottom-up process where word initial cohorts, that is to say, words beginning with same phonemes are all considered possible candidates until reaching a critical recognition point where no other words compete. Only after the word initial cohort has been activated can top-down factors begin to influence word recognition. This model was criticised for being too dependent on bottom-up processing, so in the revised version (Marslen-Wilson, 1987), some deviation of the sound signal is permitted since word recognition is possible even when the initial phonemes have been mispronounced. Candidates whose initial phonemes are fully or partially compatible are then selected or rejected on the basis of their goodness of fit with the rest of the input. If speech processing is indeed an inherently bottom-up process, then this could lead to significant difficulties in processing foreign-accented speech, which deviates from the expected L1 patterns. However, other models such as TRACE or Shortlist (McClelland & Elman, 1986; Norris, 1994) take a more interactive approach by suggesting that lexical representations can be activated at different points in the input not only at the onset of each word.

TRACE (McClelland & Elman, 1986) is a computational (connectionist) model that consists of three different levels: auditory features, phonemes and words. The authors argue that there are connections between the different levels that can excite or inhibit each other. This interactive-activation approach allows "the context to retune the perceptual mechanism on the fly" (1986, p.6). Although decoding acoustic information is part of the model, it is not solely driven by bottom-up processing since lateral inhibition enables the other levels

to significantly interact with each other. Thus, even if a word is not produced as expected, listeners can use contextual, semantic or syntactic cues to compensate.

Norris (1994) proposed another computational model called Shortlist. It is based on the idea that a race between phonological and lexical encoding takes place and the fastest process wins (Cutler & Norris, 1979). The model generates a shortlist of lexical candidates based on bottom-up input who then compete with each other according to lexical or phonemic constraints. Norris argues that top-down lexical information does not influence phonemic identification and is instead an independent process taking place after the activation of potential candidates, which involves a competition between a shortlist of phonemically-driven candidates.

The Neighbourhood Activation Model (NAM) proposed by Goldinger, Luce and Pisoni (1989; 1998) postulates that the auditory input directly activates similar sounding acoustic-phonetic patterns stored in the long-term memory. Thus, the word frequency and similarity of a target word to other words in the mental lexicon impact word recognition. To test their model, the authors examined three variables: stimulus word frequency, neighbourhood density, and neighbourhood frequency in three different experiments using monosyllabic words. They found that all of these factors play a role. High frequency words tend to be classified more quickly and more accurately than low frequency words. If the neighbourhood frequency is low, words are classified more quickly and more accurately and if the neighbourhood is dense words are classified more slowly but also more accurately. Thus, word frequency speeds up recognition, low frequency neighbourhoods accelerate and facilitate recognition and high density neighbourhoods delay but also facilitate recognition. Like Shortlist, this indicates that word recognition involves competition between similar sounding words and highlights the important role of word frequency.

Interactive-activation models would seem to account for the fact that listeners are able to successfully recognise words despite degradation in the sound signal. As van Dijk and Kintsch (1983, p.25) suggest, interaction is key because evidence against pure bottom-up models is overwhelming, whereas "[p]ure top-down models have never really existed, strictly speaking, because pure top-down processing is psychologically absurd". Currently empirical data does not allow us to favour one theory over the other, however, the evidence points towards the

idea that speech perception requires both bottom-up and top-down processing. The different word recognition models seem to agree about this, but not always about whether it requires the same extent or the same levels of interaction.

2.1.3 Categorising and Segmenting the Speech Signal

Since phonemes are co-articulated, articulatory gestures overlap in time, meaning the acoustic signal also overlaps and interacts in discreet and intricate ways (Lindblom, 1990). For this reason, there are a number of studies investigating specific phenomena that impact word recognition in order to explore such interactions. Previous work has examined how L1 phonemes are categorised, which units are used for segmentation and differences between languages in order to gain a better understanding of what role each of these aspects plays.

Studies have shown (Harnad, 1987; Liberman et al., 1957) that phonemes are perceived categorically. Listeners pick up on various acoustic cues that allow them to assign boundaries to speech sounds and thus categorise them as different phonemes. When listeners are asked to listen to speech sounds on a continuum and choose between two different phoneme categories such as /p/ or /b/, there is a clear cut off point in the middle of the continuum between the two categories (Frauenfelder & Nguyen, 2003). This inherent capacity suggests that the phoneme has an important status in the speech recognition system. Norris & Cutler (1988) compared the identification of phonemes and syllables in different monitoring tasks with foils. Results showed that phonemes were identified faster than syllables. In addition, participants sometimes responded prematurely when identifying syllables, which supports models of left to right phonemic processing and the idea that smaller units are identified faster than longer units.

That being said, there also seems to be a margin for error when identifying phonemes. If the speech sounds cannot be categorised due to a degradation in the signal, listeners must resort to using contextual information in order to recognise words. Listeners are capable of restoring phonemes that have been obscured by noise or extraneous sounds. This is known as the phonemic restoration effect (Samuel, 1981; Warren, 1970; Warren & Obusek, 1971). In addition, listeners can make use of lexical knowledge when categorising ambiguous sounds within words (Ganong, 1980; Norris, 2003). They are more likely to categorise a sound so

that it corresponds to an existing and context-appropriate word, which means the system can be biased by contextual information. This seems to support the idea that word recognition is an interactive process.

Yasufuku and Doyle (2021) argue that phonetic input, phonological knowledge and visual cues influence how phonemes are categorised by listeners. The authors used the McGurk effect to assess cross-linguistic speech perception by asking English and Japanese listeners to transcribe nonsense words presented with or without visual input. When the visual and audio information matched, phonemic categorisation accuracy was high, even for consonants that were challenging in the audio-only condition. On the other hand, when the visual and audio information was incongruent, participants showed similar McGurk effects such as fusion or favouring the visual information suggesting that perception does not only rely on the phonological constraints of the L1.

Not only do listeners have to identify and categorise the incoming speech sounds but they must also segment the signal into smaller chunks so that they can identify individual words. Different theories have arisen over the years as to whether segmentation takes place at the level of the phoneme, the syllable or even the word itself. Syllables are not subject to as much contextual variation and children are intuitively capable of identifying them from a young age. This is not the case for the phoneme, which is highly context-dependent and whose existence children only become aware of when learning to read (Frauenfelder & Nguyen, 2003). For these reasons, it has been suggested that the syllable is a more appropriate unit for segmentation.

All languages have syllables but some languages are constrained to having only CV syllables, whereas others can vary from having syllables containing only one vowel to more complex combinations with consonant clusters. In addition, some languages are syllable-timed with similar weighting given to each syllable whereas others are moraic or stress-timed languages and thus stress certain morae or syllables within a word. All of these factors can influence the way in which syllabification takes place. Cutler et al. (1986) found that French and English listeners behave differently in this respect. Inspired by Mehler et al. (1981), who found evidence of syllabification in French listeners, they asked English listeners to perform a syllable monitoring task for English words, French words and nonsense words while French

listeners were asked to perform the task for English words. They found that English listeners did not show patterns of using syllabification for any of the words whereas French listeners did for the English words, which tend to have more ambiguous syllable boundaries than French words. This suggests that syllabification is not a universal processing tool.

Indeed, it might be more accurate to say that segmentation and categorisation depend on the properties of the language being processed (Kolinsky, 1998). It has been suggested that listeners use prosodic cues in order to segment speech. According to the Metrical Segmentation Strategy (Cutler & Norris, 1988), listeners use different metrics depending on the language being processed. For example, French speakers have been shown to segment at each syllable boundary (Banel & Bacri, 1997; Mehler et al., 1981), Japanese speakers segment using morae (Otake et al., 1993) and English speakers using stressed syllables (Cutler & Norris, 1988). Although segmentation strategies seem to vary across languages, they all involve prosodic structure (McQueen et al., 1994). When lexical stress is misplaced in English, word recognition is impeded (Cutler & Clifton, 1984), therefore listeners must use this prosodic information to some extent when processing speech. In addition, Cutler and Norris (1988) found that when listeners hear two strong syllables in nonsense bisyllabic words, it hinders the detection of real words embedded within them as opposed to listening to a strong syllable followed by a weak one. For example, the word *mint* was detected more slowly in *mintayve* (strong strong) than *mintesh* (strong weak). It should be noted that the first syllable was stressed in both words. Cutler and Norris (1988) came to the conclusion that segmentation and categorisation are two independent processes. They postulate that segmentation in English is based on stressed syllables and that it is unclear whether prelexical phonetic categorisation is in fact necessary for word recognition. Nevertheless, it appears that English listeners use strong syllables and stress patterns to segment the speech signal, which means that if L2 speakers do not produce the expected patterns, it may perturb the segmentation of speech.

Another set of word priming experiments seems to support the view that segmentation is based on prosodic cues. van Donselaar et al. (2005) presented word targets to Dutch listeners after they had listened to bisyllabic fragments and monosyllabic fragments that were either appropriately or inappropriately stressed with regard to the target. For example, okTO

would be appropriately stressed in *oktober* but OCto would not as it corresponds instead to *octopus*. Results showed that when listening to bisyllabic fragments, the appropriately stressed primes facilitated recognition of the targets and inappropriately stressed primes impeded recognition. Monosyllabic fragments also had a facilitatory effect but not an inhibitory one. In addition, bisyllabic fragments facilitated the recognition of associated words.

Cooper et al. (2002) replicated this experiment with English listeners and Dutch listeners hearing English primes. They found that English listeners can exploit lexical stress patterns more effectively with bisyllabic information. Dutch listeners performed less well with English primes than in their L1 but outperformed English listeners when assigning a monosyllabic fragment in a forced-choice identification task. This experiment was replicated again for German listeners (Yu et al., 2020) using only monosyllabic fragments this time. They were also able to use suprasegmental cues when listening to German and English and outperformed English listeners in the forced-choice identification task when unstressed syllables were used as primes. This may be due to the fact that in English lexical stress is almost always accompanied by segmental changes. For example, REcord differs from reCORD not only in the stress pattern but also in the realisation of the <e>. Therefore, in unstressed syllables the information is less salient to the listener. This suggests that English listeners are perhaps more sensitive to segmental information when segmenting the speech signal than listeners from other stress-timed languages.

All of these studies seem to support the idea that stress-timed languages make use of stress patterns for segmentation. Since research shows that syllable-timed languages, such as French, make use of syllabification in order to segment speech (Banel & Bacri, 1997; Mehler et al., 1981), we can expect that French and English listeners will behave differently when completing the recognition and comprehension tasks presented in Chapter 8. Unexpected or unfamiliar stress patterns may impede intelligibility for listeners.

Investigating listeners' misperceptions can also give us insight into speech processing and the causes of intelligibility breakdowns. Bond (2005) compiled a large body of examples of listeners' misperceptions. He found that misperceptions involve consonants far more frequently than vowels. Stressed vowel misperceptions are extremely uncommon, whereas

unstressed vowels can be misperceived because they are less salient and more fluid. Consonant loss often affects word-final consonants while substitutions tend to occur at the beginning of words. When they are substituted, the manner of articulation is often maintained. These findings suggest that listeners do pay attention to phonetic information since consonants are frequently devoiced or deleted in word-final position and listeners can still retrieve the manner of articulation despite misperceiving the specific phoneme. Regarding prosodic information, misperceptions like *a cute back pain* instead of *acute back pain* reinforce the idea that listeners use stressed syllables to segment speech. He also found that listeners expect utterances to be phonologically and phonotactically appropriate but that they are ready to accept utterances that are semantically and pragmatically implausible, although they may subsequently question what they have heard. These observations highlight some universal features of speech processing, which we need to take into consideration. Vowels are easier to perceive than consonants and word-initial segments are more salient than word-final segments. The observations also support the idea of metrical segmentation.

Research suggests that listeners are very adept at categorising L1 speech sounds and can be influenced by contextual information when the acoustic information is missing or ambiguous. It also points towards language-specific segmentation whereby listeners attend to prosodic cues. It seems, therefore, that the production of vowels and prosodic patterns are important elements to maintain in order for listeners to be able to decode speech. It is also interesting to note that these features are language-specific and thus listeners may be hindered by unexpected patterns when listening to speech that does not conform to their L1 patterns. Speech processing involves many intricate levels from categorisation and segmentation to contextualisation within the mental lexicon, which are learnt at a very young age and affect how speech is perceived throughout our lives.

2.2 Acquiring and Perceiving Speech

The process of acquiring phonology differs significantly between L1 and L2 learners, which may contribute to perception difficulties for L2 speakers. These differences not only affect how L2 learners perceive sounds but also influence how speakers of different L1 backgrounds

respond to the same stimuli. As a result, differences in phonological acquisition can help explain why some L2 speakers struggle with certain sounds while others, depending on their L1, may process them with greater ease.

2.2.1 Infant Speech Perception: an impressive feat

Infants start to perceive language in the womb, where they are exposed to the sounds of one or more languages, and begin life with the ability to perceive all the different phonemic and phonetic possibilities in the existing world languages (Ohala, 2008). When listening to their parents and the people around them, infants make use of statistical learning, which involves taking statistics on the phonological system in question and grouping together phonetic units to make words. When they have acquired enough statistics, they begin to try and produce words (Kuhl, 2010). Infants are highly adept at perceiving the world around them. They are able to discriminate their mother's voice from others, their native language from a foreign one and they are "even able to discriminate foreign contrasts not present in their environment" (Dehaene-Lambertz et al., 2006, p.369). As infants grow, they become more language-specific and start to focus on their native tongue so their impressive perceptive capacities are quickly adapted to their linguistic environment (Dehaene-Lambertz et al., 2006). This determines the prism through which they will perceive speech sounds. In addition, these perceptual abilities are fundamental in order to produce language.

It is important to note that in infants, speech perception precedes speech production. Before infants even utter their first words, they are capable of discriminating among speech sounds and can recognise different rhythmic patterns (Ohala, 2008). They develop and hone this ability long before they begin to articulate language but do not actually produce their first words until age one or later. Children are not able to talk fluently about certain topics until the age of around three or four (Clark, 2003). It seems unusual then that teenagers or adults learning a foreign language are expected to successfully articulate new phonemic and prosodic features so quickly. They are also expected to learn reading, writing, listening and speaking simultaneously, which is not the case for infants learning their first language and can be detrimental since orthography has a notable effect on the encoding of phonological form (Bassetti & Atkinson, 2015; Mairano et al., 2018; Mouquet & Mairano, 2023a,b).

Another difference between L1 and L2 acquisition is the use of *motherese* (Kuhl, 2004). The term *motherese* denotes what is more commonly known as "baby-talk". Mothers, or indeed fathers, speak to their infants more slowly using a higher pitch on average, exaggerating pitch contours and stretching vowel sounds. This facilitates the perception of phonemes/phonetic units, but it is not used with older learners as it would be perceived as strange or patronising. The link between perception and production seems crucial in acquiring L1 phonology, thus it surely plays an important role in L2 acquisition as well.

While infants are able to discriminate the majority of speech sound distinctions, adults have difficulty discriminating L2 speech sounds (Best et al., 1988). Trehub (1976) assessed the ability of Canadian adults and infants to discriminate Czech contrasts. She discovered that although infants could discriminate the contrasts easily, adults struggled to do so. However, Werker and Tees (1984) demonstrated that this ability appears to decline rapidly around the age of ten to twelve months. They tested the infant and adult perception of two place of articulation contrasts; one found in Hindi and one in Thomson, a Native American Language. The American infants aged six to eight months were able to distinguish between the contrasts but American adults were not. The authors then decided to test the same contrasts on two more groups of infants; one aged eight to ten months and another aged ten to twelve months. When comparing the data from the different age groups, it appeared that those aged six to eight months performed the best, followed by the eight to ten month-olds and that those aged ten to twelve months performed as badly as adults. As Werker and Tees suggest: "The results provide strong support for the supposition that specific linguistic experience is necessary to maintain phonetic discrimination ability." (1984, p.130). It remains to be seen to what extent this discrimination ability can be recovered in later life.

As well as discriminating a wide array of phonemic contrasts, infants are also malleable in terms of stress until a certain age. Jusczyk et al. (1993) found that American infants started to show a preference for strong weak stress patterns around the age of nine months. Infants aged six months did not yet demonstrate the same preference. This implies that infants may learn to use stress patterns for segmentation and for developing their mental lexicon. In addition to this, it seems that infants have a preference for vowels over consonants. Infants develop language-specific vowel prototypes by the age of six months and become sensitive

to vowel contrasts before consonant contrasts (Cutler & Mehler, 1993). This is most likely due to the more salient nature of vowels since they are articulated with voicing and have a longer duration than consonants.

It appears that there are universal elements to language processing that begin at a very young age. In fact, Polka & Bohn (2011) developed the Natural Referent Vowel framework based on the observation that both infants and L2 listeners display directional asymmetries when discriminating between vowel contrasts, favouring peripheral vowels. These asymmetries point toward a universal perceptual bias for the peripheral vowels. The perceptual bias dissipates along with discrimination acuity as infants refine their perception strategies to suit the L1.

There are several things that we can glean from studying L1 speech perception. Although infants are endowed with the impressive ability to discriminate different phonemic/phonetic contrasts, it soon becomes language-specific. Additionally, transitioning from perceiving to producing speech is a long process that takes years to perfect even for the L1. It requires a lengthy period of statistical learning that focuses on perceiving and discriminating phonemic and phonetic contrasts and studying prosodic features before associating them with meaning. All this occurs long before the first words are uttered. In addition, adults facilitate learning by using *motherese*. There are perhaps features of L1 language acquisition that could be emulated for adult L2 learners in order to improve their perception and, as a result, their production skills. Furthermore, the speech processing patterns that are acquired from infancy shape the way in which the L2 is processed in later life.

2.2.2 The Discrimination, Assimilation and Identification of L2 Phones

While infant speech perception starts out as a blank canvas, it quickly adapts to suit L1 processing strategies. This means that L2 listeners have a well-established L1 that often interferes with their acquisition of L2 sounds. For this reason, L2 listeners often have difficulties discriminating between non-native speech sounds and decoding prosodic patterns, which may lead them to categorise and segment an L2 differently to the way an L1 listener would.

A large body of research has focused on distinguishing L2 minimal pairs that do not exist in the listeners' L1. The difficulties faced by L2 listeners have been attributed to not knowing how to categorise the new speech sounds. Two well-known models have sought to explore and explain these difficulties are the Perceptual Assimilation Model (PAM-L2, Best et al. 2007) and the Speech Learning Model (SLM, Flege 1995; Flege et al. 2021). Both models agree that the classification of new phonemes is heavily influenced by the L1.

In PAM-L2 (2007), if new phonemes are similar to existing L1 sounds then they will be assimilated. However, if they are markedly different, they are more likely to be categorised as new phonemes (*uncategorised* or *non-assimilable* type). For example, Best et al. (1988) found that Zulu click consonants, which are perceived to be markedly different from any English phonemes, were not assimilated by English listeners to existing English phonemes and were discriminated easily. When assimilation does occur, however, it can follow several different patterns. L2 phonemic contrasts which do not exist in the L1 may be assimilated to two different L1 categories (*two category* type) or to the same L1 category. When two phones are assimilated to one category, but one is closer to the L1 than the other it is referred to as a *category goodness assimilation.* For instance, French listeners may assimilate the phonemes /ɪ/ and /iː/ to the category /i/, which exists in French and is closer to /iː/, and have difficulty discriminating between them (Heidlmayr et al., 2021; Iverson & Evans, 2009). When the two phones are both considered perceptually similar and acceptable versions of the same L1 phone, it is considered a *single category assimilation* and discrimination is difficult. The model predicts that *single category assimilations* will be more difficult for listeners to discriminate than *category goodness assimilations* and that *two category assimilations* and *uncategorised* or *non-assimilable* types should be easier to discriminate than either *single category* or *category goodness* types.

The SLM (Flege, 1995; Flege et al., 2021), on the other hand, aims to investigate the ultimate attainment of L2 pronunciation, so it is not solely a perception model but it does make certain predictions based on perceptual factors. Although it does not consider all pronunciation variants to be caused by perceptual differences between the L1 and the L2, it does concede that many have a perceptual basis. Unlike PAM-L2, it predicts perception difficulties based on phonetic differences rather than phonological ones. A new category can

be established if a difference is perceived between L1 and L2 phones and this is more likely to be achieved if there is a greater phonetic difference between them. Like PAM-L2 though, the SLM predicts that the more similar the contrasting L2 phones, the more difficult it will be to discriminate between them.

There is overwhelming evidence to support the idea that discrimination is more difficult when two contrasting L2 phones have been assimilated to a single L1 category. Tyler et al. (2014) tested American-English listeners on six non-native vowel contrasts and found that they had less difficulty discriminating *two category* and *uncategorised* contrasts than *category-goodness* or *single category* contrasts. In addition, Flege et al. (2021) reviewed research investigating the English /r/-/l/ contrast as perceived by Japanese listeners, who have notorious difficulties discriminating between them. The studies show that Japanese listeners do have great difficulties distinguishing them, but that with exposure, they are more likely to develop a new category for the phoneme /r/ because it is perceived as being more dissimilar to Japanese /ɾ/ than English /l/. These findings support predictions of both models.

A series of studies by Llompart and Reinisch (2019a) tested German speakers on English vowel contrasts in three different tasks: categorisation, imitation and word reading. They were tested on a contrast that exists in both English and German (/ɪ/-/iː/) and a contrast that exists in English and is difficult for Germans (/ɛ/-/ae/). Unsurprisingly, German listeners were better at distinguishing between /ɪ/-/iː/ than /ɛ/-/ae/ in all three tasks both perceptually and productively. Further analysis revealed that the relationship between imitation and word reading is strongly correlated for the /ɪ/-/iː/ contrast but not for /ɛ/-/ae/ contrast. This implies that imitation and production are not always aligned when it comes to difficult contrasts, perhaps due to the higher cognitive demands of the tasks, which may degrade the performances when the new categories have not been fully established. Thus, the positive effects of imitation may be ephemeral without prolonged training. In addition, the results of the categorisation task support the idea that assimilation patterns are strongly influenced by the L1. In another study, Llompart and Reinisch (2019b) also found that German listeners performed better on a lexical decision task when words contained the /ɪ/-/iː/ contrast and not as well when words contained the /ɛ/-/ae/ contrast, which reinforces

the idea that participants had not yet formed two separate categories for the latter contrast.

Research has also shown that the size of the L1 phonemic inventory plays a role in the assimilation and categorisation of the L2. Iverson and Evans (2009) compared German and Spanish listeners vowel identification accuracy and assimilation tests before and after high variability phonetic training (HVPT) to investigate the impact of L1 inventory size. German has a larger vowel inventory than Spanish, so the authors hypothesised that this may help when identifying L2 English vowels. Indeed, they found that German listeners improved more than Spanish listeners after training and, although Spanish listeners improved with extra training, it would seem that having a large inventory facilitates new learning.

The assimilation process seems not only to depend on the L1 but also on the variety of the L2. Escudero and Chládková (2010) found that Peruvian listeners show different patterns of assimilation for American English and Southern British English (SBE) vowels. They compared assimilation patterns of the nine monophthongs common to both varieties with the five monophthongs of Spanish. The assimilation of the vowels /iː/ and /uː/ was relatively stable as they were mostly assimilated to Spanish /i/ and /u/. The patterns were rather different for the remaining vowels. Listeners used a single category /e/ to categorise three different American vowels /ɪ/, /ɛ/ and /ae/ but only two SBE vowels /ɪ/, /ɛ/. On the other hand, they used a single Spanish category /a/ to categorise three SBE vowels /ae/, /ɑ/ and /ʌ/ but only one American vowel /ɑ/. In addition, SBE /ʊ/ was more likely to be assimilated to Spanish /u/ but American /ʊ/ was more likely to be assimilated to Spanish /o/. This seems to indicate that listeners are indeed sensitive to phonetic differences and that different varieties of the same language can impact assimilation patterns.

The discrimination of phone contrasts is also affected by environmental factors and research has shown that listeners have difficulties identifying phonemes in adverse conditions. Cutler et al. (2004) investigated the interaction between phoneme identification and noise comparing L1 and L2 speakers of English. They found that while Dutch listeners fared worse than English listeners overall, both Dutch and English listeners' performances were worse in the noisy condition, but there was no disproportionate difference between noise and L1. For this reason, they conclude that phoneme identification is not the cause of L2 speakers' difficulty understanding speech in noisy conditions. Instead, they believe this may be due

to slower and less accurate processing across different levels: prosodic, semantic, syntactic, not just phonemic. Another interesting finding is that for both L1 and L2 speakers, initial segments were more difficult to identify than final segments and vowels were easier to identify than consonants, which seems to indicate that there are some universal elements in speech processing since it echoes Bond's (2005) findings on misperceptions. Additionally, they noted the influence of L1 phonology on the L2 in the Dutch listeners' responses to syllable-final consonants. As the voicing of final consonants is illegal in Dutch, the listeners made more voicing errors on final consonants in comparison to English listeners.

Suprasegmental features are also subject to discrimination difficulties. So and Best (2010) examined the perception of Mandarin tones by different L1s and found that L1 prosodic systems can have an impact on tonal discrimination. Cantonese, Japanese and English listeners heard syllables produced with the four tones of Mandarin, a language in which tones have phonemic status. Since the prosodic systems of the listeners were different, they expected different patterns. Cantonese is a tonal language like Mandarin, whereas Japanese is a pitch-accent language and, while the pitch-accent pattern is often dictated by moraic constraints, some lexical meanings are distinguished by pitch. English, on the other hand, is a non-tonal stress-accent language in which relatively few words are distinguished by stress and this distinction is often accompanied by segmental changes. When comparing the three L1s, they found that Cantonese and Japanese listeners outperformed English listeners, therefore using pitch distinctively in the L1 aids discrimination. In addition to this, the Cantonese listeners showed some language-specific constraints since they had difficulty with Mandarin tones that were similar to Cantonese. However, this was not the case for Japanese and English listeners who showed no patterns of that nature. Instead, some language-independent patterns appeared since similar tone pairs were more difficult to identify than dissimilar ones.

In order to explain the differences between tonal, pitch-accent and stress-accent languages, Schaefer and Darcy (2014) suggest examining assimilation patterns in terms of pitch prominence. All languages use pitch but not to the same degree or for the same function, thus they argue that comparing languages in terms of pitch prominence is more appropriate than comparing languages with or without tones. To test their theory, they asked speakers of

Mandarin (tonal), Japanese (pitch-accent), English (stress-accent) and Korean, which does not use pitch for lexical distinctions, to perform an AXB discrimination task of Thai tones. Results revealed a hierarchy in which "the functional prominence of pitch in the L1 determines accuracy in a phonological discrimination task." (p.9). In other words, performance accuracy corresponded to the extent to which each language uses pitch. Mandarin speakers performed the best followed by Japanese speakers, then English and Korean speakers. However, there was no significant difference between English and Korean speakers. This again highlights the fact that our L1 heavily influences our L2 perception, even the extent to which pitch is used can facilitate perception.

Another study by Dupoux et al. (1997) compared French and Spanish speakers' discrimination of stress contrasts and segmental contrasts. In Spanish, stress can distinguish lexical pairs, but in French that is not the case. Unsurprisingly, therefore, Spanish listeners performed well in both tasks, whereas French listeners performed worse than Spanish listeners in the stress condition. However, French listeners performed better in a subsequent simpler version of the stress task. This suggests that French listeners do not attend to stress cues, unless forced to do so by the task in question.

Not being able to distinguish L2 phonemic contrasts or prosodic patterns means that L2 comprehension involves a higher cognitive load and is less efficient than L1 comprehension overall (Tyler, 2019). Since discrimination is a bottom-up process and L2 speakers have a tendency to rely more on bottom-up processing than top-down processing (Jenkins, 2000), it can contribute to making speech processing a highly complex task and impede the intelligibility and comprehension of the L2. It is likely that such difficulties also have an impact on L2 pronunciation since perception and production are inextricably linked.

2.2.3 French Listeners Discriminating English Phones

Like all L2 listeners, French listeners are likely to encounter difficulties when processing an L2. A small number of studies have focused on how French listeners perceive L2 English. They confirm the well-established idea that the L1 influences L2 perception and highlight specific difficulties that French listeners face when decoding L2 English. This can also shed

light on the patterns of pronunciation produced by the French Psychology researchers in our corpus, which is presented in Chapter 6.

Heidlmayr et al. (2021) combined behavioural and neurophysiological (EEG) methods to investigate how phonological and semantic information interact in speech processing and the impact they have on contrast discrimination. L1 French participants had to listen to English sentences that contained either a semantically congruent or incongruent item that differed on one phonological dimension. For example, "The anchor of the ship was let down" versus "The anchor of the *sheep was let down" (p.5). They tested participants on three contrasts that do not exist in French /ɪ/-/iː/, /θ/-/s/ and /r/-/w/. The participants also listened to sentences that were congruent or incongruent on a lexical-semantic dimension. For example, "I got soaked in the rain, so I asked him for a towel to dry/*skip my hair" (p.5). The EEG monitored the participants' brain activity while hearing the sentences and after listening to each sentence they had to judge whether the sentences were acceptable or not. The Event Related Potential (ERP) markers along with listeners' judgements revealed that participants performed more accurately for lexical-semantic incongruence than phonological incongruence and that this finding interacted with L2 proficiency. The more proficient the participant, the more accurate they were. This suggests that L2 learners are able to construct phonemic categories as their proficiency increases, although their performances may not be as accurate as L1 speakers. This is in line with Flege et al. (1997) who also found that experienced listeners of different L1s (German, Spanish, Mandarin and Korean) were better at perceiving English vowel contrasts than inexperienced listeners. However, Heidlmayr et al. (2021) conclude that their results do not allow them to understand the assimilation patterns underlying these findings. It may be that the French listeners have assimilated the closer one of the two L2 phonemes to the existing French category and created a new category for the more discrepant L2 phoneme or they may have created two new phonemic categories for the L2 phonemes. In either case, the evidence suggests that the L2 phonological contrasts were difficult to discriminate for low-proficiency learners.

Iverson et al. (2012) also studied vowel perception. They trained experienced and inexperienced French participants on 14 English vowels and then tested them on identification, discrimination and production. They found that overall both groups of participants improved

after training. However, improvements were variable. In terms of identification, participants were better able to identify 11 of the 14 vowels after training but /ɪ/, /ɑɪ/ and /ʌ/ were resistant. As for discrimination, there were only significant improvements for three pairs of vowels /ɑː/-/ɒ/, /ɔː/-/ɑʊ/ and /əʊ/-/ɔː/. Additionally, there were only improvements in production for three vowels /iː/, /eɪ/, and /ɑʊ/. This suggests that some vowel contrasts may be more resistant than others.

On the other hand, Krzonowski et al. (2016) focused on three pairs of vowel contrasts. The authors tested French listeners on the English vowel contrasts /ɪ/-/iː/, /ae/-/ʌ/ and /ʌ/-/ɑː/ and compared three groups. One had received perception training, one had received production training and a control group. The group that showed the greatest improvement overall was the group that had received perception training. The perception group improved their identification and discrimination of all the vowel contrasts. Furthermore, their production accuracy also improved even though they did not receive explicit production training.

Another set of studies has investigated French listeners' perception of the glottal fricative. Since /h/ is voiceless and "lacks the turbulent airflow that characterizes other fricatives" (Mah et al., 2016, p.2), it can be considered difficult to perceive. For this reason, Mah et al. (2016) sought to determine whether its low perceptual salience could explain why L2 learners have difficulty discriminating it. They tested French listeners /h/ perception using mismatched negativity (MMN) in a linguistic and non-linguistic task and found that French participants only detected /h/ in the non-linguistic condition. They attribute this to having difficulty forming a phonological representation for /h/ as opposed to difficulties attributed to the acoustic properties of the phoneme itself. However, Melnik and Peperkamp (2019; 2021) found that French listeners accuracy improved at the prelexical and lexical levels of processing after training. It is also encouraging to note that the improvements were preserved four months later.

In another study, Tyler et al. (2019) examined French listeners' perception of the dental fricatives /θ/ and /ð/. The authors asked participants to complete six discrimination tasks and two categorisation tasks. Interestingly though, participants were required to categorise what they heard using French phonemic categories not English ones and then rate the goodness of fit of the selected category. Results showed that most participants categorised

/θ/ as /f/ (68%) and /ð/ as /v/ (58%), whereas only 9% of participants categorised /θ/ as /s/ and 20% categorised /ð/ as /z/. The labiodental fricatives were considered a better fit for the dental fricatives than the alveolar fricatives. This does not match observations of French speakers' productions, which suggest that /s/ and /z/ are the most common substitutes.

Overall, it seems that French listeners experience difficulties perceiving the glottal fricative and discriminating English vowel contrasts. In addition, the dental fricatives are perceived as closer to the labiodental fricatives than the alveolar fricatives. Discrimination difficulties could potentially lead to word recognition difficulties and slow down speech comprehension, the implications of which will be discussed in Chapter 8. However, research has also shown that perception training can improve discrimination and perhaps even aid in the creation of new phonemic categories, which can in turn lead to an improvement in production.

2.3 Summary

This chapter has examined how cognitive load interacts with speech perception. Studies have shown that visual interference can increase cognitive load, therefore, reducing performance accuracy. Accentedness appears to slow down processing times yet listeners seem to adapt quickly, so it remains to be seen whether an L2 accent induces high cognitive load or represents a desirable difficulty for listeners.

We also reviewed cognitive models of speech perception, which aim to describe how the brain processes language. Interactive-activation models appear to explain how listeners can effectively recognize words even when the sound signal is impaired. In spite of their differences, the word recognition models tend to concur that both bottom-up and top-down processing are used to process speech, but with different degrees of interaction.

This chapter has also presented previous findings on categorisation and segmentation. Studies indicate that listeners are highly skilled at classifying L1 speech sounds, but they tend to rely contextual cues when the acoustic signal is degraded. Research also indicates that segmentation is a language-specific phenomenon, in which listeners focus on prosodic cues. Thus, vowels, due to their salience, and prosodic patterns appear to be crucial for

listeners to decode speech. Since these characteristics are specific to each language, L1 segmentation strategies are likely to affect the way the L2 is decoded.

We then discuss the innate ability of infants to discriminate the phonological contrasts, which declines rapidly in the first year of life, and contrast this with the discrimination difficulties that older L2 listeners face. The models PAM-L2 and SLM suggest that L2 phonemic contrasts that do not exist in the L1 are categorised differently depending on the their similarity to the L1, with L2 sounds being assimilated to similar existing L1 sounds. The studies presented here support this view. Finally, we focus on studies that have examined discrimination difficulties that French listeners experience with L2 English contrasts. Findings show that vowel contrasts and the glottal fricative appear to be challenging for French listeners. In the next chapter, we examine the aspects involved in producing intelligible speech.

Chapter 3

Out of the Mouth

It is all very well instructing learners of English to aim to be intelligible, yet, despite a large body of research being conducted (Jenkins, 2000; Munro & Derwing, 2015; Bradlow & Bent, 2008), it is unclear as to what exactly constitutes intelligible speech. It is likely that there is no single answer to this question, however, studying speakers' productions can bring us closer to understanding some of the elements that facilitate or hinder intelligible communication. This chapter focuses on the pronunciation models used in France and the effectiveness of teaching. It also discusses the notion of error and previous research on how production errors affect intelligibility and comprehensibility. Finally, it reviews pronunciation difficulties for French speakers.

3.1 Pronunciation Models and Teaching

It is tempting to consider L2 pronunciation variants as errors and to promote a particular model as the gold standard, however, the primary function of language is communication. This means that successful communication should be the gold standard, thus a speaker who is intelligible and comprehensible has achieved this goal even if the norms of the target language are never fully mastered. The difficult yet crucial task is to understand which pronunciation variants impede intelligible communication and what to teach learners. In order to determine which elements of pronunciation to focus on in the classroom, it is necessary to decide which pronunciation model to teach, what type of errors learners make and whether those errors affect intelligibility and comprehensibility. French researchers usually start learning English

at school, so we will first consider the pronunciation models used in the French schooling system and then discuss the effectiveness of pronunciation teaching.

3.1.1 Which pronunciation models to teach?

Before examining L1 English norms, we must consider the concept of a norm itself. Although linguistic norms often appear to be a fixed set of rules, they are constantly adapting, shaping and evolving. Language is a living entity, which responds to human needs, desires and imagination. According to Datska (2019), a norm viewed from a dynamic perspective is "always the result of socio-historical selection of the language elements from the available ones, the newly coined ones, or those that are again made current in active use by speakers" (p.229). Datska adds that the norm also plays a role in deciding the acceptability of the different pronunciation variants.

Bamgbose (1998) identifies three different types of norm: the code norm, the feature norm and the behavioural norm. The first is the standard variety, the second refers to typical properties and rules of linguistic features and the third denotes expected patterns of behaviour when interacting with others. Behavioural norms may not always be acceptable according to the standard variety, but sometimes become acceptable through common usage. Detey et al. (2016) also provides three distinctions: the objective norm described by linguists, the prescriptive norm used for learning, and the subjective norm related to perceptions of usages. While teachers tend to favour standard models and prescriptive norms, it is important to consider that as the world around us evolves so does language. There are a great many L2 speakers using English around the world so we need a model that reflects learners' needs and communication goals, but we also need to be more tolerant of foreign-accented English. Choosing the right model is a complex decision that should take into account linguistic, pedagogical, and sociocultural factors.

Despite recent interest in using L2 pronunciation models and changing teaching paradigms (Jenkins, 1998; Kachru & Smith, 2008; Murphy, 2014), the two most widely taught pronunciation models have been Received Pronunciation (RP) and General American (GA), and France is no exception to this (Ferragne et al., 2024). The widespread use is due to their status as standard varieties in the United Kingdom and the United States and the historical influence

of these countries around the world, the former as a colonising power and the latter as economic, cultural power (Crystal, 2003). Whether they should remain the predominant models is subject to discussion among advocates of the World Englishes approach as both varieties come with sociocultural connotations (Jenkins, 2000; Widdowson, 1994).

RP is a British accent that tends to be associated with the south-east of England but it can be found across England (Wells, 1982a). It has its origins in the English public school system and, as such, is synonymous with affluence and good education. Thus, it is considered a non-geographical prestige accent or sociolect. One of the first mentions of the term "received" goes back to Walker's (1791) Pronouncing Dictionary (Cruttenden & Gimson, 2014). Later, Alexander Ellis first abbreviated the term to "r.p." (Crystal, 2017). However, Daniel Jones was the first to create a phonological description of RP in the early 20th century, though he considered it to be a useful accent as opposed to a prestigious one:

> I do not consider it possible at the present time to regard any special type as 'Standard' or as intrinsically 'better' than other types. Nevertheless, the type described in this book is certainly a useful one. It is based on my own (Southern) speech, and is, as far as I can ascertain, that generally used by those who have been educated at 'preparatory' boarding schools and the 'Public Schools'. This pronunciation is fairly uniform in these schools and is independent of their locality. It has the advantage that it is easily understood in all parts of the English-speaking countries...The term 'Received Pronunciation' is often used to designate this type of pronunciation. This term is adopted here for want of a better. I wish it, however, to be understood that other types of pronunciation exist which may be considered equally 'good'. (Jones, 1976, 9th ed, p.12)

RP is not the only name given to this accent. It is also known as Queen's English or BBC English since the broadcasting company mainly employed speakers of this accent until more recent years (Roach, 2004).

Yet, over time, this accent has undergone some changes and shows considerable variation among speakers (Cruttenden & Gimson, 2014). Many now feel that RP is no longer an appropriate model for learners, particularly in light of the shift away from nativeness. Jenkins

(2000) has criticised the promotion of RP as a pronunciation model as it is becoming less and less common among contemporary L1 speakers. She argues that RP is a minority accent, that it is difficult to master and that it has altered over time, thus teachers risk "equipping learners with old fashioned pronunciation" (Jenkins, 2000, p.15).

Another accent that more closely reflects the reality in today's Southern England is Estuary English (EE), which falls somewhere on the continuum between RP and Cockney (Llamas & Jiménez, 2003; Przedlacka, 2001). However, a common transcription has not been agreed upon, so Wells (1997) suggests that rather than adopting EE altogether, it would be more realistic to update the transcription of RP to be used a pronunciation model. One of the main benefits of teaching RP is that it has been thoroughly described in numerous textbooks and pronunciation dictionaries (Roach, 2009). Thus, teachers may consider adopting a version that reflects RP's evolution such as Standard Southern British English (SSBE), which is often referred to as the modern equivalent of RP (Fabricius, 2017). It falls on the continuum between EE and RP, reflects reality more closely in Southern England today and is still close enough in transcription to RP. As a result, it can serve as an appropriate model in the classroom.

Across the Atlantic, the standard variety is known as GA or Standard North American English (SNAE) and it is "traditionally associated with parts of the midwestern and western United States and with central and western Canada" (Boberg, 2015, p.229). It is the accent often used by national television broadcasters and in higher education, hence the fact it is sometimes called Network English (Cruttenden & Gimson, 2014). Wells (1982b) describes GA as the accent which does not show marked Eastern or Southern characteristics, thus comprising the majority of Americans. It is not a single, unified accent, but rather "a concept referring to non-southern and non-eastern accents" (1982, p.470). Interestingly, the geographical area that GA represents is a reflection of the historical and political divisions of the USA separating the Northern unionists from the Southern confederates and the long-established East from the newly settled West (Brunet, 2023).

One of the most salient differences between the norms of Southern British English and North American English is rhoticity. GA or SNAE is a rhotic accent, therefore, /r/ is articulated in all contexts not only at the onset of syllables as it is in RP, EE and SSBE.

In addition, while they share 24 consonants, albeit with phonetic differences, there are 17 vowels to master in GA and 20 in RP. One could argue that using GA as a model reduces the workload for L2 learners. GA has also been described in pronunciation dictionaries and the United States has considerable cultural influence throughout the world through its media, therefore, is easily accessible for the learner of English.

In France, RP has historically been used in the classroom more often than GA yet, with the advent of the internet and the proliferation of American cinema and television, the latter seems to be having an influence on students' pronunciation (Ferragne et al., 2024). A study by Yibokou et al. (2019) revealed that some university students in France seem to be developing a mid-Atlantic accent due to the combination of English and American norms. They recorded 10 French students who practise online informal learning of English, the majority of whom declared watching mostly American films and series, but stated that they had more contact with British teachers than American ones. They analysed six differences between GA and RP norms: rhoticity, the intervocalic <t>, vowel nasalisation, the stress patterns of certain two-syllable words, the stress pattern and number of syllables in certain words and the realisation of the graphemes <i> and <y> in certain words. Three speakers had GA-dominant patterns and seven had RP-dominant patterns, yet most combined both norms. Speakers strongly favoured GA's rhoticity and two-syllable word patterns, but they preferred RP's intervocalic <t>, lack of vowel nasalisation, overall stress patterns and realisation of <i> and <y>. This suggests that learners can be influenced by a variety of different sources, not just teachers in the classroom (Kruk, 2012).

A recent study by Ferragne et al. (2024) also demonstrated that French university students have a tendency to combine RP and GA norms. The authors rated 307 French students' productions and compared this with the output of automatic speech recognition and automatic accent identification software. They found that around 60% of speakers displayed GA-dominant patterns, around 35% showed RP-dominant patterns, and 5% combined both norms to the same extent. However, in total only around 7% of speakers produced consistent RP or GA patterns. Interestingly, GA-dominant speakers were considered more native-like than RP-dominant speakers, although whether this is due to speaker aptitude or the GA norm itself is unclear. Nevertheless, the GA norm appears to be more popular among French

university students.

In the introduction, we briefly touched upon the differences between English as a Foreign Language (EFL), English as a Second Language (ESL), English as an International Language (EIL), and English as a Lingua Franca (ELF). French speakers typically begin learning English in an EFL context where language learning takes place in a classroom setting in a non-English speaking country (Ellis, 1994), however, depending on their future needs pronunciation goals may be different.

Henderson (2021) explains that in the French university context, students learning English can have different goals. English majors can choose native-like pronunciation as their goal, whereas students with other majors can give precedence to intelligibility. In France, future English teachers are required to pass one of two competitive exams: the *CAPES* or the *Agrégation*, which expect future teachers to master either RP or GA (Ferragne et al., 2024). On the other hand, French students studying Psychology probably only need to master English if they go on to become researchers. Hence, intelligibility for international communication is a more appropriate goal.

Teaching only RP and GA does not reflect the variety that exists throughout the English speaking world and no choice would be perfect, however, learners need a model of some nature to guide them (Dalton & Seidlhofer, 1994). Or as Przewozny-Desriaux (2018, p.7) puts it:

> From a methodological point of view, the notion of "native speaker" as a norm helps the learner to be aware of phonological issues and phonetic training. It helps to represent phonological structure and constraints, systemic and non-systemic variability, inter and intra-dialectal variation and streams of English.

This does not mean that L2 speakers must replicate the pronunciation model, but use it as a basis for learning. The emphasis and time spent on pronunciation in the classroom can be adapted depending on the goals of the learner. It is perhaps more important to expose students to other varieties perceptually so that they can understand different varieties of accents more easily, but continue to use a standard model as a guide for pronunciation

teaching. In this dissertation, we have chosen to compare the L2 productions in our corpus with the SBE norm for two main reasons. Firstly, it is the norm that is predominantly taught to French learners, thus they are likely to be familiar with it (Henderson et al., 2012). Secondly, the fieldworker is an SBE speaker, which may unwittingly influence the informants' productions. Lastly, as we explain in 4.3, three SBE speakers were also recorded to serve as a control condition for our perceptual experiment.

3.1.2 Is pronunciation teaching effective?

The challenges for EFL/ESL teachers aiming to tackle pronunciation are numerous. One of the main difficulties teachers face is knowing which features deserve special attention. Some teachers also become disheartened when learners appear to make little or no progress in this area. Another problem is the lack of training that teachers themselves receive and, when asked, teachers often say that teaching pronunciation is one of the things they are the least comfortable with (Capliez, 2015; Henderson et al., 2012). In addition, the pronunciation of English is often regarded as complex and unteachable, particularly when it comes to teaching prosody (Herment, 2018; Jenkins, 2000; Levis, 2016). However, there are patterns that can be explained to learners and research has shown that pronunciation teaching can help improve speech production. Henderson (2021) suggests that teachers consider three questions when making pedagogical choices about pronunciation features:

- language: Which features are 'worthwhile' and 'do-able' in instructed language learning?
- cognitive process: What can the speaker's brain cope with? What do their listeners' brains need?
- social factors: What is appropriate to a given context/setting?

Asking questions like these can help teachers decide what is relevant and useful for their learners. In fact, research has shown that teaching pronunciation does lead to improvement and is indeed 'worthwhile' and 'do-able'.

Many studies have investigated whether focusing on segments can improve the pronunciation of L2 speakers. Bradlow et al. (1999) found that high variability phonetic training

(HVPT) improves Japanese listeners' discrimination and production of the /r/ and /l/ contrast and that the improvement can be maintained three months after the initial experiment. Saito and Lyster (2012) also demonstrated that Japanese speakers improved their production of /r/ following form-focused instruction with corrective feedback, however, the group receiving form-focused instruction alone and the control group showed no significant improvement. In a task-based pronunciation training framework, which included pre- and post-test ABX discrimination tasks and delayed non-word/ delayed sentence repetition tasks and an interactive map-task, Mora and Mora-Plaza (2023) found that L1 Spanish speakers improved their production of the English phonemes /ɪ/ and /iː/ as the production of "/ɪ/ became lower in height and slightly more centralized, whereas /iː/ became slightly more target-like only in height." (p.14). Segmental training, thus, seems effective in improving L2 production.

A study by Kartushina et al. (2015) also demonstrated that combining visual feedback with training led to an improvement in production. French participants were trained on four Danish vowels. They had to listen to the vowels and repeat them. The Mahalanobis acoustic distance between the French L2 productions and the pre-recorded L1 Danish productions was then calculated and appeared on the screen in the form of two dots to show the differences between the participants' vowels and the target vowels. The participants also showed an improvement in perception on an ABX discrimination task. The findings indicate that production training helps to improve L2 vowel pronunciation and that training exclusively on production can also improve perception.

Research has also compared both segmental and suprasegmental training to determine whether one is more beneficial than the other. A study by Derwing et al. (1998) investigated the impact of teaching different pronunciation features to ESL learners. The learners received 12 weeks of training on either segmental features, global and prosodic features or no specific instruction and were recorded reading sentences and narrating a picture-story before and after instruction. Forty-eight L1 Canadian English listeners rated the speakers' sentences for comprehensibility and accentedness. Both groups receiving explicit instruction showed an improvement in comprehensibility but the segmental group received a better accentedness rating than the others. For the picture-description task, six ESL teachers were chosen

to rate the speakers for comprehensibility, accentedness and fluency. For this task, no improvement in accentedness was found and the only group who showed an improvement in comprehensibility and fluency was the global group. Therefore, it would seem that segmental instruction can improve accentedness in controlled tasks but that this learning is not transferred to spontaneous tasks, whereas a focus on suprasegmentals can improve comprehensibility in both controlled and spontaneous tasks.

Derwing and Rossiter (2003) followed up on this experiment by asking the same six ESL teachers to identify learner errors and code them as likely to interfere with comprehensibility, bothersome or salient. They also gave overall impression scores. Overall, 43.7% of errors were classified as salient, 32.0% as bothersome and 24.1% as comprehensibility errors, which tended to be predominantly phonological. Further analyses were conducted on phonological errors and filled pauses. Findings revealed that the segmental group made significantly less phonological errors and that the global group reduced the number of filled pauses, although not significantly. This suggests that focusing on segmentals can reduce some phonological errors but that focusing on suprasegmentals can improve fluency.

In another study, Gordon et al. (2012) also organised learners into 3 groups receiving either segmental instruction, suprasegmental instruction or non-explicit instruction for three weeks within a communicative methodology framework. Twelve L1 American English listeners rated the speakers in pre- and post-test recordings for comprehensibility. Findings showed that both trained groups improved but that only the suprasegmental group improved significantly in terms of comprehensibility. This again reinforces the idea that focusing on suprasegmentals can be beneficial.

Two meta-studies on pronunciation instruction provide a useful overview. Saito (2012) compared 15 studies and found that all studies apart from two showed significant improvement following pronunciation teaching and both segmental and suprasegmental training improved production. In addition, both form-focused instruction and form-focus in a communicative context were found to be beneficial, although form-focused instruction fared less well in spontaneous speaking conditions. Lee et al. (2015) compared 86 studies and found that several patterns emerged. Longer interventions produced much larger effects, instruction with feedback was more effective than without and instruction provided by teachers provided

greater effects than computer-provided instruction. In addition, within-group studies found larger effects in the classroom context than in the laboratory but the opposite was true for between-group studies. Finally, instruction focusing on different features of pronunciation was relatively homogenous but studies focusing on suprasegmentals or both segmental and suprasegmental features produced larger effects. When comparing overall improvements across studies, the authors found that within-group studies showed substantial improvements in their pre- and post-test performances and that experimental groups in between-group studies outperformed control groups.

It seems clear, therefore, that L2 learners benefit from receiving instruction and that said instruction should involve a variety of different pronunciation features since a global approach tends to be more successful. A segmental approach may improve accentedness and a suprasegmental approach may improve fluency and comprehensibility, so combining the two would certainly be advantageous for learners and as many have pointed out, the separation of segments and suprasegmentals is unnatural since "segmentals are dependent on suprasegmentals in English, and suprasegmentals always have segmental effects." (Levis, 2016, p.432). Levis (2016) calls for research to be taken into account when creating teaching materials. Although HVPT has been shown to improve students perception and production and intonation research has evolved, these methods appear to be rarely used by teachers. For example, Herment (2018) advocates the use of visualising the sound waves in order to teach intonation as a highly effective way for learners to acquire new patterns, yet this method is seldom used in the classroom.

There are also other new methods emerging such as accent imitation and embodied pronunciation training (Mora & Mora-Plaza, 2023), which are promising. Henderson and Rojczyk (2023) explored using foreign accent imitation with a group of French university students studying Food Science. After training and awareness raising, the students were recorded reading sentences in their 'best' French, in French with an English accent (no norm specified) and in English. Acoustic analysis showed improvements in diphthongal realisations, good alveolar /r/ accuracy and VOT increase for /k/. The recordings of the English-imitation French sentences were also evaluated by 235 listeners from 12 different L1s, who were asked whether each speaker was a native French speaker. Perceptual ratings

revealed that listeners were often fooled into thinking they were listening to L1 English speakers. This indicates that accent imitation could be a fruitful approach to improve pronunciation and, as the authors point out, it is very easy to put into place.

Another research project, in which I took part, has focused on embodied methods. As part of the *PICL!* project (Phonologie Incarnée de l'anglais au Collège Labitrie!, 2019-2024), I collected data and implemented embodied pronunciation training sessions. This project took a longitudinal approach in which secondary school students were followed for four years. Experimental and control groups were created to assess the efficacy of the embodied method and questionnaires allowed us to track the evolution of self-efficacy beliefs. During the Covid-19 pandemic, video modules were used for the training sessions and when it was possible to return to the classroom, training sessions took place at the beginning of the students' English classes. The embodied method involved associating different pronunciation features with an iconic gesture. For example, the closing diphthong /əʊ/ was indicated with a closing hand gesture. Results from Year 1 and Year 2 of the protocol show a positive effect on self-efficacy beliefs for the embodied groups (Rouaud et al., 2022) and an improvement in production for certain groups of words (ship/sheep/show/shot) and (hit/heat/hope/hop) (O'Callaghan et al., 2023). The word-group effect may be due to the iconicity of the gestures themselves, further research would be necessary to confirm this and the data from the final years of the protocol remains to be analysed. However, the first results do indicate that embodied pronunciation training is beneficial for learners.

Teaching pronunciation is effective in improving L2 production and there are many new promising methods to achieve this. In addition to implementing new methods influenced by research, teachers need to consider the types of errors that their students make so that they can decide which features may require more or less time devoted to them in the classroom, but they also need to consider which errors affect intelligibility.

3.2 Errors, Slips of the Tongue or Variation?

Not all production errors interfere with communication, therefore it would be more useful for teachers and students to prioritise errors that impede understanding. However, it is

unclear as to which errors cause intelligibility problems and, even when an individual error is understood, the high cognitive load of listening to multiple production errors may lead the listener to lose concentration or be less effective in decoding and understanding the message as a whole. Thus, it begs the question as to what is considered intelligible, and therefore acceptable variation, and which errors need to be prioritised in terms of classroom time and corrective feedback.

3.2.1 Error Analysis and Interphonology

An error is often conceived as some form of deviation from the language norm. This could involve using agrammatical syntax, choosing an inappropriate lexeme or pronouncing a word differently to the way one would expect. For a long time, any deviation from the norm, including foreign accentedness, was considered erroneous. Recent paradigms, such as Levis' (2005) intelligibility principle as opposed to a nativist one, have taken a more tolerant approach but much earlier work investigated L2 variation through the prism of production errors.

Corder (1975) distinguishes between two types of error: systematic and non-systematic. The systematic error, or error of competence, consistently deviates from the norm as the learner has acquired the erroneous form whereas the non-systematic error, or error of performance, is a slip of the tongue or a mistake rather than an error per se. Even L1 speakers make mistakes when speaking due to fatigue, emotion or other physical and psychological states. For L2 speakers, however, many errors are due to interference from the L1 (Corder, 1975; Capliez, 2011; Fromkin, 1980). Corder (1975) cites three main causes of L2 error: linguistic transfer (L1 to L2), the incorrect generalisation of L2 language rules (intralingual errors) and false concepts from teachers or materials. All of these factors may contribute to having a foreign accent. With this reasoning, a great deal of L2 production errors could be considered as systematic errors of competence since learners have acquired a form that deviates from the norm, however, L1 transfer is incredibly difficult to overcome.

Acquiring an L2 phonological system results in the development of an interphonological system that combines elements of the L1 and the L2 and evolves as acquisition progresses (Detey, 2010). The term *interphonology* stems from the earlier coined term *interlanguage*,

which englobes not only phonology but also grammar, syntax, morphology and lexicon. The idea being that learners acquire patterns that are unique and neither form part of the L1 nor the target L2 system. Selinker (1972, 2014) argues that interlanguage should be considered a linguistic system in its own right. Since some phonological features resist acquisition, the intermediary system may *fossilise* as the learner's acquisition stabilises (Han & Selinker, 2005; Selinker & Lakshmanan, 1992; Selinker, 2014). This means that the learner's acquisition is maintained but does not significantly improve "no matter what the age of the learner or amount of explanation and instruction he receives in the TL" (Selinker, 1972, p.215).

Since L1 transfer is one of the main causes of production errors, much attention has been focused on comparisons between languages in order to predict errors. The Contrastive Analysis Hypothesis does exactly this, however, it has often been criticised for not taking into account more subtle phonetic distinctions or for oversimplifying the complexity of speech (Wardhaugh, 1970). Although the strong version of this hypothesis is more widely accepted in phonology than other linguistic fields, not all production errors can be predicted by examining differences between the L1 and the L2. Learners often diverge from the norm in less predictible ways. Hypercorrection can cause learners to utter phonemes in the wrong place. For instance, *thousand* realised [θaʊθənd] and *oven* realised with an intrusive /h/ are examples of French learners anticipating phonemes that are difficult to articulate and do not exist in French. This type of phenomenon is not well explained by contrastive analysis. In addition to this, Eckman (1977, 1991) suggests that not all differences between languages will result in the same level of difficulty in acquisition. He argues that some language features are universally more marked, or in other words less common, than others and, therefore, more difficult to acquire. Dental fricatives are a good example of marked features as they are not found in many languages.

There are several other major problems with contrastive analysis highlighted by Derwing & Munro (2015). Perception and production are conflated, yet many learners are able to perceive sounds that they cannot produce or that they produce with difficulty. The model does not explain patterns of acquisition either, which change over time. Contrastive analysis does not take into account individual learner differences nor it does not reveal the underlying

cognitive processes behind pronunciation errors. L1 transfer is a more complex phenomenon than contrastive analysis would suggest. Cutler (1981) draws attention to another problem with traditional error analysis. When collecting data, some production errors are more difficult to detect than others. As a result listeners may overlook some errors in favour of more salient ones. This can lead to misrepresenting or misinterpreting the causes of certain errors, which in turn makes it difficult to decide how to remediate and prioritise errors.

Another bone of contention is terminology. Some have argued that the term *error* itself is inappropriate as Derwing & Munro (2015, p.56) explain:

> The study of L2 learner errors and their remediation is fraught with controversy. In fact, some sources even object to the term 'error' or argue vehemently against error correction, asserting that it is not only useless, but harmful to learners (Truscott, 1996). While heated debates on such matters seem to carry on eternally in some academic circles, they have little to do with the practical reality that language teachers face...Teachers who see their role as one of guiding learners toward the achievement of L2 communicative competence naturally feel a responsibility to address such sources of difficulty. They also realize that they cannot escape this situation by taking the view that 'errors' don't really exist or that the term cannot be used and acted upon in the classroom.

If the learner's goal is intelligibility, it is important to consider which errors to prioritise regardless of the terms used to describe the phenomenon of L1 transfer. Although L2 speakers may make many production errors, some may not render speech unintelligible.

3.2.2 Which L2 variants impede intelligibility?

There is such a variety of communicative contexts with different speakers, listeners, situations and environments that it would be nigh on impossible to determine which specific features render speech unintelligible in every kind of context. However, research can draw us closer to the existing patterns or more universal features that hinder intelligible communication. Errors are often separated into two main categories: segmental errors, which involve phonemes, allophones or phonetic distinctions, and suprasegmental errors, which relate to stress, rhythm

and intonation. This section reviews previous research investigating segmental and suprasegmental features that are deemed to be important for successful communication in English.

Segmental errors can be further organised into four main types (Derwing & Munro, 2015, p.58):

1. Insertion/Epenthesis - including a segment not present in the target form
2. Deletion - not including a segment that is present in the target form
3. Substitution - placing a segment in the target form with a segment from a different phonemic category
4. Distortion - producing a segment in the target form in a way that may be noticeably non-target, but which does not change the phonemic category of the segment

These different types of errors can have a negative impact on communication. Jenkins (2000) postulates that the mispronunciation of segmental features is the principal cause of intelligibility breakdowns between L2 speakers. This may also be because L2 listeners rely more heavily on bottom-up processing. In her Lingua Franca Core (2000, p.132) she argues that in order to ensure mutual intelligibility L2 speakers must maintain:

1. Most consonant sounds
2. Appropriate consonant cluster simplification
3. Vowel length distinctions
4. Nuclear Stress

In her years observing L2 speaker interactions, Jenkins found that consonant conflation and the simplification of consonant clusters proved to be particularly problematic, although the deletion of a consonant was found to be more detrimental than the insertion of a vowel into a consonant cluster. Derwing and Rossiter (2003) also found that L2 speakers seemed to be more sensitive to segmental variants. They surveyed ESL students so as to ascertain which features they perceived to be difficult. Eighty-four per cent of the problems identified

were related to segmental features, whereas only ten per cent were related to suprasegmental features. Thus, it appears that L2 speakers seem to notice segmental variation more than suprasegmental variation.

Even though segmental features are important to maintain, some phonemic distinctions may play a more important role than others in determining whether speech is intelligible. In order for a sound to be given phonemic status, it must have a distinctive function within a language. That is to say it must have minimal pairs. Some phonemes have very few minimal pairs such as /ʊ/ - /u:/ or /dʒ/ - /ʒ/, whereas others like /p/ - /b/ or /ae/ - /e/ have a large number of minimal pairs (Brown, 1995). Therefore, it is important to take into account the number and frequency of minimal pairs, the acoustic similarities of the two phonemes and whether the minimal pairs belong to the same lexical class (Brown, 1988; Catford, 1987). All of these elements contribute to the concept of functional load.

Functional load is seen as a more effective way of establishing a hierarchy of importance for segments and, thus, may be useful for teachers to help determine priorities. Munro et al. (2006) tested L1 Canadian English listeners perception of L1 Cantonese speakers utterances that contained both high and low functional load errors. The segmental errors mainly concerned consonantal substitutions and were selected based on Brown (1988) and Catford's (1987) calculations of functional load. Listeners were asked to rate the accentedness and comprehensibility of the utterances. High functional load errors resulted in more severe judgements of accentedness and comprehensibility, whereas low functional load errors had less impact on comprehensibility. The effect of low functional load errors on accentedness was not cumulative, nor did either type of error have a cumulative effect on comprehensibility, which implies that the nature of the errors is more important than the number of errors that a speaker makes.

While segmental features are important, the mastery of a phonemic inventory alone does not suffice to guarantee intelligible communication. Lepage and Busà (2014), argue that suprasegmental features are extremely important to maintain. In their study, L1 Canadian English listeners heard 184 words in a carrier sentence uttered by 20 French Canadians and 20 Italians. The stimuli words contained misplaced vowel reduction and word stress. The results show that misplaced vowel reduction hinders intelligibility more than the absence of

vowel reduction and that misplaced leftwards stress (e.g. ENdurance) impedes intelligibility more than misplaced rightward stress (e.g. cataLOG). Their findings also suggest that when combined, vowel reduction and misplaced word stress are particularly detrimental.

A study by Field (2005) also investigated the impact of misplaced lexical stress on intelligibility. This time, L1 English listeners and L2 listeners from a variety of L1s heard bisyllabic words recorded by an L1 English speaker. The words were either produced with the standard stress pattern, with stress shifted to the other syllable or with a stress shift plus a change in vowel quality. Findings showed that both L1 and L2 speakers were affected by stress being shifted away from the standard pattern. Furthermore, it appeared that misplaced rightwards stress (e.g. seCOND) impedes intelligibility more than misplaced leftwards stress (e.g. BEgin), which contradicts Lepage and Busà's findings. Finally, misplaced stress alone was more detrimental than misplacing stress and changing the vowel quality. This may be because the change in quality was from a weak to a full form, which is perhaps more informative in terms of perceptual salience.

Although there is no consensus about whether segmental or suprasegmental features are more likely to interfere with intelligibility, there is probably no singular answer, and perhaps no need for one. Instead the difficulties more likely depend on the L1 and L2 in question and the speakers and learners who need to communicate with each other. That being said, research seems to indicate that not all segments are equally problematic in terms of intelligibility. It is important to take into account the functional load of different segmental contrasts. In addition, misplaced stress seems to hinder intelligibility whether stress is shifted to the left or to the right. These features may be problematic for intelligibility but are they problematic for French speakers?

3.3 A Tale of Two Systems

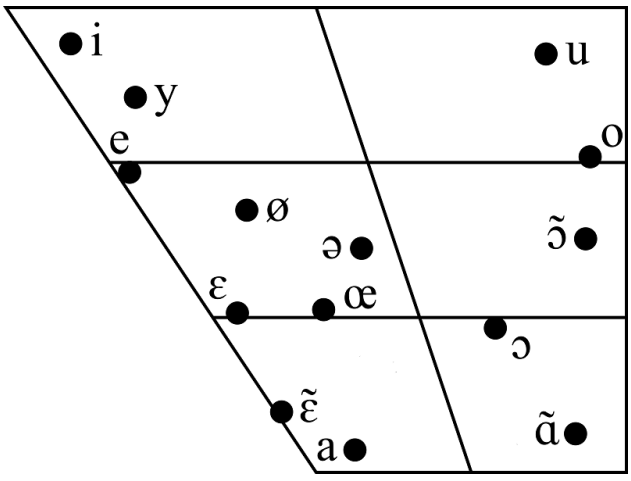
Learning an L2 requires speakers to produce and articulate initially unfamiliar phonemes and prosody and, as discussed, many errors are due to L1 transfer. Since different languages have different phonemic inventories and prosodic systems, these differences can create problems for L2 speakers who must master many new phones. While these differences are not the

only source of difficulty for L2 speakers, it is important to consider their impact on learners. The phonological systems of French and English are described in the following section and differences between the two systems are discussed. The English norm chosen was SBE as it is often used in the French education system. It is also the accent used by the control speakers in our experimental protocol, which is described in Chapter 7. Previous work on potential or observed difficulties for French speakers of L2 English are then described and, finally, the impact of orthography is discussed.

3.3.1 The French and SBE Phonological Systems

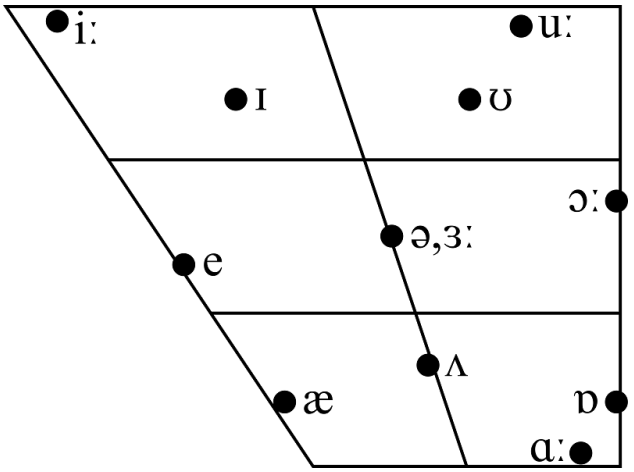
French can be described as having up to 16 vowels; between ten and twelve oral vowels and three to four nasal vowels depending on the variety (Deschamps et al., 2004; Fougeron & Smith, 1993; Malécot, 2019). Standard French or Reference French, which is the norm usually associated with "a certain social class (educated people) and geographical area (Paris and surroundings)" (Detey et al., 2016, p.58), has 11 oral vowels and three nasal vowels. Vowels are often displayed on a trapezium like the one below and described according to three main criteria: tongue height, the position of the tongue inside the mouth (front, centre or back) and whether the lips are rounded or not (rounding). French has both oral vowels, which are produced with air flowing through the mouth, and nasal vowels, which are articulated with air flowing through the nose.

Figure 3.1
Standard French Vowels, adapted from Capliez (2011) and Detey et al. (2016)



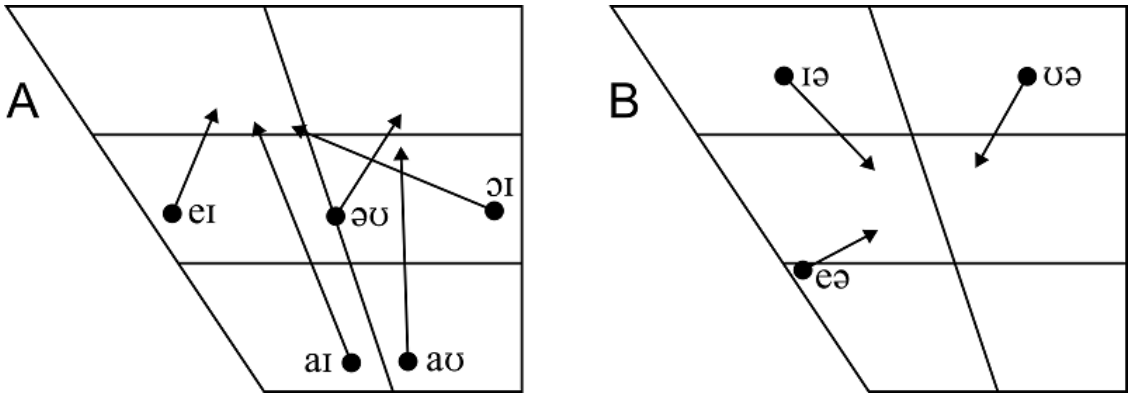
On the other hand, RP and SBE have 20 vowels. Traditionally RP is described as having 12 are monophthongs and 8 diphthongs (Roach, 2004), as we see in figure 3.2 and 3.3. This is what is usually taught to French learners. Cruttenden and Gimson (2014) explain that RP has undergone changes and suggest updating the description to 13 monophthongs and 7 diphthongs because /eə/ has become monophthongised to /ɛː/ for most contemporary speakers'. RP and SBE do not have nasal vowels per se, although some English varieties nasalise certain phonemes. As well as being described in terms of height/aperture, position and rounding, RP and SBE monophthongs vowels are also described as long or short, although many now prefer the terms tense or lax since the differences between long and short pairs involve not only changes in duration but also quality. The figure below illustrates the monophthong vowels with the diacritic ː indicating vowel length.

Figure 3.2
RP Monophthong Vowels, adapted from Roach (2004)



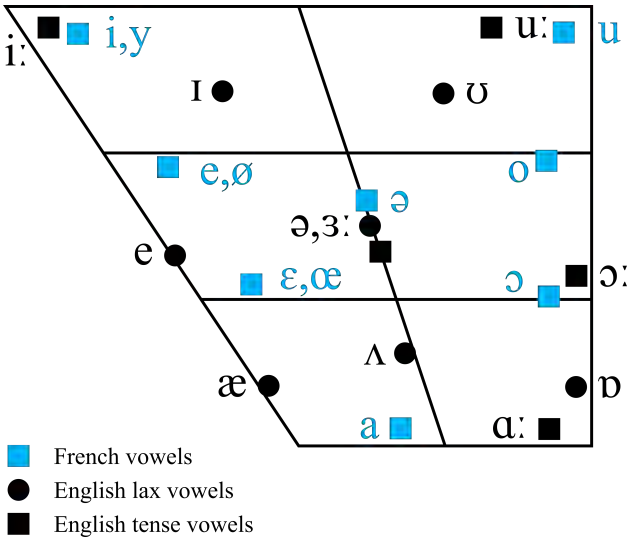
In addition to monophthongs, RP and SBE also have diphthongs, which are described as either closing or centring diphthongs and involve a glide between two elements by changing the position of the tongue.

Figure 3.3
RP Closing (A) and Centring (B) Diphthongs, adapted from Roach (2004)



When comparing vowel phonemes, the only vowel that is 'shared' by French and English is the schwa as shown in the figure below. This means that French learners must master a large number of new English vowel sounds.

Figure 3.4
French and English Vowels, adapted from Rouaud et al. (2022)



There are more similarities between the two languages in terms of consonants, which are defined by their place and manner of articulation and voicing. Of the 24 SBE and 20 Standard French consonantal phonemes, both languages share 19 consonants (Detey et al., 2016; Cruttenden & Gimson, 2014). This includes /r/ although it is realised markedly differently as [ʁ] in Standard French and [ɹ] in SBE. The phonemes /tʃ/ and /dʒ/ only appear in French as English loan-words like *match* or *manager* and the /ŋ/ exists in certain

varieties of French but not in Standard French. Therefore, the dental and glottal fricatives do not appear in Standard French at all: /θ/, /ð/ and /h/. Conversely, the palatal nasal consonant /ɲ/ does not exist in SBE.

Figure 3.5
RP Consonants, from Roach (2004)

	Bilabial	Labiodental	Dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Plosive	p b			t d			k g	
Affricate					tʃ dʒ			
Nasal	m			n			ŋ	
Fricative		f v	θ ð	s z	ʃ ʒ			h
Approximant	(w)				r	j	w	
Lateral approximant				l				

Not only does a mismatch between phonemic inventories cause difficulties for L2 speakers, the L1 also has an irrefutable impact on the articulation of shared phonemes. As Henderson and Rojczyk (2023, p.116) explain, English and French have very different articulatory settings:

- for English, the jaws are loosely closed, and the lips are only moderately active, whereas for French, the jaws are slightly open, and the lips are rounded and much more active;
- the main consonant articulation in an English AS is tip-alveolar, but French uses a blade-dental one;
- the oral cavity is more relaxed for English, without the contracted cheeks characteristic of a French AS.

Therefore, although some phonemes may exist in both phonological systems, their realisations are different. For example, the bilabial plosive /p/ exists in both French and English but is produced with aspiration in word-inital position in English but not in French and the plosive /t/ is articulated on the alveolar ridge in English but behind the teeth in French. The L1 has a tendency to pervade L2 articulatory habits and this can also be a source of difficulty for L2 speakers. In fact, many remain unaware of such differences.

In addition to having different phonemic inventories, French and English have different prosodic systems. Firstly, French is traditionally conceived as a syllable-timed language, whereas English is described as a stress-timed language (Abercrombie, 1967), although it has been argued that the dichotomy is not so clear cut (Astésano, 2016). In French, stress tends to fall on the final syllable of the word or groups of words, while English alternates between stressed and unstressed syllables. Furthermore, stress is lexically distinctive in English but not in French, hence stress being referred to as post-lexical in French. English is also characterised by a trochaic foot, while French is described as having an iambic foot (Astésano, 2016). Finally, intonation contours are realised differently in the two languages (Herment, 2022). Such differences may also lead to difficulties for French learners of English. However, suprasegmental features are beyond the scope of the present dissertation[4] since our acoustic and descriptive analyses focus specifically on segmental features. Suffice it to say that French and English differ considerably on a segmental and suprasegmental level.

3.3.2 L2 English Production Difficulties for French Speakers

Since the phonological systems of French and English are markedly different, production difficulties are to be expected in learners. Of course, not all of these difficulties will result in intelligibility breakdowns but will contribute to foreign-accentedness. Previous observations have indicated a multitude of possible production errors that French speakers are likely to produce.

For Mees & Collins (2013, p.215) learner errors can be organised into three main categories, with the first category being the one to prioritise:

1. Errors which lead to a breakdown of intelligibility.
2. Errors which give rise to irritation or amusement.
3. Errors which provoke few such reactions and may even pass unnoticed.

According to these authors, the highly significant problem areas for French speakers are the non-aspiration of /p/ /t/ /k/, the realisation of the dental fricatives, the omission of the

[4] We do address these features in the *PICL!* project.

/h/, the realisation of /r/, confusion between /ɪ/ and /iː/ as well as /əʊ/, /ɔː/ and /ɒ/ and finally stress and rhythm. This constitutes quite a long list of potential difficulties.

Capliez (2011) argues that one of the main problems French learners face is misplacing stress as patterns appear unpredictable for learners. In addition to this, many French speakers do not make the distinction between tense and lax vowels, therefore, the pairs /ɪ/ - /iː/, /ae/ - /ɑː/ and /ʊ/ - /uː/ tend to be neutralised to /a/, /i/ and /u/. Therefore, he also highlights stress and vowel contrasts.

Kenworthy (1987) also proposes a hierarchy of three categories of error: High Priority, Low Priority and Optional Attention. In the first category, she cites many potential errors that French speakers may make: rhythm and word stress, the absence of /t/ and /d/ in /tʃ/ and /dʒ/, the absence of /ŋ/ or of /h/, the non-aspiration of /p, t, k/, not distinguishing between vowel contrasts (/iː/ - /ɪ/, /e/ - /eɪ/, /əʊ/ - /ɔ/ /ae/ - /ʌ/) and linkage in connected speech. Strangely, she places consonants /θ/ and /ð/ both in the category High Priority and Optional Attention. In the Low Priority category, she cites the articulation of /t/, /d/ and /l/ behind the teeth instead of on the alveolar ridge, and the monophthongisation of the diphthongs /eɪ/ and /əʊ/. Finally, in the category Optional Attention category, alongside the dental fricatives, she cites the pronunciation of /r/, /ʊ/, and contrastive stress. This long list of potential errors may seem daunting for learners, however, more evidence is needed to establish whether these are indeed typical errors made by French learners and whether all of the errors in the High Priority category are indeed important to preserve. For example, as /tʃ/ and /dʒ/ exist in loanwords and /ŋ/ in non-standard varieties of French, they are perhaps not as prone to error as some of the other suggestions on the list.

Some more recent studies have investigated French-accented English empirically in order to ascertain whether French speakers do indeed make such errors. Krzonowski et al. (2018) compared the productions of the English vowels /ɪ/, /iː/, /ae/, /ʌ/ and /ɑː/ realised by 38 L1 English speakers and 48 L1 French speakers. The French speakers' English productions were also compared with their productions of the French vowels /a/ /e/ /i/ and /œ/. L2 vowel productions were more variable than L1 productions (both English and French), which is to be expected. French speakers often confused /ɪ/ and /iː/ but more successfully distinguished between the contrasts /ae/, /ʌ/ and /ɑː/. They were also able to produce vowel length

distinctions, although not to the same extent as L1 English speakers. The authors suggest that English /ɪ/ is often produced as French /i/, English /ʌ/ like French /œ/ and English /ae/ like French /a/.

As discussed in 2.2.3, Iverson et al. (2012) trained experienced and inexperienced French learners on 14 English vowels, which were organised into four clusters: (/ɛ/, /ɑː/, /ae/, /ʌ/), (/iː/, /ɪ/, /aɪ/, /eɪ/), (/ɒ/, /əʊ/, /ɔː/) and (/uː/, aʊ/, /ɜː/). While their perception of the vowels improved, the improvement in production was modest. Training and experience were beneficial but improvement only reached significance for three vowels (/i/, /eɪ/, and /aʊ/). It also differed from improvements in identification accuracy, which were broader covering 11 vowels. The production improvements were judged by how accurately English listeners identified the vowels, thus it would seem that the French speakers were not always producing the acoustic correlates that correspond to what English listeners expect. This may result in intelligibility differences for English listeners or instead contribute to perceptions of foreign-accentedness.

In another study on French and Italian speakers' vowel productions, Mairano et al. (2019) compared the Pillai scores, Euclidean distances and Linear Discriminant Analysis (LDA) classification scores with L1 speaker judgements of nativelikeness and comprehensibility. The acoustic measurements of the vowel contrasts /ɪ/ - /iː/, /ʊ/ - /uː/, /ae/ - /ɑː/ and /ɒ/ - /ɔː/ show overlapping categories in some learners' vowel productions. Thus, French speakers do seem to have difficulty with vowel contrasts. Interestingly, the acoustic measurements correlate strongly with L1 judgements of nativelikeness and comprehensibility.

In terms of consonants, Contreras Roa et al. (2020) demonstrated that French learners can produce the /s/ - /z/ contrast and progressive voicing assimilation of morphemic -s. While other consonants such as /h/, /θ/ and /ð/ have been highlighted as difficult to perceive (Mah et al., 2016; Melnik & Peperkamp, 2019, 2021; Tyler et al., 2019), more research is needed to assess the extent to which these perception difficulties transfer to production difficulties.

3.3.3 The Impact of Orthography

As well as having different phonemic inventories and prosodic systems, there is also another difficulty for French learners of English. English is not orthographically transparent since it

does not have a good grapheme-phoneme correspondence. Unlike languages such as Spanish or Italian, which have mostly one-to-one grapheme-phoneme correspondences, SBE English has only five vowel graphemes for 20 vowel phonemes. This means that there are often one-to-many grapheme-phoneme correspondences and combinations of digraphs do not always have the same pronunciation either. This can have a impact on the way the word is encoded as Tyler (2019, p.617) suggests:

> Each time learners read a word in the L2 they may be reinforcing a phonological structure for that word that is based on L1 grapheme-phoneme correspondences that have been adapted to the L2...in cases where the orthography does not signal a clear phonological difference, their internal rehearsal of the pronunciation of L2 words via orthography may reinforce a perception that the L2 phonemes are equivalent rather than distinct.

As orthography can heavily influence the way in which words are encoded, it is also likely to impact production. In addition, given the historical influence of Norman French on the English language, there are many homographs in French and English. Thus, French learners may be able to recognise new written words but have great difficulty pronouncing them (Poussard, 2003). In order to investigate the semantic similarities of false-friends, Walter (2001) created a corpus of 4,196 perfect English-French homographs, whose written form is exactly the same in English and French but whose pronunciation is often very different. Although her aim was not phonological in nature, it indicates that there are many words whose orthography could cause production difficulties based on their similarity with French. Furthermore, the corpus excluded words that are relatively transparent, for example, *biology* - *biologie*, which suggests that the impact could be greater still.

Orthography has been shown to impact the pronunciation of Italian speakers of English. In Italian double consonants are produced as longer than single ones, which is not the case in English. On the other hand, in English voiceless plosives are produced with longer VOTs than in Italian. Mairano et al. (2018) compared Italian learners, Italian late bilinguals and L1 English speakers productions of VOT values, which are orthography-independent, and double consonants represented orthographically. Unsurprisingly, the L1 English speakers

produced the longest VOTs, followed by the bilinguals, who produced intermediate ones and then the Italian learners, who produced the shortest ones. However, these VOT durations increased compared with their L1 Italian productions. Interestingly though, the bilinguals produced more native-like VOTs than learners but not more native-like productions of geminate consonants. Both Italian groups produced double consonants as longer than single ones. Thus, bilinguals were influenced by orthography in the same way as learners, despite living in the UK for six years on average. Bassetti et al. (2020) found the same pattern in a delayed repetition and a rhyme judgement task, where Italian speakers rejected homophones that were spelled with single and double letters.

A few recent studies have examined the impact of orthography on French undergraduate students. Mouquet and Mairano (2023a) replicated a study by Bassetti and Atkinson (2015) in which learners completed a read aloud task followed by a word repetition task. The tasks included words with silent letters so as to ascertain whether seeing the orthographic form affects productions. They confirmed previous results demonstrating that when presented with the orthographical form, French speakers produced more intrusive consonants corresponding to silent letters. In another study on the production of silent letters, Mouquet and Mairano (2023b) asked French undergraduate students to complete a picture naming task and an AB audio preference task. Despite not being presented with the orthographical form at all, orthography still had a strong impact on the production and perception of silent letters. Evidence strongly suggests, therefore, that L2 production is affected not only by L1 perception and production but also by orthography. This is another interesting consideration to take into account in the EFL/ESL classroom, however, more research is needed to establish methods to mitigate the effect of orthography.

3.4 Summary

In this chapter, we have presented the pronunciation models predominantly used in France. We argue that having a model can help learners even though, from a sociolinguistic perspective, only teaching SBE and GA does not mirror the diversity that exists within the English language. On the other hand, learners can be exposed to different varieties when working on

listening activities. In addition, research indicates that pronunciation teaching is effective and there are many promising methods emerging that teachers can use in the classroom.

Work on error analysis is also presented in this chapter. Not all errors are detrimental to intelligibility and comprehensibility. The effectiveness of communication is likely to be influenced by the specific L1 and L2 involved and the individuals who need to interact with one another. In addition, studies suggest that certain segments are not equally challenging regarding intelligibility and comprehensibility, thus, it is essential to consider the functional load of various segmental contrasts. Moreover, incorrectly placed stress appears to impede understanding for English listeners.

Due to the significant differences in the phonological systems of French and English, learners are likely to encounter production difficulties. The literature indicates that French speakers of English are likely to produce a wide variety of errors and some recent work suggests that they are heavily influenced by orthography. However, not every one of these errors will lead to a complete loss of intelligibility, some only contribute to the presence of a foreign accent, which is why it is important to investigate the relationship between foreign-accentedness and intelligibility.

Implications and Objectives

Part I has provided the theoretical framework necessary to understand the interplay between perception and production in intelligible and comprehensible speech. Firstly, we underlined how academic communication requires not only the use of domain-specific codes but also a mastery of English since it has become the lingua franca of research. This means that French researchers have to become confident communicators of English and be intelligible and comprehensible when they speak. Although this is now a common communicative situation, it has not been the subject of much research.

On the other hand, considerable work has investigated how speech is perceived from a cognitive to a linguistic perspective. In reviewing the literature, we have discussed key findings on how speakers of different languages perceive speech. The segmentation of the speech signal and phoneme categorisation are highly language-specific (Cooper et al., 2002; Cutler et al., 1986; Mehler et al., 1981). As a result, decoding the acoustic signal can be difficult when it does not match expectations, whether this translates as discrimination difficulties for the L2 listener or as unfamiliar variability in the speech signal for the L1 listener. Research seems to indicate that vowels and prosodic patterns play an important role in allowing the listener to decode speech (Bond, 2005; Cutler et al., 2004).

We have also looked at how L2 production errors are often due to L1 transfer (Corder, 1975; Fromkin, 1980). It is still unclear, however, which L2 production errors affect intelligibility and comprehensibility. One concept that can help in determining error importance is functional load since research shows that maintaining phonemic contrasts with a high functional load may facilitate communication (Munro & Derwing, 2006). In addition, studies have shown that preserving English stress patterns may help English listeners (Field, 2005; Lepage & Busà, 2014).

Research has also demonstrated that accentedness can affect intelligibility and comprehensibility, but the degree of impact varies depending on factors such as listener experience, linguistic background, and context (Adank et al., 2009; Bent & Bradlow, 2003; Gass & Varonis, 1984; Munro & Derwing, 1995a). Sharing the same L1 may be beneficial for the listener (Bent & Bradlow, 2003; Smith & Bisazza, 1982) as well as familiarity with the speaker's accent or the topic of discussion (Gass & Varonis, 1984).

Despite these insights, certain gaps remain. Specifically, little research has examined how French-accented English is perceived in academic settings and, to our knowledge, no studies have varied the degree of French-accentedness and its impact on the listener. Furthermore, while many studies explore either acoustic properties or listener perception, we intend to comprehensively address both aspects together. The principal aim of this dissertation is to examine the impact of French-accentedness on intelligibility and comprehensibility in an academic context. We adopt a twofold approach: an acoustic analysis of French-accented English and a perceptual experiment comparing listeners' accuracy scores and perception ratings. By integrating these two components, this research seeks to examine French-accented segmental phenomena and understand how variability in the speech signal affects listeners.

Having established the theoretical foundation, Part II presents the methodological choices and protocol used to collect authentic data for our Corpus of L2 Academic Psychology English.

Part II

Corpus of L2 Academic Psychology English: CO-LLAPSE

Chapter 4

Bridging Theory and Practice: Implementing the Protocol

The corpus elaborated for this dissertation comprises the L2 English productions of thirteen French Psychology researchers and takes a variationist sociolinguistic approach to data collection. In order to record different interphonological phenomena and subsequently create experimental stimuli for the intelligibility and comprehensibility tests, the French researchers were recorded completing a variety of tasks. This chapter discusses the theoretical and methodological considerations underpinning the protocol and describes the speakers' sociolinguistic profile and the adapted protocol in detail.

4.1 Sociolinguistic Fieldwork Methods

One of the principal objectives of creating a sociolinguistic corpus is to observe variation in the vernacular of speakers of different social and linguistic backgrounds. The vernacular can be defined as an informal style of speech, free from monitoring or hypercorrection that one uses in every day, casual situations (Labov, 1972; Tagliamonte, 2006). Since sociolinguists are interested in linguistic differences between different social groups, they must choose linguistic variables of interest when embarking on a new study. As Labov (2008, p.2) aptly puts it:

> The definition of a linguistic variable is the first and also the last step in the analysis of variation. It begins with the simple act of noticing a variation — that there are two alternative

ways of saying the same thing.

Noticing and recording variation is essential in order to quantify language use (Milroy, 1980). Thus, such corpora aim to record certain features of the speech community in the most naturalistic way possible using "tests, elicitations, intuitions, and observations of the vernacular" (Labov, 1972, p.99). The most common methods include recording speakers' productions during sociolinguistic interviews or observing their interactions with others.

That said, gaining access to a speaker's natural style is not without challenges. Speakers tend to adapt and accommodate to those around them (Giles et al., 1991). When speaking to those outside of their speech community, they may abandon certain features of their natural speech to converge to the speech of their interlocutor. In addition, informants have a tendency to monitor their speech when being recorded as they feel they are being observed. The observer's paradox is a well-known methodological issue that researchers must try to curtail where possible in order to obtain data that is representative of the speech community in question (Labov, 1972; Milroy & Gordon, 2008). In order to avoid this paradox, the fieldworker can employ different techniques to avoid convergence and accommodation.

One technique used to obtain speech that is more naturalistic is to observe the informant speaking to another member of their linguistic community. Building rapport with the informants or using the 'friend of a friend' technique to meet informants can also help to minimise this effect. Milroy (1980) went so far as to integrate working-class communities in Belfast over a lengthy period of time. This is known as the participant-observation technique whereby the fieldworker becomes an active member of the community while observing language phenomena at the same time. While this may be effective in reducing the effect of the observer's paradox, it is time-consuming and demanding. Labovian quantitative survey methods, on the other hand, involve different tasks that vary in terms of style, thus data can be collected over a shorter time-frame and naturalistic speech can still be obtained. In any case, no method can completely overcome the paradoxical relationship between observing and recording participants' speech and collecting authentic data.

Another theoretical and methodological concern is how to recruit speakers. It is essential

for sociolinguistic studies to collect data that represents the diversity of the linguistic community since this can better reflect the language patterns of the broader population. For practical reasons though, informants are often selected on the basis of stratified random sampling. In other words, they are initially selected according to specific linguistic variables of interest and then stratified according to secondary variables such age, gender or place of birth (Tagliamonte, 2006). This is primarily because the speech communities under study may be minority groups or specific to a very particular geographical location, therefore, completely random sampling means the researcher may not obtain data from the relevant speech community. There is a delicate balance to be found between investigating specific linguistic phenomena and selecting a sample that is representative of the population.

The size of the corpus can also affect the generalisability of the findings. Larger corpora provide more data that allow for stronger conclusions to be drawn, however, phonological corpora are inclined to be small as they involve the study of finite features (Viollain & Chatellier, 2018), which means that a lot of observations can be obtained in a shorter time-frame. Furthermore, the transcription and annotation of phonological features can be laborious and time-consuming, thus researchers may not have the time or resources to exploit large quantities of data (Tagliamonte, 2006). This may change with the advent of automatic transcription and annotation, however, models are often trained using standardised pronunciation and are perhaps less appropriate for L2 English. For this reason, as explained in Chapter 5, manual transcription and annotation has been used.

All of the aforementioned considerations must be taken into account when undertaking sociolinguistic fieldwork. While no method is perfect, it is essential to make sound, theoretical and methodological decisions to ensure that the data will be as representative as possible and, at the same time, capture the variation of different speech communities and individuals.

4.2 The PAC Programme

Our Corpus of L2 Academic Psychology English was elaborated on the basis of previous research within the framework of the *Phonologie de l'anglais contemporain: usages, variétés*

et structure[5] (PAC) programme (Durand & Przewozny, 2012; Mairano & Bouzon, 2021; Przewozny et al., 2020), which aims to provide corpus-based research on contemporary spoken L1 and L2 English. The PAC programme is itself inspired by Labovian methodology and is firmly anchored in using a corpus-based approach to test linguistic theories and to embrace the variation that exists in speech.

The PAC programme[6] aims to describe and document different varieties of English spoken around the world from the inner, outer and expanding circles. Both native and learner corpora have been developed within this framework allowing a wide array of phenomena to be studied in different sociolinguistic contexts. As a result, English variation can be systematically studied and theoretical models put to the test. The subcorpora can also provide valuable insights for the teaching of English. The subcorpora have elaborated a variety of tasks adjusted to their own specific needs, but the common protocol includes:

- two wordlists
- a list of sentences
- a text
- an interview with the fieldworker
- an informal conversation

The PAC protocol incorporates different styles of speech going from very controlled (word lists) to spontaneous (conversation). This enables researchers to observe multiple phenomena in a variety of contexts. Recording the reading of word lists makes the data of different speakers comparable but it induces less natural speech, whereas recording conversations allows researchers to capture more authentic productions. As Przewozny-Desriaux (2018, p.8) suggests:

[5]Phonology of Contemporary English: usage, varieties and structure
[6]For more information see: https://www.pacprogramme.net/

> the audio recordings reflect four main registers of speech acts: the reading of words (or phonological items of study) in citation form, the reading of a text (items in connected speech, level 1), semi-guided conversation and free conversation (connected speech, level 2) in a more familiar setting. Phonologically speaking, this four-level audio capture enables the researcher and the teacher to crosscheck the phonological system of a speaker, internal variation as well as phenomena of variation from one speaker to another one, according to different degrees of discourse fluidity.

Our theoretical and methodological choices were motivated by the interphonological (IPCE-IPAC), sociophonological (PAC-LVTI), pedagogical (PAC-ToE) components of the PAC protocol (Durand & Przewozny, 2012; Mairano & Santiago, 2019; Mairano et al., 2019; Mairano & Bouzon, 2021; Przewozny et al., 2020). PAC-LVTI (Langue, Ville, Travail, Identité / Language, City, Work, Identity) focuses on specific phenomena of language variation and change in L1 varieties of English in urban contexts. IPCE-IPAC (InterPhonology of Contemporary English) records learner corpora, so the aim of this research group is to describe different varieties of L2 spoken English and explore language acquisition processes. PAC-ToE (Teaching/Learning of English) is devoted to investigating methods that can be implemented in pronunciation teaching, such as in the *PICL!* project. Inspiration was drawn from these three components because the Corpus of L2 Academic Psychology English elaborated for this dissertation displays L2 English productions and the informants need to use English in a very specific context: academia. As such, it has to take into account interphonological concerns as well as sociolinguistic ones. The informants are members of the same academic community but they also share the same L1: French. For this reason, the informants were carefully selected on the basis of their L1 and their profession and the materials were adapted to reflect an academic context and elicit features of French-accented speech.

4.3 Adapting the PAC Protocol

The protocol elaborated for this research was approved by the Research Ethics Committee of the University of Toulouse, France (agreement n°2021-368) and consists of a variety of different tasks in order to capture the internal variation of each speaker and the variation of the group as a whole. It includes two reading tasks, an informal conversation with the fieldworker, videos of conference presentations that the informants had given in English in a variety of ecological academic contexts and a sociolinguistic questionnaire in order to record demographic and sociolinguistic information for each speaker.

The aims of the protocol are twofold; on one hand, to record and report the L2 English productions of L1 French psychology researchers and, on the other hand, to use the reading tasks to provide stimuli to assess the intelligibility and comprehensibility of French speakers' L2 English. For this reason, it should be noted that, in addition to recording 13 L1 French researchers' speech, three L1 Southern British English (SBE) speakers were recorded reading the same word list and text, one of whom also read the transcription of the selected conference presentation. This enabled us to create a control condition for the experimental protocol, which is presented in 7.2. As discussed in 3.1, SBE was chosen since it is the norm that is traditionally taught in French classrooms, therefore, French speakers are likely to be familiar with it. This section focuses solely on the description of the interphonological protocol, which was used to elicit the French researchers' L2 English productions.

Data collection took place during the Covid-19 pandemic, which meant that, while it had initially been planned to record the speakers in sound-proofed booths, the recordings were made using the Zoom software. Overall, the quality of the recordings was good and permitted observation of the phonological phenomena under study. Informants were recruited by contacting Psychology departments across France, by word of mouth or by using the 'friend of a friend' technique, in other words, via a researcher who they knew. Once the informants had shown an interest in wishing to participate, they were contacted by email and subsequently agreed to a one-hour meeting. Before starting the recording, the informants were asked to open a link to the sociolinguistic questionnaire on Qualtrics (2025) and read the consent form. After they had formally consented, they were asked to keep the

page open and to return to the questionnaire after completing the other tasks.

Depending on the recording situation, the PAC programme's conventions may recommend beginning with the less formal tasks in order to mitigate the observer's paradox. However, since many of the informants agreed to a one-hour meeting maximum and the two reading tasks were essential for the creation of the experimental protocol, we decided to start with the reading tasks so as to ensure there was enough time for these tasks. In addition to this, we considered the fact that L2 speakers have less control over their ability to converge towards the norm than L1 speakers and that if the informants were presenting at an international conference, they would probably try to converge to the norm to the best of their ability anyway. As such, a formal style of speech is an accurate representation of an academic context. It should also be noted that the fieldworker is an L1 English speaker. Although, efforts were made to make the informants feel as comfortable as possible, this may have unintentionally influenced the informants' productions.

4.3.1 Reading Task: Word List

Since one of our aims was to investigate the use of English in an academic context, the PAC protocol was adapted to include lexical items and texts from the Psychology domain. The word list (table 4.1) is composed of 140 words chosen from the Psychology Academic Word List (Xodabande & Xodabande, 2020), which is a list of 1,537 frequent academic Psychology word types (17,9% of the total corpus) occurring in the corpus of psychology research articles. Some of the tokens from that list are specific to the Psychology domain and others also correspond to tokens from the Academic Word List (Coxhead, 2000). The 140 words chosen for this protocol were those that were specific to the Psychology domain alone.

Table 4.1
Psychology Word List, O'Callaghan (2025)

1) Household	36) Schizophrenia	71) Score	106) Spatial
2) Inhibitory	37) Beta	72) Auditory	107) Database
3) Threshold	38) Placebo	73) Disorder	108) Ratings
4) Alcohol	39) Ego	74) Cortex	109) Mate
5) Horizontal	40) Validity*	75) Autism	110) Facial
6) Priming	41) Clinical	76) Withdrawal	111) Fixation
7) Switching	42) Linear	77) Activation	112) Gaze
8) Single	43) Symptoms	78) Valence	113) Ideation
9) Lingering*	44) Infants	79) Demographic	114) Psychosis
10) Correlation	45) Pitch	80) Alpha	115) Height
11) Cognitive	46) Amygdala	81) Magnitude	116) Gyrus
12) Capture	47) Likert	82) Span	117) Hyperactivity
13) Personality	48) Grid	83) Algorithms	118) Psychiatric
14) Perceptual	49) Rural	84) Haptic	119) Suicide
15) Patient	50) Book*	85) Gamma	120) Diagnosis
16) Tactile	51) Look*	86) Somatic	121) Minus
17) Tinnitus	52) Cue	87) Cluster	122) Mindfulness
18) Tones	53) Mood	88) Frontal	123) Parietal
19) Schema	54) Abuse	89) Robust	124) Anova
20) Specific	55) Acuity	90) Drugs	125) Emotional
21) Split-brain	56) Recruited	91) Muscle	126) Cohort
22) Study	57) Therapeutic	92) Vulnerability	127) Nodes
23) Storage	58) Illusion	93) Subtle	128) Burnout
24) Rhythm	59) Temporal	94) Mask	129) Arousal
25) Stimulus	60) Sessions	95) Classroom	130) Discounting
26) Trait	61) Sensory	96) Narcissism	131) Questionnaire
27) Spectral	62) Reference	97) Saccade	132) Multivariate
28) Strengths	63) Empathy	98) Graph	133) Impaired
29) Clothes*	64) Psychometric	99) Onset	134) Software
30) Texts*	65) Efficacy	100) Neuroticism	135) Peer
31) Feedback	66) Versus	101) Optimal	136) Superior
32) Median	67) Verbal	102) Congruent	137) Hemisphere
33) Peak	68) Maternal	103) Chronic	138) Neuronal
34) Species	69) Interpersonal	104) Foraging	139) Employ*
35) Esteem	70) Urban	105) Baseline	140) Coitus*

Note. * Items not in Xodabande's list

The items were also selected on the basis of predicted pronunciation difficulties for French speakers of L2 English, therefore, several lexical items had to be added that included the

less frequent phonemes /ʊ/ and /ɔɪ/ as well as word-final /i/, /ŋ/ and the consonant cluster /θs/. We aimed to record as many phenomena as possible including the realisation of all vowels, problematic consonants /h/, /θ/ and /ð/, lexical stress, consonant clusters and the aspiration, or lack thereof, of voiceless plosives. This allowed the possibility of recording phenomena that have not been studied as well as allowing comparison with the results of previous studied phenomena (Hanulikova & Weber, 2010; Iverson et al., 2012; Krzonowski et al., 2018; Mairano et al., 2019). Furthermore, Xodabande's list contains the singular and plural form of certain tokens (e.g. symptom and symptoms). In some cases the singular form was chosen and in others the plural form so as to document the speakers' production of morphemic -S (Mairano et al., 2021a,b). The analyses of the present work will focus on the consonantal phonemes /h/, /θ/ and /ð/ and monophthong vowels, but further research may be conducted at a later stage on other phenomena.

A number of other considerations were taken into account in view of the fact that the word list was also designed as experimental material for the intelligibility tests. Acronyms were not chosen as the word list was created to assess intelligibility and comprehensibility at the word level not that of individual letters, nor was it intended to investigate the speakers' production of individual letters. As a result, acronyms such as ET, VS, ADHD, IQ were all excluded. In the same way, names or related words were not included (e.g. Cronbach, Gaussian, Cohen) because it was not intended to evaluate the speaker's production of proper nouns. Finally, in order to simplify data wrangling for the intelligibility tests, we tried to avoid homophones (e.g. *weighted* vs *waited* or *genes* vs *jeans*) or in certain cases we accepted both different spellings (33. *peak* vs *peek* and 112. *gaze* vs *gays*).

The informants were asked to read out the cardinal numbers before saying the words. The observer's paradox tends to lead informants to pronounce more carefully or to converge towards a more standard pronunciation, particularly with reading tasks. Since informants focus on pronouncing the words in the list, they tend to pay less attention to their pronunciation of the numbers and this allows us to test the consistency of pronunciation variants. However, since the informants of our corpus are L2 speakers, it turned out to be bothersome for many to say the numbers in English and some stopped reading them. It does have the benefit of forcing the informants to pause between words but it should be noted that it can be

troublesome for L2 speakers.

4.3.2 Reading Task: Text

The text that the informants were asked to read was taken from an academic article by Budson et al. (2002) on the topic of false recognition in Alzheimer's disease and in patients with frontal lobe lesions. Again, a Psychology theme was selected in order to simulate an academic context for the experimental protocol. The extract chosen consisted of the introductory paragraphs in order to avoid co-reference issues such as referring to concepts or definitions mentioned beforehand. The idea being that during the later recognition tests the listeners would not need to refer to extensive prior knowledge of the topic. The text also includes the same phonological phenomena under study: consonantal phonemes /h/, /θ/ and /ð/ and monophthong vowels and other phenomena that can be analysed at a later stage.

Psychology Text Task, O'Callaghan (2025)

Increasing attention has been focused on memory distortions in patients with various kinds of brain damage. Research in this area has contributed to our understanding of normal memory function, memory failure in specific brain diseases and the occurrence of clinically relevant memory distortions in certain patient populations. Memory distortions in patients with amnesia and those with probable Alzheimer's disease have recently been explored using experimental false recall and recognition paradigms. False recognition occurs when people incorrectly claim to have previously encountered a novel item that is in some way related to a previously studied item. Researchers have demonstrated robust levels of false recognition in healthy adults. After studying lists of semantic associates (e.g. candy, sour, sugar, bitter, good, taste, and so forth) that all converge on a non-presented theme word or related lure (e.g. sweet), participants frequently intruded the related lure on free recall tests and made very high levels of false alarms to these words on recognition tests. Studies using five study-test trials have shown that patients with amnesia made fewer false alarms to related lures than did control participants. With repeated study–test trials, control participants exhibited increasing levels of true recognition together with decreasing levels of false recognition. Patients with amnesia also demonstrated increased true recognition but, in contrast to controls, showed no evidence of decreasing false recognition across trials.

> Interestingly, patients with Korsakoff amnesia exhibited increased false recognition across trials, whereas patients with non-Korsakoff amnesia (e.g. those who suffered anoxia, encephalitis or other types of damage to their medial temporal structures) showed fluctuating levels of false recognition across trials. Results were interpreted on the basis of the idea that true and false recognition depend on memory for two different kinds of information: specific details of a prior encounter with a particular item (item-specific recollection), and the general meaning, idea or gist conveyed by a collection of items. As the items are presented in the association paradigm, a gist representation is developed, which may result in an experience of recollection or familiarity when either a studied item or a related lure is presented on a later recognition test. Thus, in this paradigm, accurate recognition of previously studied items probably depends on both item-specific and gist information, whereas false recognition of related lure words depends on remembering gist but not item-specific information.

4.3.3 Conference videos

One extension of our protocol consisted in collecting data from an authentic academic context so as to record the same interphonological phenomena as ecologically as possible. For this reason, the speakers were asked to share videos of presentations that they had given in English at international conferences. These covered a variety of Psychology topics and one was selected to be used as a listening comprehension task for the experimental protocol. In order to respect the anonymity of our speakers, the conference presentation topics will not be described since other members of the academic community may recognise the researchers through their work.

4.3.4 Informal Conversation

After completing the reading tasks, the speakers had an informal conversation with the fieldworker about their research topics, their use of English and their views on needing to use English in an academic context. Some interesting points were highlighted in these discussions, which will be discussed in section 4.4.2. Here are examples of the types of

questions that were asked:

Discussion Questions, O'Callaghan (2025)

Questions related to work

Could you tell me about your work?

Could you explain your domain of expertise/research topic?

When was the last time that you had to present your work in public?

Do you enjoy your job?

Questions related to language use

Do you often use English for your research?

Do you feel comfortable speaking about your work in English?

Do you have any anecdotes about using English at a conference?

If you did not need to speak English for work and research purposes, would you have studied the language anyway?

Do you use English in your free time?

Have you ever been to an English speaking country?

Question related to hobbies

What do you do in your free time? (sport, music, etc...)

Do you enjoy travelling?

Do you like learning about other cultures?

Do you like learning languages?

4.3.5 IPCE-IPAC Questionnaire

Once the reading tasks and informal conversation had taken place, the informants were asked to return to the questionnaire on Qualtrics (2025). The majority of the speakers completed the questionnaire with the fieldworker still present on Zoom. The IPCE-IPAC questionnaire allows important sociolinguistic and interphonological information about each informant to be collected and comparisons to be made between speakers and with other corpora. Informants provided demographic information and responded to a variety of questions about their education, profession, the languages they speak and use with their families/partners, their level of English, use of English, age of learning, pronunciation preferences and goals. The questions can be found in Appendix B.

4.4 The L2 Speakers' Sociolinguistic Profile

The responses to the ICPE-IPAC questionnaire allow us to describe our cohort of informants and establish whether the patterns of language use they exhibit can be attributed to sociolinguistic factors. Although any corpus is subject to intra-speaker variability, there are also patterns to be found that provide insight into how language is used by certain groups of speakers.

The 13 informants (4 male, 9 female) are all L1 French speakers who use L2 English on a regular basis for their research. At the time of data collection, their ages ranged from 26 to 67 years old and they were either PhD candidates (3) or researchers (10). Most of the speakers started learning English at secondary school at around the age of 11. Due to recruitment difficulties, the sample is not balanced in terms of gender. However, this is also representative of the Psychology domain. It does, however, represent a wide age range going from the late twenties to retirement age. In the table below, the names of participants have been changed, which is explained in further detail in 5.1.1.

Table 4.2
Informants' Demographic Information

Speaker	Gender	Age	AOL*	Profession
Paul	Male	60	10	Researcher
Charlotte	Female	26	11	PhD Candidate
Marie	Female	29	9	Postdoctoral Researcher
Martin	Male	42	12	Researcher
Jean	Male	54	11	Researcher
Louise	Female	52	11	Researcher
Alain	Male	67	32	Researcher
Julia	Female	47	12	Researcher
Claire	Female	53	11	Researcher
Sophie	Female	27	10	PhD Candidate
Hélène	Female	27	11	PhD Candidate
Alice	Female	29	14	Postdoctoral Researcher
Anne	Female	36	6	Researcher

Note. * AOL stands for age of learning

When asked about which languages they use and for which purposes, the speakers all reported speaking French with their parents and two speakers reported also speaking a

second language with their parents (Italian, Creole). Of the 12 speakers who had partners at the time of the study, nine speakers reported speaking only French with their partners, two speakers reported speaking French as well as a second language (English, Portuguese) and two reported speaking only English with their partners. Along with speaking L2 English, the speakers reported speaking a variety of foreign languages (Spanish, Italian, Portuguese, Dutch, German, Hebrew, Russian) at either elementary or intermediate level.

Table 4.3
Language use other than English

Speaker	Language with parents	Language with partner	Foreign Languages
Paul	French	French and Portuguese	Spanish and Portuguese
Charlotte	French	English	Italian, German, Dutch/Flemish
Marie	French and Creole	-	Spanish and Portuguese
Martin	French	English	German
Jean	French	French	Hebrew
Louise	French and Italian	French	German
Alain	French	French	Spanish
Julia	French	French	Spanish
Claire	French	French	German
Sophie	French	French	German
Hélène	French	French	Spanish, German, Russian
Alice	French	French	Spanish and German
Anne	French	French and English	-

In addition to using English for research, the speakers had spent time in English-speaking countries. Eight speakers had previously lived in the USA, the UK, Canada or South Africa for varying periods of time (6 months to 5 years) and the remaining five speakers had spent short stays in English-speaking countries from one to seven weeks.

Table 4.4
Time spent in English-speaking countries

Speaker	Country	Time spent
Paul	USA	2 years
Charlotte	UK, USA	6 months, 1 week
Marie	Barbados, UK	1 week, 1 week
Martin	USA, Ireland	5 years, 1 week
Jean	Canada, UK, USA	1 month, 4 months, 7 months
Louise	Australia, Canada, UK, USA	1 month, 5 weeks, 4 years, 1 year
Alain	UK	3 weeks
Julia	UK	4 months
Claire	USA	1 year
Sophie	Canada, South Africa	4 months, 8 months
Hélène	Ireland, UK	1 week, 1 week
Alice	South Africa	1 year
Anne	Canada, South Africa, UK	1 month, 2 weeks, 7 weeks

4.4.1 L2 English Use

Considering their high level of education and their regular use of English in academia for publications and conference presentations, it was not deemed necessary to evaluate the speakers' level by means of a test. Since the speakers' level of English was not tested, they were asked to rate their level of English for the four following skills: reading, writing, listening and speaking. This also enabled us to gain insight into how the speakers perceive their own English skills. Most of the speakers self-reported an intermediate or advanced level across the four skills.

Table 4.5
The Speakers' Perception of their English Skills

Speaker	Reading	Writing	Listening	Speaking
Paul	Advanced	Advanced	Advanced	Advanced
Charlotte	Advanced	Advanced	Advanced	Advanced
Marie	Advanced	Advanced	Intermediate	Elementary
Martin	Like a native	Like a native	Like a native	Advanced
Jean	Advanced	Advanced	Advanced	Advanced
Louise	Advanced	Advanced	Advanced	Advanced
Alain	Intermediate	Advanced	Elementary	Intermediate
Julia	Intermediate	Intermediate	Intermediate	Intermediate
Claire	Advanced	Advanced	Advanced	Advanced
Sophie	Advanced	Intermediate	Like a native	Advanced
Hélène	Advanced	Intermediate	Advanced	Intermediate
Alice	Intermediate	Advanced	Advanced	Advanced
Anne	Intermediate	Intermediate	Advanced	Intermediate

They were also asked how frequently they use English for the same four skills. It is interesting to note that for most of the speakers, speaking was the least frequently used skill whereas reading was a very frequent activity for the informants. This is logical since the majority of academic articles are produced in English therefore reading is a vital skill for any researcher to keep abreast of the literature, whereas the majority would not need to speak English in their daily lives.

Table 4.6
The Speakers' Frequency of Four English Skills

Speaker	Reading	Writing	Listening	Speaking
Paul	Daily	Daily	Weekly	Weekly
Charlotte	Daily	Daily	Daily	Daily
Marie	Daily	Daily	Rarely	Rarely
Martin	Daily	Daily	Daily	Daily
Jean	Daily	Daily	Daily	Weekly
Louise	Daily	Daily	Daily	Daily
Alain	Daily	Daily	Weekly	Weekly
Julia	Daily	Weekly	Weekly	Weekly
Claire	Daily	Weekly	Weekly	Weekly
Sophie	Daily	Daily	Daily	Weekly
Hélène	Daily	Rarely	Daily	Rarely
Alice	Weekly	Weekly	Daily	Weekly
Anne	Daily	Weekly	Daily	Weekly

The speakers were then asked a number of questions specifically related to pronunciation. They were asked to describe their pronunciation of English. As shown in the table below, none described themselves as sounding like an L1 speaker. Therefore, the speakers recognise their French-accentedness and either accept it as part of their identity or accept the unlikelihood of attaining L1 pronunciation norms. Regarding pronunciation goals, six favour nativeness and seven prefer intelligibility thus rejecting the necessity of speaking like an L1 speaker. It would seem that little by little perceptions are changing in this respect and that L2 accents are accepted within the academic community.

Table 4.7
The Speakers' Perceptions of their Pronunciation

No. Speakers	How would you describe your pronunciation of English?
5	I have good pronunciation with a light foreign accent
8	I have intelligible pronunciation with an evident foreign accent
	What is your goal with respect to English pronunciation?
7	I want my English to be intelligible, but I do not care about sounding like a foreigner
6	I would like to sound like a native

Table 4.8 summarises the speakers' preferences in terms of accent. It seems that the majority feel more comfortable with American English, which also reflects changes in the way

language is acquired by learners. Despite British English being widely taught as the norm in classrooms, L2 speakers have access to a large variety of language input via films, television, streaming services and the internet, with American English being more predominant in these areas. This falls in line with findings from a survey launched by Henderson et al. (2012) in seven different European countries (Finland, France, Germany, Macedonia, Poland, Spain and Switzerland). The teachers were asked about which varieties they prefer and what they believe their learners prefer. Overall, the survey reveals that although British English (RP/SBE) is the norm the teachers prefer to use, GA is perceived to be preferred by learners, although in France RP and GA appeared as equal alternatives. In our corpus, there is a preference for American English.

Table 4.8
The Speakers' Accent Preferences

Speaker	Speaking Model	Easier to understand
Paul	American English	American English
Charlotte	Other - unsure	American English
Marie	American English	American English
Martin	American English	American English
Jean	Other - Not conscious of having a model	Other - It depends more on the person
Louise	British English	Other - Both
Alain	British English	British English
Julia	Other - European English	Other - European English
Claire	American English	American English
Sophie	British English	American English
Hélène	American English	American English
Alice	British English	British English
Anne	American English	American English

4.4.2 The Researchers' Impressions of Using English in Academia

During the informal conversation with the fieldworker, the speakers had some insightful comments about the way they use English for research and the different issues they face. The informants talked about their own pronunciation mentioning phenomena such as h-omission, difficulty with dental fricatives and intonation. In general, they showed awareness

of having a French accent when speaking L2 English.

> Charlotte: at the beginning of my PhD I would say I'm studying the effect of socioeconomical status on health and I often had people saying like "Elf? Elf? Like these small things @@ because **probably my 'h' was not pronounced enough** so they were imagining like this Christmas elves and @@ so yeah that was some funny interactions

> Jean: when I listen to myself on a video, er, such as the one I sent to you, er, **I really hear my French accent** so I don't feel so happy about it but er, I can't do better than what I'm doing.

> Julia: sometimes it's er, you, you feel that your, your, your interlocutor is waiting for something but you are already finished because **you are not putting the, the, the, you know the right way the accent**, so you just er, like er, er, expe- expecting @ a following sentence or something but it's ok, I have finished so @

> Claire: he [a colleague] told me that often he doesn't er, o- overthink when he talks because he, he realise that people could er, manage...and I say ok if he can do that I, I can do that too and er ha- and it's, it's good to, to remove, you know, a, a level of stress, say **'Ok, they will manage to understand even if my pronunciation is well, er, some er, somehow off'**. I- if they can follow what I'm saying and then it's also for, for oneself to be less stressed by the situation.

Some speakers seem less concerned about their accents and others more so but unable to change their pronunciation. The majority seem to favour the ability to communicate over having native-like pronunciation. Sadly, some speakers even commented on their fear or lack of ease when speaking English during conferences.

> Marie: **I feel, er, less confident** [speaking English], er, when I cannot prepare in advance. . . I know that it not the same when I talk about my, my work in French and in English and in

conferences is English language.

Julia: sometimes I, **I feel er, embarrassed** because I, I search my word... I don't feel at ease, er, when I speak English because I, it's a sort of a burden... Yes, I'm not comfortable, but I speak in English er, every week with my colleagues in fact.

Paul: We [in France] have a culture that values nice language here in this country. And it, it actually creates a kind of trauma for most students and **most academics who feel ashamed to not pronounce the word the way they think they should be pronounce them**. I'm talking about 90 percent of my colleagues. They go to an English speaking meeting and their main worry is not to communicate their scientific findings, it's 'will I look like I'm an idiot because I don't speak the language well?' Because they've been trained to think that someone who doesn't speak well has to be an idiot. That's the way the French mix up language proficiency and intelligence.

Many commented that they were very comfortable using English for their research but less so in everyday situations. In fact, some prefer to speak about their work in English rather than in French.

Martin: in fact, I don't know if you get that from other people, er, but I think sometimes **I could feel more comfortable speaking about my work in English than in French**, because I think about my work in English a lot, I mean we read papers in English.

Charlotte: I would think even more [comfortable] than French now, so specially about talking about work, like **I find it really hard to talk about my work in French**... sometimes I feel like I'm more comfortable speaking in English [than other foreign languages] because people don't expect me to speaks perfectly English.

Louise: **the language of science and publication it's English**... it could even happen that when I discuss with student and suddenly have to discuss things about research I quickly

switch to English because I don't have really the words in French for some of them or I don't, or it flows so easily in English.

Alice: I mean for me **research equals English** @

As the previous comment highlights, whether they like it or not, French researchers are obliged to publish and present in English if they wish to share their research with the international community. This can sometimes be a daunting task. During the interviews the speakers also discussed their preferences of speakers who they find easier to understand. Many seem more comfortable speaking to other L2 speakers and discuss difficulties with understanding L1 speakers.

Charlotte: I was doing this project and er, with international collaborator from the US, and the dynamic of the conversation is totally difference when there is more than one native in the conversation, because they will take over the thing and then it's really har- like, at this moment I realise 'Oh yeah, ok, I'm not yet at the level of natives because they are speaking so fast and throwing ideas like the time that I think is still quite lower, like slower than if I would speak probably my own language'... **It's hard to speak with natives** and speaking with people [who] are learning is definitely the best way to learn, er, for me... if you're with internationals it's always, people are quite patient with you so you always figure out a way to communicate right?

Julia: I think it's er, it's er, **it's easier to understand Spanish or Italian [people]** because we are in the same er, way of speaking English regarding the speed... I think **it's not so easy sometimes to follow English people** because they are really speed, really, and also with American people I have some, di- difficulty f- about the accent, depending on the accent... I went to conference on zoom for example, in er, in er, United State or, with Australian people, also with Asiatic people who are speaking in English and I'm, I met some difficulty in following all the, the, their speech during er, er, er, all day conference for example,

it's not so easy for me.

Alice: **when we are not, non-English native speakers we kind of help each others**, so when you see someone who is looking for a word and you kind have a sense of the word, he or she is looking for, you can help, er, and then I also feel that there are less judgements when you speak English as a non-native speaker to someone who is just like you. I'm not saying that English native speakers are judgemental, that's not what I'm saying

Fieldworker: No, I know what you mean. That's, there's less pressure maybe to,

Alice: Yes, exactly.

Anne: [It is] A lot easier [to understand L2 speakers] because their accent, like the German accent or the Latino accent is great. I think it's kind of like the French accent. So I really understand the, er, them speaking. Well er, I, **I guess every nationality is easier to understand that, than English er, er, accent**.

Alain: **They [native speakers] speak as if everybody was a native speaker and it's quite disturbing for foreign people**, it's quite disturbing.

As the last comment highlights, speaking with L1 speakers can be intimidating at times. At international conferences, researchers can come into contact with fellow researchers from all over the world and this can sometimes lead to communication breakdowns. The speakers also relayed times when they had experienced such breakdowns.

Jean: I know that sometime when I, I, I, the question's accent is quite, er, sometime an issue so there are some cases in which er, I feel it's not so easy to be understood because er, the way I'm pronouncing the words is er, makes them difficult to understand or ambiguous so it, **it happened to me that I had some difficulties to either understand a colleague or that he, she or he understands me**.

Alain: When I attend er, a talk by something else, usually I don't understand the questions or not always, but when it's my talk, I don't know why but I, I understand the questions @ fortunately...**what is the, disturbing for me is variety of accents in English and er, and I think English are easier to understand than some American people**.

Sophie: at some point one of the jury members asked me question and **I thought I understood the question but I didn't @ so I, I just tried to give an answer that wasn't the point at all** and he was very kind, like the way he tried to rephrase the question afterwards I understood that I said something very silly that wasn't related to the question at all but it just, he didn't say 'Oh you didn't understand my question'. He tried to rephrase it in a way that I understood I didn't answer the question.

Fortunately, these communication breakdowns do not have serious consequences but it is important to note that they can happen frequently and affect the L2 speakers' confidence. Clearly, it seems that to improve international communication, it is necessary to expose learners of English to different varieties of English, both L1 and L2, in order to give them the tools they need to be successful international communicators. L1 speakers might also consider adjusting their vocabulary and speed of speech.

4.5 Summary

This chapter presented the methodological choices that need to be made when conducting sociolinguistic fieldwork. Ideally, sociolinguists aim to record phenomena as authentically as possible, but this requires privileged access to the speech community under study. That is why when recruiting informants, it helps to use the 'friend of a friend' technique. It is also important to mitigate the observer's paradox where possible by putting informants at ease. Doing this helps to guarantee that the data will be as representative as possible, while also reflecting the diversity of speech communities and individuals.

We then describe how the common PAC protocol was adapted for this dissertation and the decisions made on how to implement the protocol. Although the same types of tasks

(reading and interactional) were used, the materials were modified to emulate an academic setting. There were four main tasks and a questionnaire:

- reading a Psychology wordlist
- reading the introduction of an academic article
- sharing a video of a conference given in English
- an informal conversation with the fieldworker
- filling in the IPCE-IPAC questionnaire

A description of the informants' sociolinguistic profile and their use of English is provided as well as their thoughts and feelings about how they perceive the use of English in academia. Some of the French informants feel confident when using English for academia, whereas others are uneasy about communicating internationally.

Chapter 5

Data Processing and Extraction

Several steps are necessary in order to be able to analyse the corpus recordings both acoustically and descriptively. The audio files must be prepared and processed meticulously before any subsequent analysis. Following these steps is essential for the comparability of different data. It also ensures that the spoken data is converted into written form, which allows relevant patterns to be identified. Once the preparation is complete, the speech analysis can be performed. In this chapter, we describe the steps taken to prepare our corpus recordings for descriptive and acoustic analysis and explain the choices that were made.

5.1 Transcription and Annotation

As discussed in Chapter 4, the corpus protocol was implemented within the framework of the PAC programme. The project also stipulates a number of conventions in order to make each subcorpus as replicable and comparable as possible. Therefore, the survey recordings were named and transcribed according to these conventions. A selection of vowels and consonants were subsequently annotated based on a number of criteria discussed below.

5.1.1 Renaming and Anonymising the Audio Files

The first step of data processing involves splitting the audio files by task and renaming them in order to anonymise the speakers. The common PAC coding system was used, which involves:

- Letters corresponding to the country in which data collection took place (eg: *fra* for France)
- Letters corresponding to the region or town (eg: *to* for Toulouse)
- A letter indicating the number of times fieldwork took place in the same area
- The initials of the informant and, if necessary, a number to distinguish informants with the same initials
- A letter indicating the type of task that was carried out (eg: *w* for word list)

Although the PAC coding system was used to rename all of the audio files, we also decided to use an additional anonymisation strategy by giving new names to each informant and using them in the present dissertation. There are two main reasons for this. Firstly, our informants are all French psychology researchers and, therefore, the population is much reduced meaning that readers may be more likely to identify the researchers using their initials. Secondly, this allows us to avoid referring to the informants as a series of numbers and letters, which can seem a little dehumanising.

5.1.2 Standard Orthographic Transcription

The following step requires all of the different tasks on audio file to be annotated orthographically in *Praat* (Boersma & Weenink, 2022). It is one of the most well-known and well-used software for speech analysis and allows researchers to do multiple tiers of annotation and perform a wide variety of acoustic analyses, speech synthesis and statistical tasks. It is also free and open-source making it a popular choice among researchers. In *Praat*, orthographic transcription can be aligned with the speech signal and visualised on a spectrogram. This thesis follows the PAC conventions for transcription (Carr et al., 2004; Durand & Przewozny-Desriaux, 2015). Standard orthographic transcription (SOT) is used and each speaker receives their own tier. In this case, British English orthography was chosen as the preferred variety since it was the norm with which the corpus productions' were compared. As speech is spontaneous in nature, it does not always reflect the organisation found in written language,

thus, PAC stipulates the following conventions for transcription:

- Full stops indicate long pauses
- Commas indicate short pauses
- Question marks are used for questions
- Truncated words are followed by a dash
- Repeated words are separated by commas
- Parentheses can be used for observations of non-linguistic elements such as background noises
- Contractions may be used if they are part of standard orthography
- Hesitations are always transcribed as 'er' for British English and 'uh' for American English regardless of the sound actually produced
- Acronyms that are pronounced as words are spelt as such, whereas acronyms which are spelt out letter by letter are written with an underscore between each letter

One of the benefits of using the same transcription conventions is that it enables researchers to produce comparable data and, thus, facilitates data comprehension and sharing. In addition, transcribing speech can be difficult when it does not follow the forms found in standard language systems. For example, repetitions, hesitations and disfluencies are frequent in spontaneous speech. Therefore, it is all the more important to follow the same procedures when transcribing the same phenomena (Durand et al., 2014).

In order to further anonymise the audio files after transcription, a script by Hirst (2013) was used to remove identifying information. This Praat script conserves the prosodic information of the utterance while rendering names or places unintelligible. It uses a line in the textgrid that has been coded to highlight the words to anonymise. Therefore, it is necessary to label the information one wishes to remove and align it with the speech signal. Twelve hours and 45 minutes of speech was transcribed and anonymised as just described.

5.1.3 Segmenting and Annotating Vowels

Once SOT is complete, it is possible to proceed to the next stage of processing. This depends on the features of interest under study. Since the present study aims to describe features of the French interphonological system in English, we considered the production difficulties cited in 3.3. As the annotation and alignment of speech can be a time-consuming process, only some features were selected. We decided to focus on monophthong vowel contrasts since they are difficult to produce and perceive for French speakers (Capliez, 2011; Kenworthy, 1987; Krzonowski et al., 2018; Mairano et al., 2019; Mees & Collins, 2013). Further work may be performed on diphthongs at a later stage.

In order to prepare the speech samples for analysis, all monophthong vowels, except the schwa, were segmented and aligned manually for the two reading tasks (the word list and the text). We decided to focus on these two tasks because these recordings were subsequently used to create the experimental stimuli for the intelligibility and comprehensibility tests. In total, 6,339 tokens were annotated. The vowels were labelled with the IPA symbols according to the SBE norm, not as they were phonetically realised by the speakers. Although manual annotation takes much longer than automatic annotation software, it is more accurate as Brunet (2023, p.259) suggests:

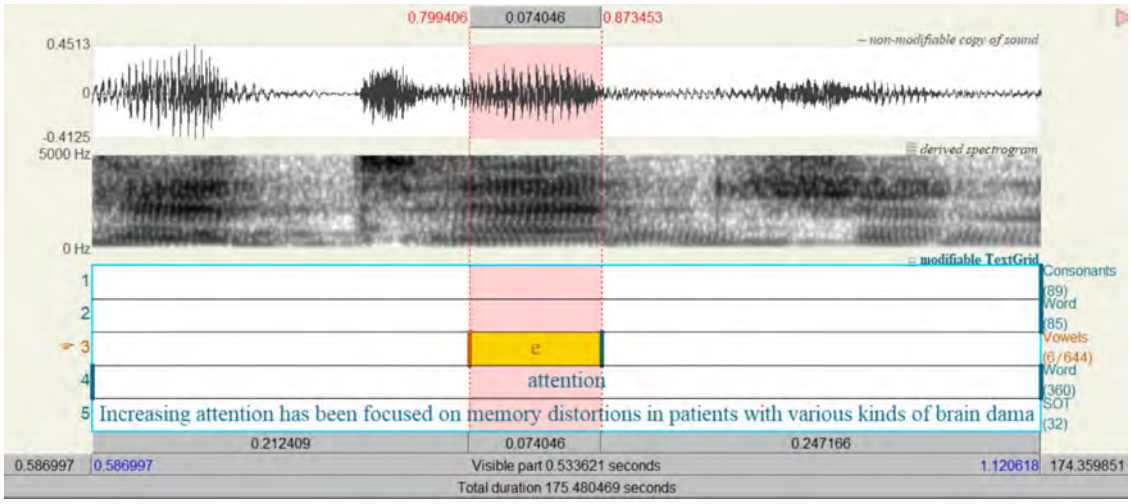
> In particular, vowel boundaries are much more precisely identified through manual annotation, as the annotator can rely on visual cues (the spectrogram) as well as audio cues. Additionally, automatic annotation software often fares much worse with non-standard linguistic varieties, requiring additional verification.

This study analyses L2 speech so this is of particular concern. It would seem that automatic annotation software is improving in leaps and bounds but it still calls for subsequent human verification, thus, we decided to proceed with manual annotation.

Of the total 6,435 vowel tokens, 96 had to be excluded for a variety of reasons. For example, if there was a noise in the background or the speaker laughed distorting the token. Stressed vowels were annotated according to the SBE norm including both primary and secondary stress. Thus, weak forms (/ə/, /i/ and /u/) were excluded as they do not

correspond to the full monophthong vowels in their most representative form. Tokens in some words were not taken into consideration in the text productions because they exist in free variation or are grammatical words, which undergo vowel reduction. For example, the first syllable of *either* can be realised with [iː] or [aɪ] and *have* can be realised as strong [hæv] or weak [həv].

Figure 5.1
Example of SOT and annotation in Praat



Phonotactic constraints were not taken into consideration. For example, Labov et al. (2008) recommends not including vowels produced before /l/ and /r/, or after /w/ and /y/ when analysing North American English because of coarticulation effects. However, we decided to prioritise a maximum of tokens. In addition, since the variety under analysis is L2 and the speech was labelled according to the L1 norm, the labels may not always reflect the sounds actually produced. For example, the first syllable of *tinnitus* was realised as [taɪ] not [tɪ] by some speakers. For this reason, it was deemed preferable to obtain as many tokens as possible for comparison.

5.1.4 Consonantal Coding and Extraction

With similar considerations in mind (see 3.3), the consonants /h/, /θ/ and /ð/ were chosen for analysis since they are notoriously difficult to acquire and produce for L2 learners,

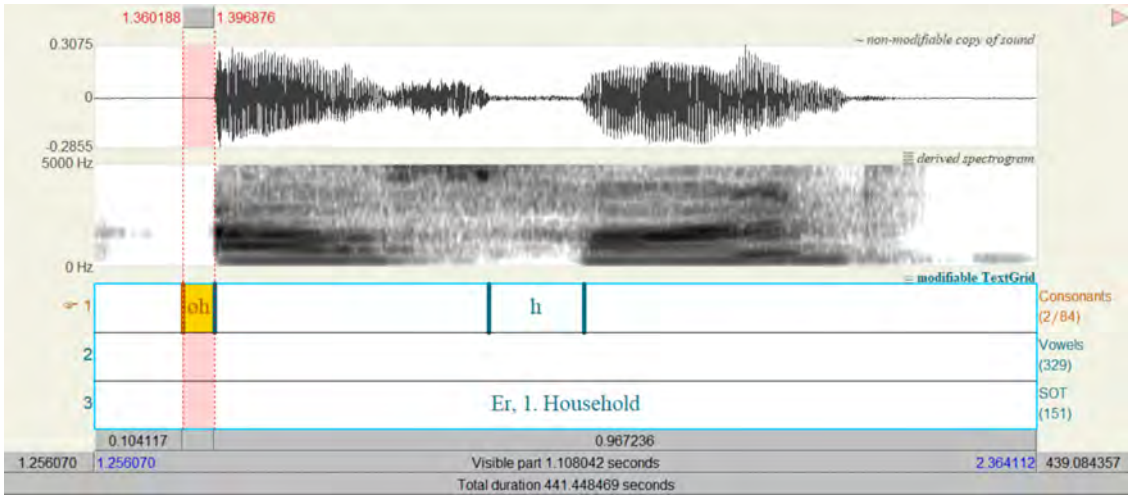
including French speakers. For the consonantal phonemes, we decided to perform descriptive analysis to establish the different types of realisations made by the French informants. In order to do this, a code was used for annotation, which permitted subsequent extraction using an ad hoc script in *Praat*.

Table 5.1
Coding System for Consonants

Target Phoneme	R.0	R.1	R.2	R.3	R.4	R.5	R.6
/h/	h	Øh	hh				
/θ/	θ	s	t	f	zr	ðr	ʃ
/ð/	ð	z	d	v	sr	θr	fr

R0 corresponds to the target realisation, while R1 to R6 represent different realisations present in our corpus. The coding system involved labelling the informants' realisations with the corresponding IPA symbols, but with the following differences. *Øh* was used when the /h/ was omitted and *hh* was used if it was intrusive. The *r* stands for reversed and was used when the voicing did not correspond to the target. For example, /θ/ is voiceless so *ðr* indicates that the phoneme /ð/ was used, in other words, the place of articulation was correct but the voicing was not. The same applies to *θr zr, sr* and *fr*. Admittedly, this annotation system could have been simplified but it still permitted the extraction of the different realisations of the consonants under study, as shown in the example below.

Figure 5.2
Example of Consonantal Coding in Praat



5.2 Preparing Vowel Data

The segmentation and annotation process was a prerequisite for the acoustic analysis. Once this was complete, it was possible to extract formant values for monophthong vowels in preparation for further analysis. This allows us to capture the acoustic properties of the vowels, providing measurable data on vowel quality, which in turn permits comparisons across speakers and in relation to the SBE norm.

5.2.1 Formant Extraction

Formants are spectral peaks that occur when the vocal folds resonate. Phoneticians are usually only interested in the first five formant frequencies since F5 and above tend not to be dependent on articulation (Boersma, 2014). When analysing vowels, measurements are usually taken of the frequency of the first and second formants (Labov et al., 2008). This represents the way vowels are positioned in the vocal tract in terms of height and backness as Harrington (2010, p.42) explains:

> These phonetic dimensions are loosely correlated respectively with the extent of mouth opening and the location of the maximum point of narrowing or constriction location in the vocal tract. Acoustically, these differences are (negatively) correlated with the first two resonances or formants of the vocal tract: thus, increases in phonetic height are associated with a decreasing first formant frequency (F1) and increasing vowel backness with a decreasing F2.

Before extracting formant values, it was necessary to choose a default maximal frequency range for each speaker. This tends to be 5000 Hz for males and 5500 Hz for females as the range depends on the length of the vocal tract (Boersma, 2014). F1, F2 and F3 values were then extracted using a script in *Praat* based on a tutorial by Stanley (2017). The script measures the formant values at the midpoint of the vowels. Judging vowel quality based on values at the midpoint is done in order to avoid coarticulatory effects from the surrounding sounds. This is the point at which the contextual influence is at its lowest and the vowel is most similar to its citation-form production (Harrington, 2010). Hillenbrand

(2012) advocates extracting at multiple points in order to obtain a more complete picture of the spectral movements, however, Van Son and Pols (1990) compared different methods measuring Dutch vowels at different points in time and found only small differences and even Hillenbrand (2012) acknowledges that static measurements are widely used as a they can be convenient and useful depending on the research objectives. For the purpose of this study, extraction at the midpoint is sufficient to measure the quality of the vowel in order to compare vowel contrasts.

5.2.2 Normalisation

After formant extraction, vowel productions then need to be normalised because a great deal of variation can be found across speakers. The raw hertz values of vowels can be drastically different from speaker to speaker despite occupying a similar position in the vowel space. These differences are in large part due to the fact that speakers have different sized and shaped vocal organs (Harrington, 2010). Peterson and Barney's (1952) seminal work demonstrated that there is significant variation in formant frequencies among men, women and children due to differences in anatomy. Normalisation permits comparisons between speakers because it compensates for anatomical differences but at the same time maintains distinctions between different vowels and differences that are due to sociolinguistic phenomena. This is because it "ignores a vowel's *absolute* position but maintains its *relative* position (i.e., with regard to other vowels)." (Brunet, 2023, p.265).

There are a variety of normalisation methods used in sociolinguistic studies. They differ in terms of what they are comparing and are referred to as either *intrinsic* or *extrinsic* (Flynn, 2011). Speaker-intrinsic methods compare the productions of one speaker, whereas speaker-extrinsic ones make comparisons across speakers. The latter tend to be used far less since they require a large sample of speakers, which is not always the case in sociolinguistic studies (Watt et al., 2011). Vowel intrinsic methods take information from just one vowel as opposed to many vowels (vowel-extrinsic). Similarly, formant intrinsic methods take information from occurrences of individual formants instead of across multiple formants (extrinsic). Adank et al. (2004) compared 11 different normalisation techniques on Dutch vowels and found

that vowel-extrinsic methods performed better than vowel-intrinsic ones, and that formant-intrinsic methods fared better than formant-extrinsic ones. Lobanov normalisation was found to be the most effective in reducing anatomical variation while preserving phonemic and sociolinguistic variation, closely followed by Nearey's formula. Flynn (2011), also found that vowel-extrinsic, formant-intrinsic procedures were the most successful when he compared 20 normalisation techniques on British English vowels.

Given previous findings, the formant values were normalised using the Lobanov technique (Lobanov, 1971), which is a speaker-intrinsic, vowel-extrinsic, formant-intrinsic method. The data is transformed to z-scores and this has "the effect of centering each speaker's vowel space at coordinates of zero (the mean); the axes are then the number of standard deviations away from the speaker's mean" (Harrington, 2010, p.130). This method was implemented in RStudio using the *phonR* (McCloy, 2012) and *vowels* (Kendall & Thomas, 2018) packages. The vowels were then plotted in the vowel space (see 6.2.2) and were ready for further acoustic analysis.

5.3 Summary

In this chapter, we have discussed all the steps taken to prepare the vowel and consonant data for segmental analysis and the methodological decisions that were made.

Firstly, the recordings were transcribed using SOT with an SBE target following PAC conventions. This was done in order to match the norm chosen for production and perception. It is also important to follow the same conventions as it makes data comparable and it facilitates the transcription phenomena such as disfluencies and hesitations.

Vocalic and consonantal phenomena were subsequently segmented and annotated manually for a total of 6,339 exploitable vowel tokens and 792 exploitable consonant tokens. Manual annotation was chosen as it is more precise than automatic methods and there were concerns about how accurately automatic annotation would label L2 speech. Once this was complete, the phenomena of interest were extracted using scripts in *Praat*. The formant values of the vowels were extracted at the midpoint to avoid coarticulation effects and consonantal realisations were extracted and quantified.

Finally, the vowel tokens were normalised so as to enable a better comparison between speakers. The Lobanov method was used since it has been shown to be very effective at reducing anatomical differences while, at the same time, maintaining phonemic and sociolinguistic variation. These important steps were taken in order to prepare the data for analysis, which we present in the next chapter along with the results.

Chapter 6

French Interphonology: Analysis and Results

French and English differ considerably in terms of their phonological and articulatory systems leading to the creation of a French interphonological system that differs from L1 English norms, as discussed in 3.3. This chapter aims to describe certain features of the French researchers' interphonological system. Namely, the distinction of monophthong vowel contrasts and the realisation of the consonantal phonemes /h/, /θ/ and /ð/. Pillai scores were calculated for pairs of vowels in order to evaluate the extent to which the speakers distinguish vowel contrasts in production. Consonantal realisations were recorded in order to compare target realisations with substitutions and/or omissions. The results are discussed in light of previous observations and studies.

6.1 Acoustic Distances

Measuring acoustic distances helps to quantify the distance between putative vowel categories (Nycz & Hall-Lew, 2014). This method has traditionally been used by sociolinguists to determine whether vowel changes are taking place in the form of mergers or splits. According to Nycz and Hall-Lew (2014), acoustic distance metrics must effectively measure the distance between word classes within acoustic space, account for the extent of overlap between these classes, consider the uneven distribution of naturalistic data, and facilitate comparisons among speakers in a corpus. Until relatively recently, one of the most common methods has been to compute the Euclidean distance between two vowels. This measure is taken

using Pythagorean theorem and "is calculated by summing the square of the horizontal and vertical distances between the points and taking the square root" (Harrington, 2010, p.134). However, more recent work has turned to using new methods, among which the Pillai score.

Pillai scores usually serve to evaluate existing or ongoing vowel mergers in different sociolinguistic varieties by measuring the degree of overlap between two categories. The score is obtained by computing a MANOVA, which produces a value that ranges from 0 to 1. Zero indicates that there is complete overlap between the two categories and 1 indicates that there is no overlap (Mora, 2021).

In two different studies comparing methods of measuring vowel overlap, Pillai scores performed very well at quantifying differences between vowel categories. Nycz and Hall-Lew (2014) compared the spectral overlap assessment metric (SOAM), Pillai scores, Euclidean distance and mixed effects regression and adjusted Euclidean distance. Pillai scores were found to be effective at capturing overlap and offering between-speaker comparisons, although all of the methods compared showed similar patterns when comparing extreme values. The authors recommend choosing a method based on clearly established research questions and by looking at the distributional properties of the dataset. Kelley and Tucker (2020) compared SOAM, the *a posteriori* probability (APP)-based metric, the vowel overlap analysis with convex hulls method (VOACH) and the Pillai score. They found that the Pillai score performed the best overall in terms of accuracy and precision as well as being able to account for distributional variation in the dataset. Another advantage is that Pillai scores are also accurate when calculated using spontaneously produced, naturalistic data, even when the data is unbalanced regarding specific phonological environments, as long as the unbalanced distribution is generally comparable among all speakers within the sample (Hall-Lew, 2010). For example, if /ʊ/ is less frequent than /uː/ across all speakers, comparison will still be possible and the Pillai score is still relatively robust.

The aim of our acoustic analysis is to evaluate the extent to which the French informants can produce distinct L2 English vowel categories. Therefore, it is necessary to investigate the amount of overlap between said categories. Pillai scores are an effective method of capturing overlap, they can cope with unbalanced distributions and they can take into account a variety of dependent variables not just F1 and F2 values.

6.1.1 Using Pillai Scores to Evaluate L2 Speech

Although these measures are often used to compare mergers or splits in speakers of the same L1 (Nycz & Hall-Lew, 2014), recent work has been done on L2 varieties. By evaluating L2 speakers' productions with objective measures, it is possible to see whether new phonological categories have been developed for different vowel categories. Furthermore, as discussed in 3.3.2, Mairano et al. (2019) compared Pillai scores and Euclidean distances with L1 speaker judgements and found that Pillai scores correlated strongly with judgements of nativelikeness and comprehensibility. This suggests that, to a certain extent, these measures are able to capture what listeners are able to perceive. Therefore, in the absence of L1 speaker evaluations, acoustic distance measures can be reliable predictors of nativelikeness and comprehensibility.

A follow up study by Mairano et al. (2023) examined a larger dataset of French, Spanish and Italian speakers of L2 English along with English, Spanish and Italian speakers of L2 French. They used Pillai scores intrinsically (comparing productions of two contrasting vowels) and extrinsically (comparing L1 and L2 productions) and collected L1 speaker judgements of nativelikeness and comprehensibility for comparison. They found that intrinsic evaluation was better than extrinsic evaluation at predicting nativelikeness and comprehensibility scores. Even more interestingly, it would seem that certain vowel pairs are better indicators of nativelikeness and comprehensibility than others. Vowels on the periphery of the vowel space (/ɪ/-/iː/, /æ/-/ɑː/, /ʊ/-/uː/) were better predictors than mid or central vowels. This may be due to listeners being more sensitive to these vowels or due to greater variation in speaker productions. In any case, this would be an interesting area to investigate as it could perhaps enable teachers to put more emphasis on peripheral vowels depending on the goals of their students. More research is needed, however, to determine whether these vowels affect comprehensibility or simply, accentedness.

Mora (2021) also compared acoustic distance measures on L2 speech. Pillai scores, Euclidean distances and Mahalanobis distances were calculated on L1-Spanish/Catalan learners' production of the English /ae/-/ʌ/ contrast after HVPT training. Once again, the measures correlated positively with L1 ratings of nativelikeness. Pillai scores appear, therefore, to be reliable measures of phonological distinctions in L2 speakers and correlate well with

what L1 speakers perceive.

6.2 Vowel Contrast Results

In the present study, having extracted and normalised F1 and F2 values, Pillai scores were calculated by computing a MANOVA in RStudio for the following pairs of vowels: /ɪ/-/iː/, /æ/-/ʌ/, /ɒ/-/ɔː/, /ʊ/-/uː/, /æ/-/ɑː/, /ɜː/-/ʌ/ and /æ/-/e/. As discussed in 3.3, vowel contrasts were chosen since they have been found to be a source of difficulty for French speakers (Capliez, 2011; Kenworthy, 1987; Heidlmayr et al., 2021; Krzonowski et al., 2018; Mairano et al., 2019). We decided to compute the MANOVA with and without duration as a dependent variable since many of the contrasts include tense and lax pairs. It also allows us to examine the extent to which duration influences French speakers' vowel category distinctions. In total, 495 vowel tokens appeared in the word list and the text with relatively large differences between vowel pairs as shown in the table below:

Table 6.1
Vowel occurrences in the word list and text

Vowel	Word list	Text
æ	18	19
ʌ	9	18
ɑː	5	7
e	18	63
ɜː	7	10
ɪ	64	132
iː	11	28
ɔː	8	17
ɒ	12	24
ʊ	3	2
uː	10	10

Of the 6,435 total occurrences, 96 tokens had to be excluded from analysis because of external noise, laughter or omission, which left 6,339 in total that served for calculating acoustic distance measures. Since the number of occurrences of certain vowels is low (e.g. /ʊ/ or /ɑː/), we used the formula developed by Stanley & Sneller (2023), which provides a threshold dependent on the size of the sample, in order to determine the degree of vowel distinctiveness produced by the speakers of our corpus. Having used Monte Carlo

simulations to test the reliability of Pillai scores, they argue that having a large number of occurrences leads to more reliable results and therefore recommend using the threshold formula to determine vowel mergers. Additionally, they found that the occurrences across vowel contrasts do not have to be balanced because unequal sample sizes do not affect Pillai scores, however, the bigger the total sample size, the more reliable the results were. In our study, which focuses on French speakers' L2 English, the threshold can help to establish whether our informants produce distinct phonological categories. The example below shows the output of calculations for one speaker's /ɪ/-/iː/ contrast. It should be noted that p-values are inversely correlated with Pillai scores as the null hypothesis is that there is no difference between the vowel categories.

Table 6.2
Output of MANOVA and threshold calculations

Phoneme 1	N.Occ	Phoneme 2	N.Occ	Pillai score	p-value	Threshold
/ɪ/	131	/iː/	28	0.027	.116	0.034

This example indicates that the speaker produces the close front vowels with a considerable amount of overlap since the the Pillai score is below the threshold and the p-value is above alpha level[7]. Using this criteria to establish the degree of vowel overlap, the table below shows the number of speakers in our corpus whose vowel contrasts were found to be considerably overlapping in the word list and text productions, with and without duration included as a dependent variable.

Table 6.3
The number of speakers whose vowel categories overlap in the word list and text

Vowel Contrast	Word list	Word list +Duration	Text	Text +Duration	Cumulative Total
/ʊ/-/uː/	7	6	12	11	36
/æ/-/ɑː/	12	8	4	1	25
/ɪ/-/iː/	6	3	9	1	19
/ʌ/-/ɜː/	8	3	5	0	16
/ɒ/-/ɔː/	12	1	1	0	14
/æ/-/ʌ/	0	0	1	0	1
/æ/-/e/	1	0	0	0	1

[7] Output data for each speaker's vowel contrasts can be found in the appendices.

Overall, the most problematic contrasts appear to be /ʊ/-/uː/, /æ/-/ɑː/, /ɪ/-/iː/ and /ʌ/-/ɜː/. Interestingly, the first three vowel contrasts are on the periphery of the vowel space. As discussed, Mairano et al. (2023) demonstrated that peripheral vowels were found to be good predictors of L1 judgements of comprehensibility and nativelikeness, therefore, this suggests that the peripheral vowel contrasts are important to maintain. It is also interesting to note that when including duration in the MANOVA calculation, the Pillai scores were higher indicating less overlap. Very few speakers' productions met the criteria for overlapping categories when adding duration to the text analysis. This seems to suggest that one of the ways the French informants distinguish L2 English vowel categories is by duration. Distinguishing duration alone is unlikely to equate to improving perceptions of foreign-accentedness for listeners if the quality of the vowel distinction is not maintained. However, preserving duration distinctions could perhaps facilitate intelligibility and comprehensibility for listeners, though this remains to be seen. Hillenbrand (2012, p.18) argues that vowel duration has a limited impact on vowel identification:

> listeners give little weight to duration for vowel contrasts such as /ɪ/-/iː/ and /ʊ/-/uː/ that can be distinguished with little ambiguity based entirely on spectral properties. On the other hand, vowel contrasts such as /ɔ/-/ɑ/-/ʌ/ and /æ/-/ɜ/ show a greater degree of overlap in their spectral characteristics, causing listeners to rely on duration to a greater degree in identifying these vowels.

He is referring to research conducted on L1 listeners, therefore, the distinction may be meaningful for L2 listeners. Nevertheless, if this is true then the duration distinctions produced by our French informants may be sufficient to distinguish the low mid vowels, but it also means that the high vowels may also need distinctions in their quality.

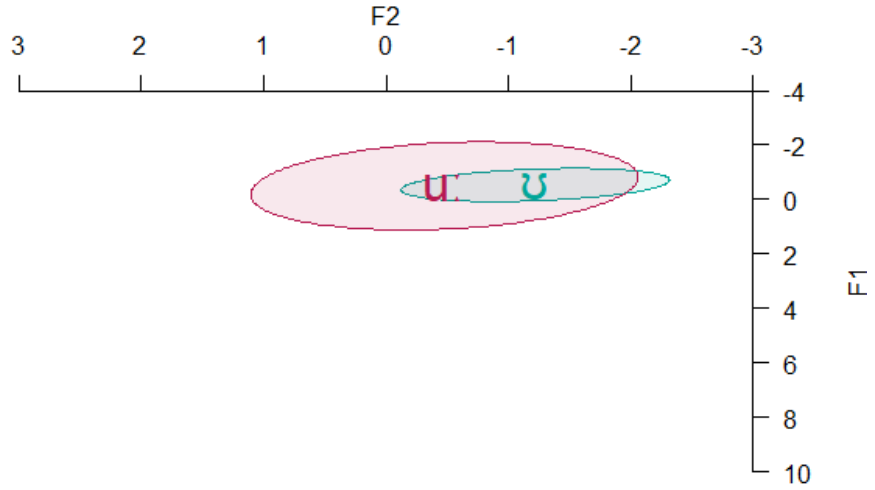
In comparing the two different tasks, the informants' vowel categories show more overlap when reading the word list than when reading the text. L1 speaker word list productions tend to converge more to standard varieties, but this was not the case for the L2 speakers. This may be due to the fact that saying the numbers before each word seemed to be distracting and bothersome, so many informants stopped mid-way or near the end and simply read each

word. This may have affected performances since it created an extraneous cognitive load by complicating the task.

6.2.1 Comparing Vowel Contrasts

In our corpus, the most problematic contrast across speakers was the /ʊ/-/uː/ contrast. The French informants may have assimilated these two categories to the French vowel /u/ and this may transfer to their production of the contrast. Duration does not appear to be used to distinguish the contrast since almost the same number of speakers showed overlapping categories in both analyses. The figure below gives an indication of the extent to which the two vowel categories overlap across speakers.

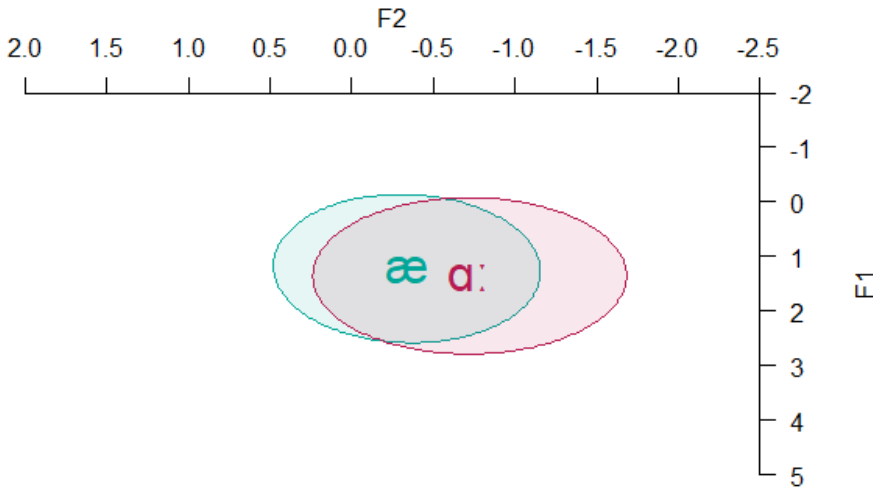
Figure 6.1
Lobanov-normalised mean values of the /ʊ/-/uː/ contrast across speakers for both tasks



While there is considerable overlap between the two categories, this does not indicate whether this distinction is important for listeners. The phoneme /ʊ/ is infrequent in terms of lexical items, but it occurs in many frequent grammatical words (e.g. *would, could, should*). As such, it may be important to maintain the quality of this phoneme to distinguish it from /uː/. On the other hand, the /ʊ/-/uː/ contrast has relatively few minimal pairs (Brown, 1988, 1995; Catford, 1987), thus not preserving the distinction may have little impact on listeners' understanding.

The second most problematic contrast was /æ/-/ɑː/ (see figure 6.2). The majority of speakers had overlapping categories for this contrast. This may be because the speakers' realisation of these two vowels converged to resemble French /a/ since it occupies a similar area in the vowel space.

Figure 6.2
Lobanov-normalised mean values of the /æ/-/ɑː/ contrast across speakers for both tasks

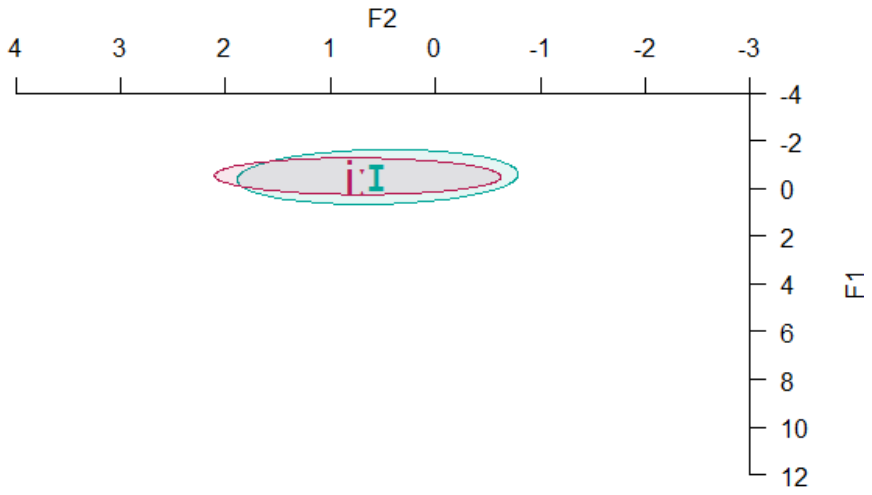


As discussed in 3.3, Krzonowski et al. (2018) investigated French speakers' productions of /æ/, /ʌ/ and /ɑː/ and found that there was less than 10% of overlap between the three categories, however, the speakers in our study showed considerable overlap for this contrast. One possible reason for the different result may be that different methods were used to determine the degree of overlap. They calculated the intersection to union ratio, whereas the present study relies on Pillai scores. It could also be because their study involved producing the vowels in bVt context (*bit, beat, bat, but, bart*), thus, the phonological environment was the same for each word, while our study involved a variety of psychology words with the vowels appearing in different phonological contexts. Another explanation may be that the speakers were English majors at University and, therefore, are highly motivated to perfect all aspects of their English. They would also have received pronunciation instruction as part of their degree. In our study, the informants are French Psychology researchers who use English for research.

Interestingly, in our study many of the French Psychology researchers showed overlap of /æ/-/ɑː/ in the word list productions but less in the text productions. In addition, when adding duration to the calculation, the number of speakers displaying overlap was reduced. Thus, duration appears to play a role in distinguishing this contrast. Krzonowski et al. (2018) also found that their speakers were able to produce duration distinctions, which do not exist in French. Regarding functional load, the /æ/-/ɑː/ contrast is placed in the middle of Brown (1988) and Catford's (1987) hierarchies, therefore, the impact of not preserving the distinction may not be considerable. In addition, this contrast is sometimes neutralised in L1 varieties such as Northern English accents, Australian or General American (GA) (Wells, 1982a).

The notorious /ɪ/-/iː/ contrast came in third place regarding the number of speakers who had overlapping categories. This was a little unexpected as this contrast is frequently cited as being problematic (Capliez, 2011; Jenkins, 2000; Kenworthy, 1987; Mees & Collins, 2013). The speakers in Krzonowski et al.'s (2018) study were less successful at producing the /ɪ/-/iː/ contrast than the /æ/, /ʌ/ and /ɑː/ contrasts since the speakers' /ɪ/-/iː/ contrast overlapped by around 50%. In our study, over half of the speakers had overlapping categories for this contrast without including duration as a dependent variable. When combining all the speakers' normalised mean values, the two vowels considerably overlap and appear to occupy the same area in the vowel space (see figure 6.3).

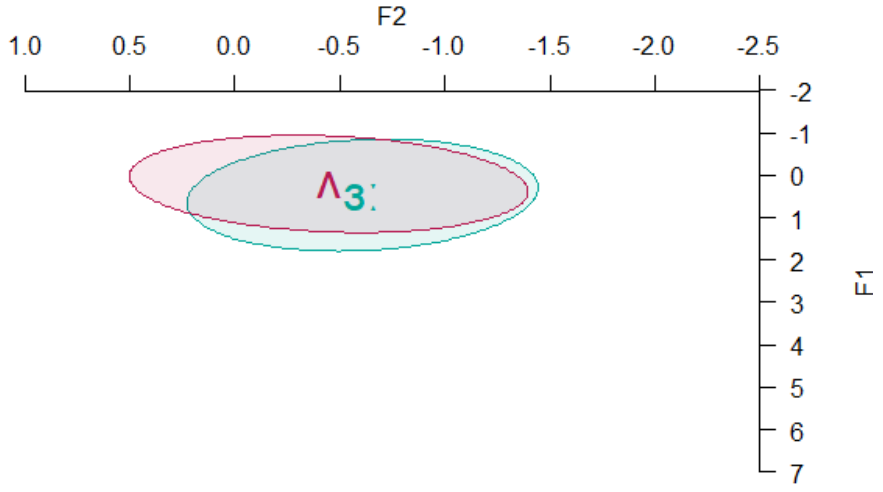
Figure 6.3
Lobanov-normalised mean values of the /ɪ/-/iː/ contrast across speakers for both tasks



Interestingly, when adding duration to the calculation, the number of speakers who fit the criteria for overlapping categories was greatly reduced. Once again, it seems that the speakers are able to distinguish the vowels by duration rather than in terms of vowel quality. However, as this contrast has a high functional load, it may not suffice to distinguish by duration alone. Listeners may need to perceive qualitative differences when the context is ambiguous.

Many speakers confused the /ʌ/-/ɜː/ contrast in terms of vowel quality (see figure 6.4), but when adding duration to the calculation very few fit the overlap criteria.

Figure 6.4
Lobanov-normalised mean values of the /ʌ/-/ɜː/ contrast across speakers for both tasks

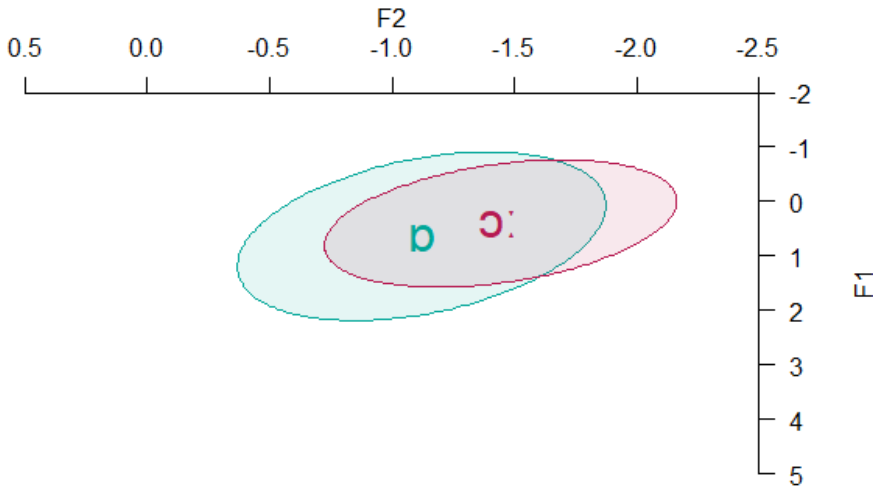


In addition to the duration difference, /ɜː/ is subject to r-colouring in rhotic varieties of English such as General American. This means that the vowel quality of /ɜː/ is influenced by /r/ and can also contribute to distinguishing the /ʌ/-/ɜː/ contrast. On the other hand, SBE is a non-rhotic variety whereby /ɜː/ simply has a long duration but no r-colouring. Although this was not the subject of analysis, only two speakers appeared to be consistently rhotic, therefore, this probably did not affect the distinction of this pair. This contrast has a mid functional load, thus, the impact of not preserving the distinction may not be highly detrimental for listeners.

Almost all of the speakers confused the /ɒ/-/ɔː/ contrast when reading the word list in terms of vowel quality. However, when reading the text and considering duration in the

calculations, only one speaker had overlapping categories.

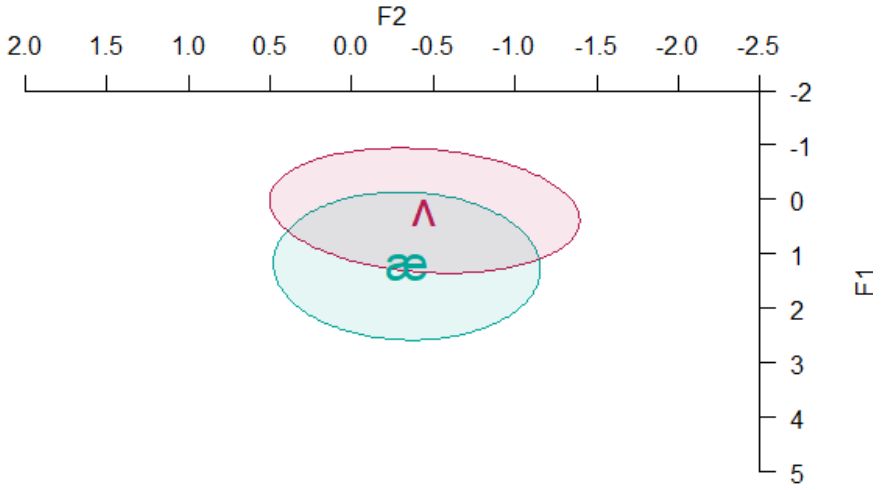
Figure 6.5
Lobanov-normalised mean values of the /ɒ/-/ɔː/ contrast across speakers for both tasks



Thus, the speakers appear to use duration to distinguish this contrast. Perhaps duration would suffice for listeners to perceive the distinction considering that this contrast has a mid to low functional load. /ɔː/ is also subject to the r-colouring phenomenon, but given that most of the speakers were non-rhotic, this probably did not affect the degree of overlap.

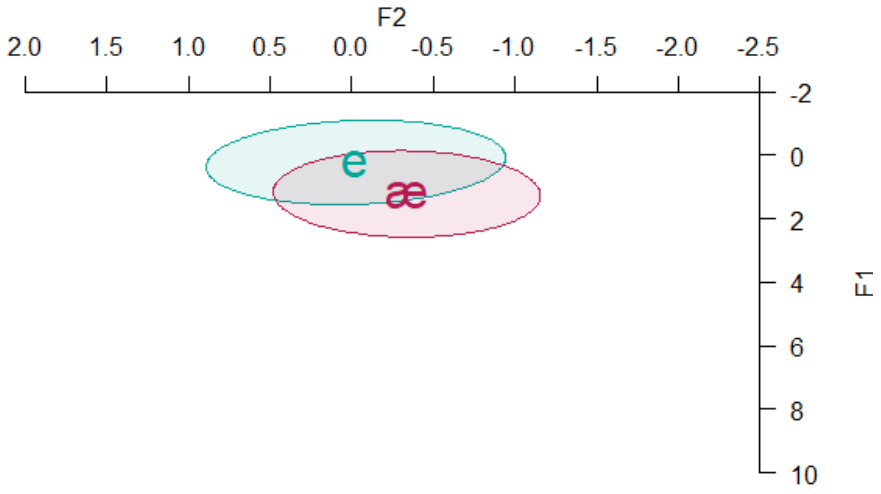
Surprisingly, only one speaker fit the criteria for overlap for the /æ/-/ʌ/ contrast, although it is often cited as being difficult. This does confirm Krzonowski et al.'s (2018) results that French speakers can produce distinct /æ/-/ʌ/ categories. It may be that this contrast is more problematic when preceding a nasal vowel, (e.g. *ankle* - *uncle*) given that French speakers have nasal vowels and sometimes nasalise English vowels. In Krzonowski et al.'s (2018) study the words were in a bVt context and in our study comparisons of phonological environments were not made. This would be an interesting area for further research.

Figure 6.6
Lobanov-normalised mean values of the /æ/-/ʌ/ contrast across speakers for both tasks



For the final contrast under analysis, /æ/-/e/, only one speaker had overlapping categories and figure 6.7 indicates more distinction between the categories. Thus, it would appear that this contrast is not very problematic for the French Psychology researchers.

Figure 6.7
Lobanov-normalised mean values of the /æ/-/e/ contrast across speakers for both tasks



This is perhaps unsurprising given that French speakers may assimilate /æ/ to /a/ and /e/ to /ɛ/, which are two distinct categories in their L1.

6.2.2 Comparing Speakers

Variability in productions was also found both within and between speakers. Some speakers have more established vowel categories, whereas others display great variation. The figures below show the informants' vowel tokens plotted in the vowel space for the word list and text, all tokens have been Lobanov-normalised.

Figure 6.8
Paul's vowel space for the word list (A) and the text (B)

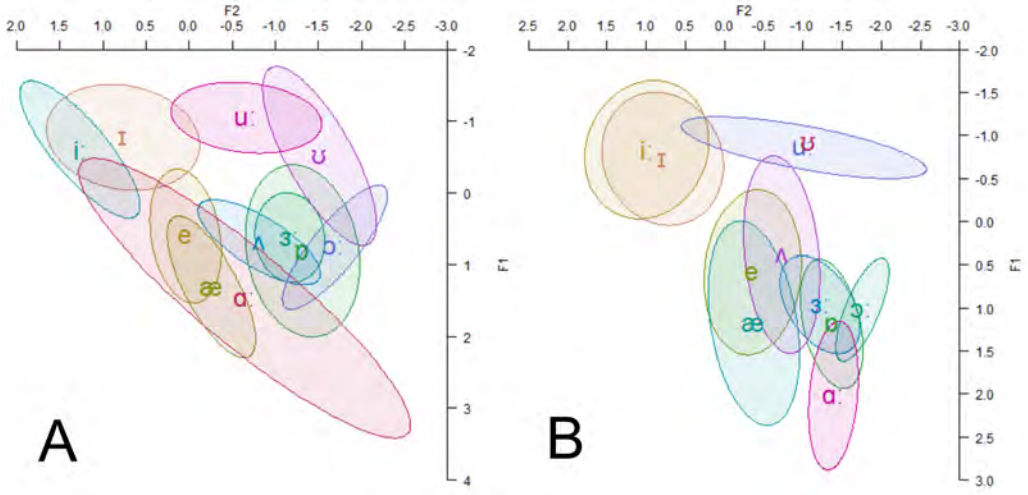


Figure 6.9
Marie's vowel space for the word list (A) and the text (B)

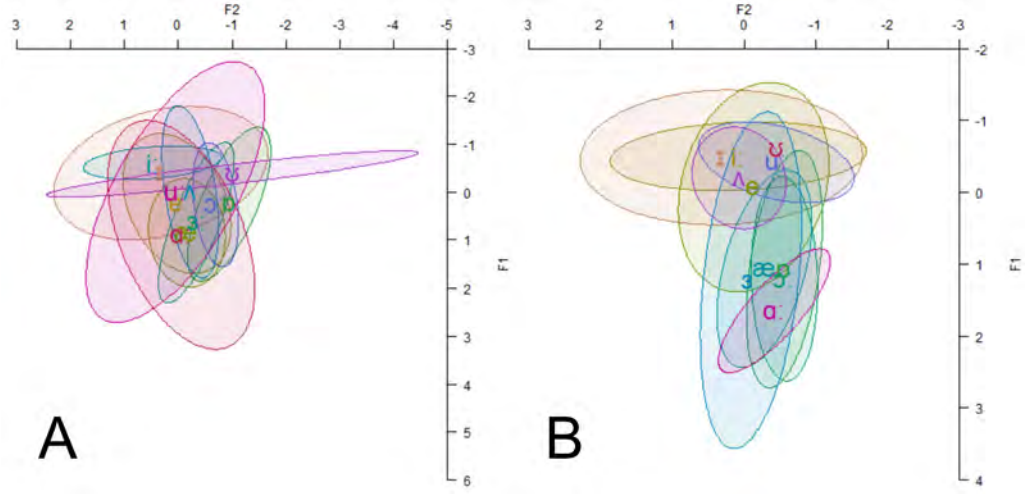


Figure 6.10
Charlotte's vowel space for the word list (A) and the text (B)

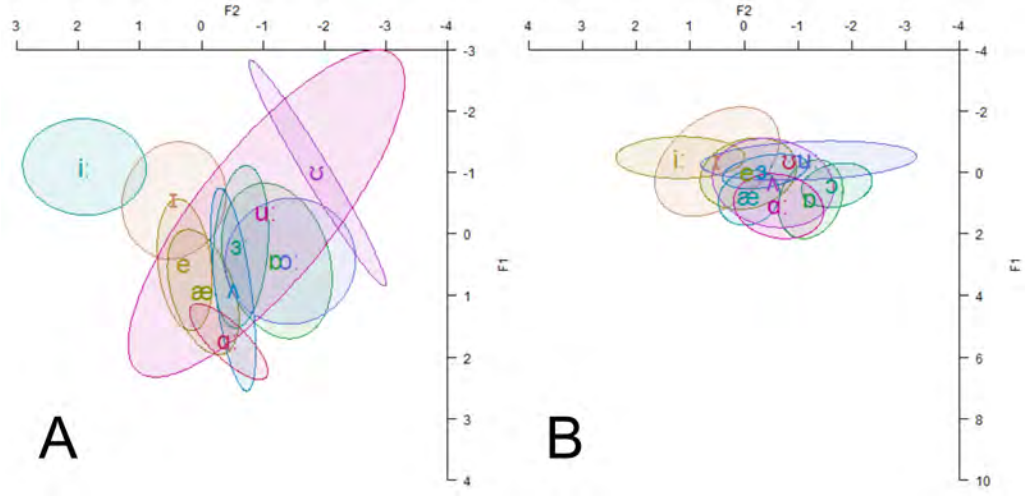


Figure 6.11
Martin's vowel space for the word list (A) and the text (B)

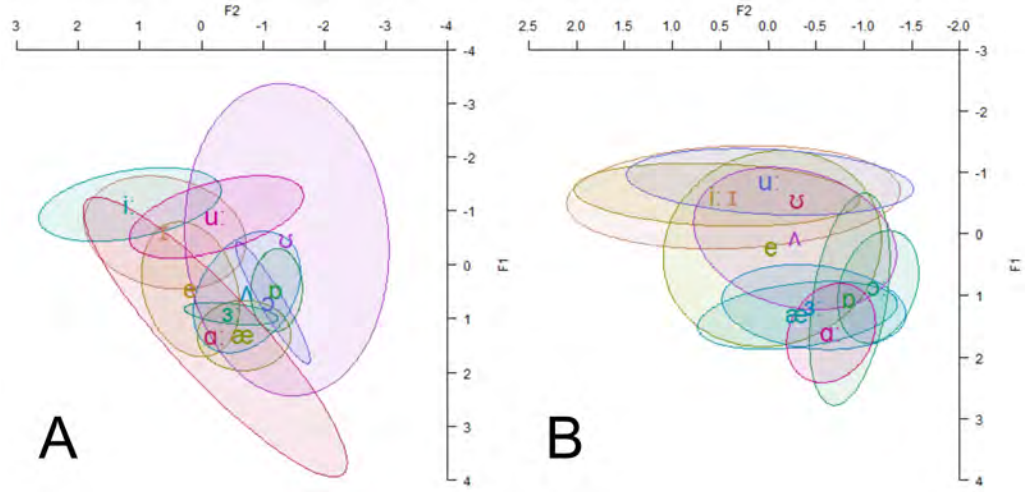


Figure 6.12
Jean's vowel space for the word list (A) and the text (B)

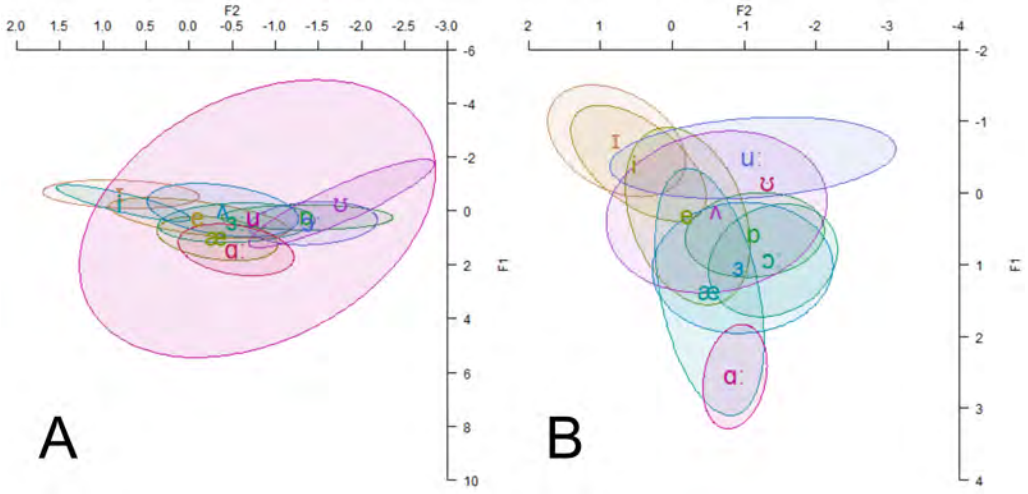


Figure 6.13
Louise's vowel space for the word list (A) and the text (B)

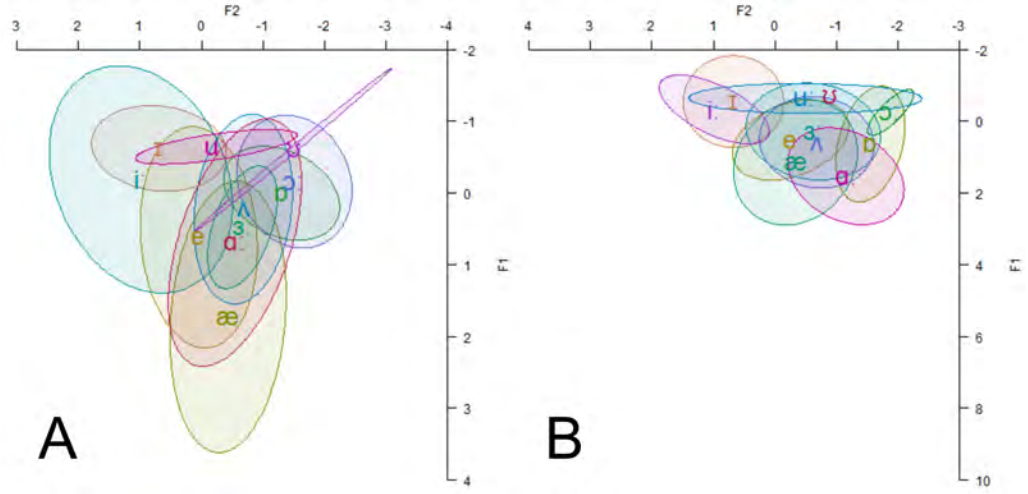


Figure 6.14
Alain's vowel space for the word list (A) and the text (B)

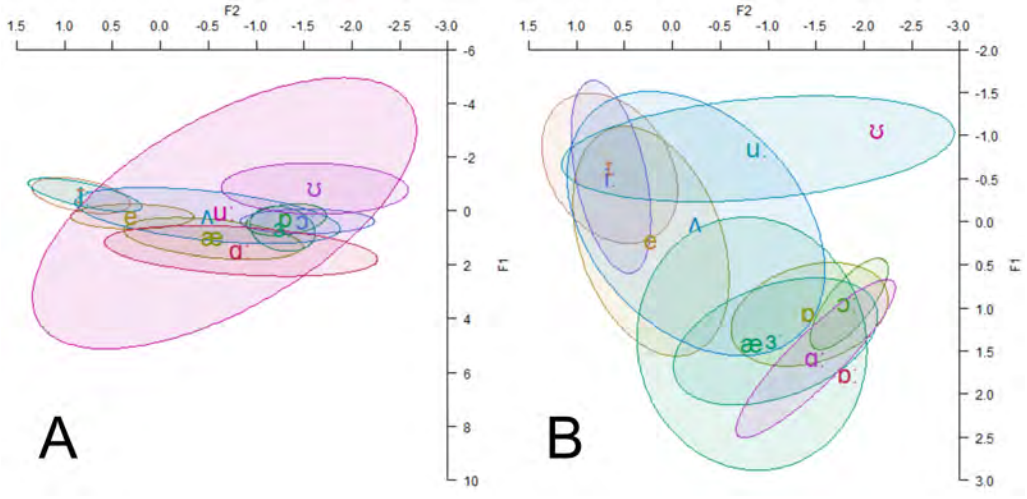


Figure 6.15
Julia's vowel space for the word list (A) and the text (B)

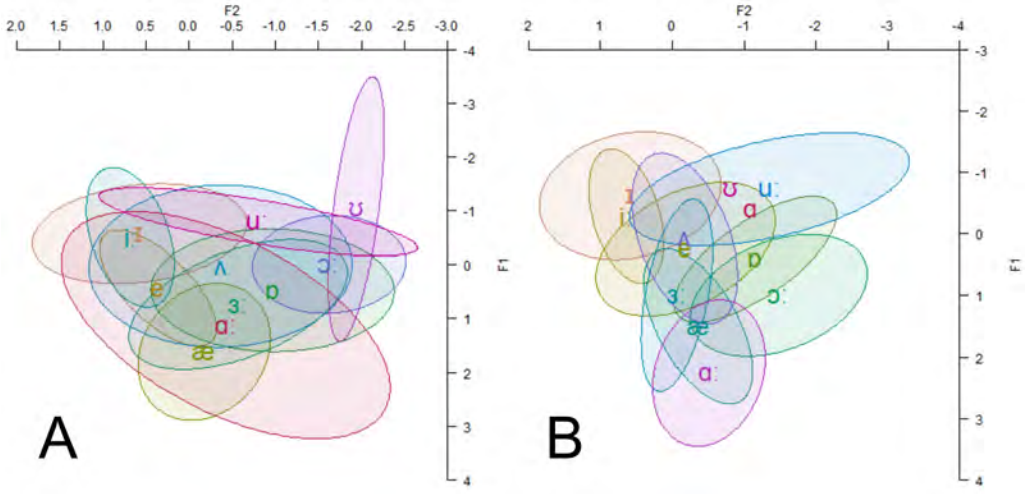


Figure 6.16
Claire's vowel space for the word list (A) and the text (B)

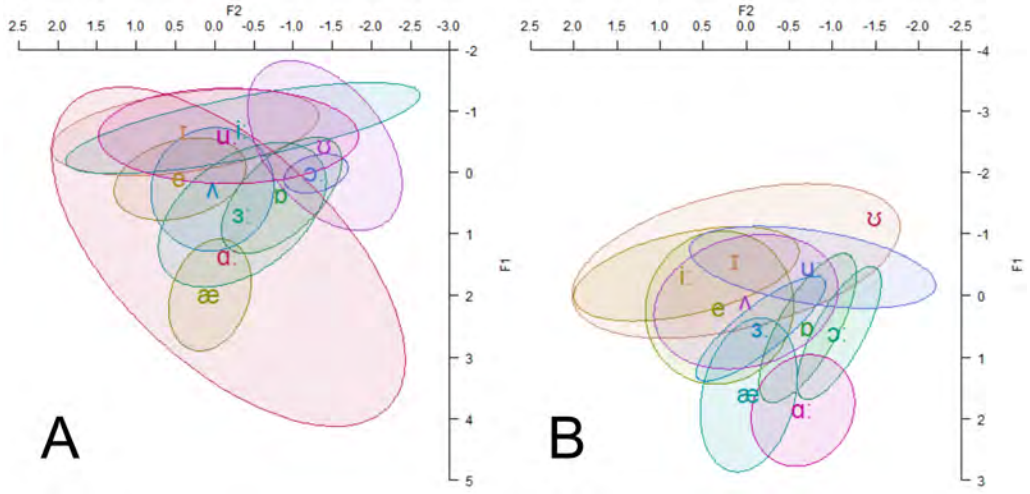


Figure 6.17
Sophie's vowel space for the word list (A) and the text (B)

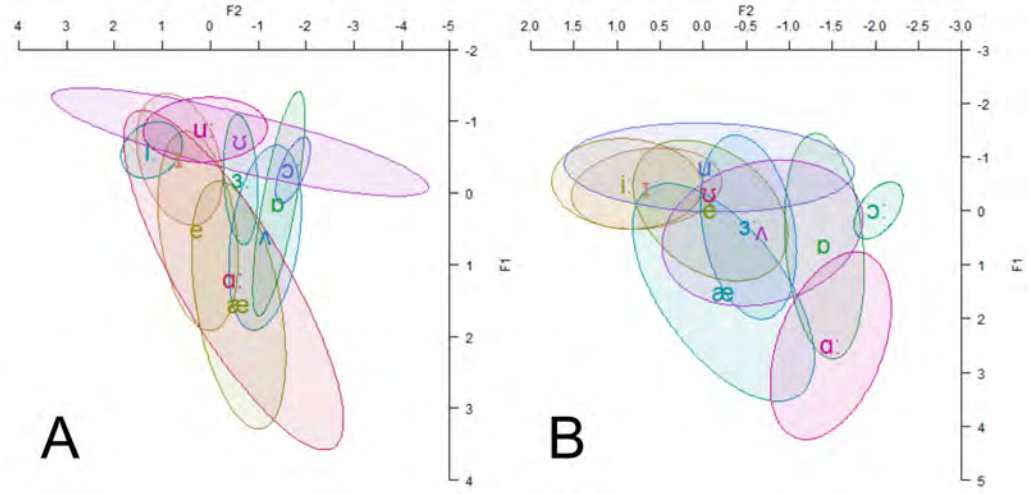


Figure 6.18
Hélène's vowel space for the word list (A) and the text (B)

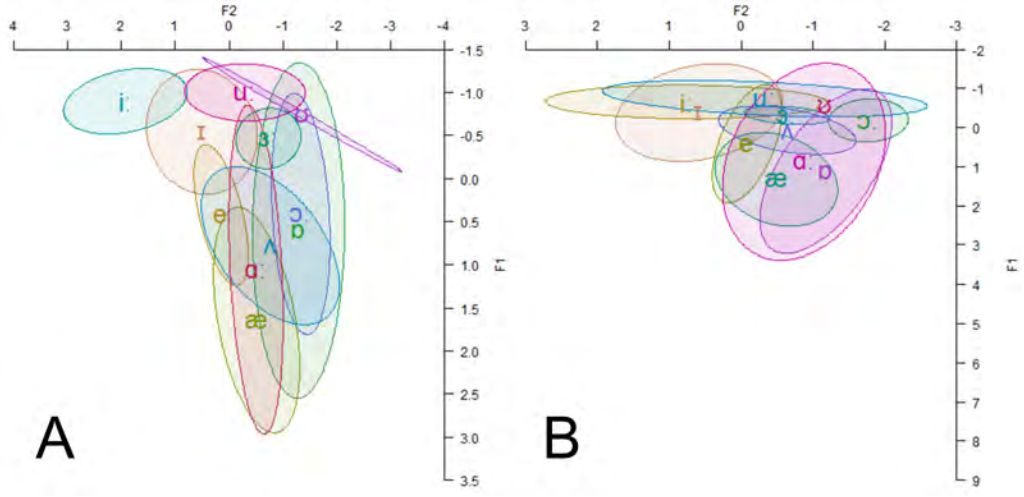


Figure 6.19
Alice's vowel space for the word list (A) and the text (B)

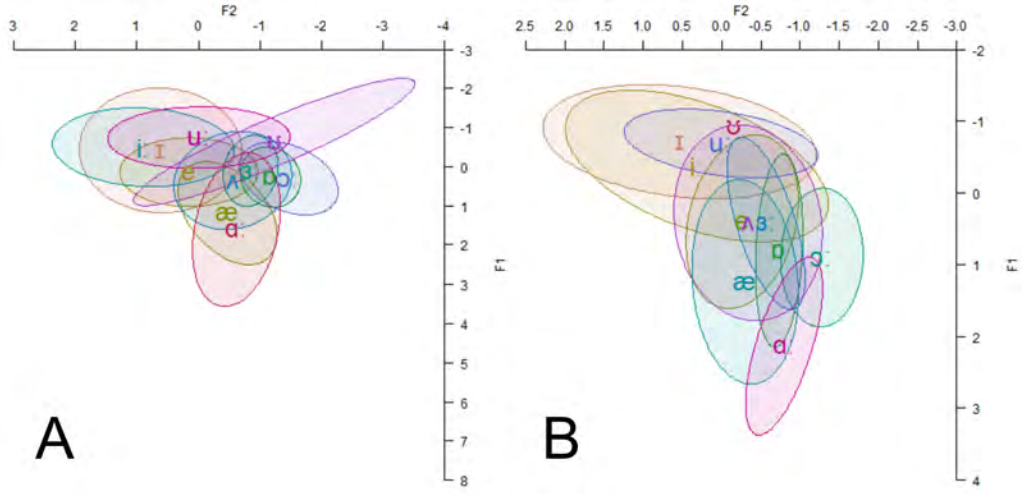
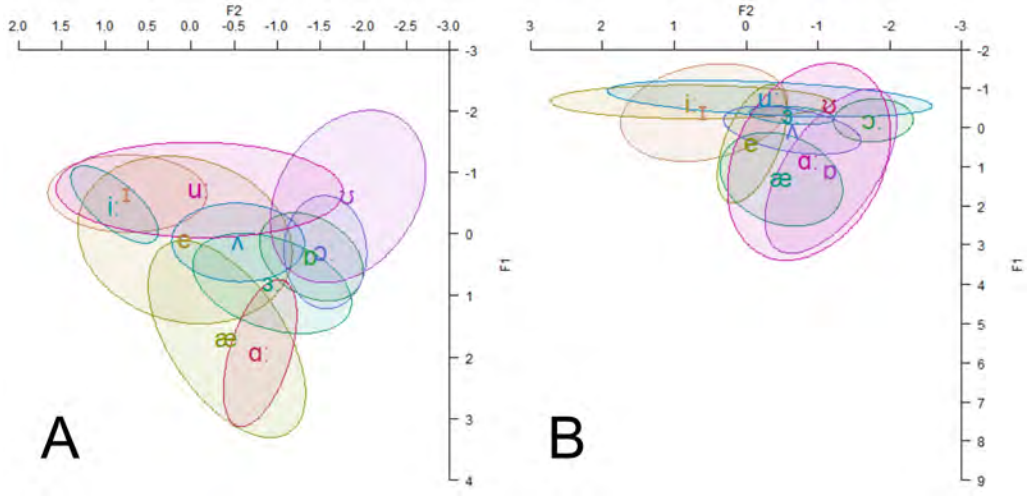


Figure 6.20
Anne's vowel space for the word list (A) and the text (B)



There is substantial variability in informants' productions, which is due to divergences from the SBE target norm and the instability of different sounds. In other words, the sound produced did not always reflect the target nor was it always produced the same way each time. For example, the /ɜː/ in *verbal* may be realised as [e] but have a more target-like realisation in *urban*, or the /ɔː/ in *autism* may be realised as [əʊ], while is it realised in target-like form in *cortex*. As a consequence, the ellipses reflect this variability.

As discussed, the Pillai scores and threshold calculation (Mairano et al., 2019; Stanley & Sneller, 2023) allow us to measure the degree of overlap for the seven chosen vowel contrasts and establish the extent to which the contrasts are maintained. The table below provides a summary of the speakers who fit the criteria for overlapping vowel contrasts in different tasks. Some speakers maintained the distinctions between most of the vowel contrasts across tasks, whereas others had multiple overlapping categories. The MANOVA output with the corresponding Pillai scores, thresholds and p-values can be found in Appendix C.

Table 6.4
Vowel overlap by speaker, contrast and task

Speaker	Task	/ʊ/ - /uː/	/æ/ - /ɑː/	/ɪ/ - /iː/	/ʌ/ - /ɜː/	/ɒ/ - /ɔː/	/æ/ - /ʌ/	/æ/ - /e/
Paul	Word list		YES			YES		
	WLD							
	Text	YES		YES				
	TD	YES						
Charlotte	Word list	YES			YES	YES		
	WLD	YES				YES		
	Text	YES			YES			
	TD	YES						
Marie	Word list	YES	YES	YES	YES	YES		YES
	WLD	YES		YES				
	Text	YES		YES		YES		
	TD	YES		YES				
Martin	Word list		YES		YES	YES		
	WLD		YES		YES			
	Text	YES		YES				
	TD	YES						
Jean	Word list	YES	YES		YES	YES		
	WLD	YES	YES		YES			
	Text	YES						
	TD							
Louise	Word list		YES		YES	YES		
	WLD							
	Text	YES			YES		YES	
	TD	YES						
Alain	Word list	YES	YES	YES		YES		
	WLD	YES	YES	YES				
	Text	YES	YES	YES				
	TD	YES						
Julia	Word list		YES	YES	YES			
	WLD			YES				
	Text	YES	YES	YES				
	TD	YES	YES					
Claire	Word list	YES	YES	YES	YES	YES		
	WLD	YES	YES					
	Text			YES	YES			
	TD							
Sophie	Word list	YES	YES			YES		
	WLD	YES	YES					
	Text	YES		YES	YES			
	TD	YES						
Hélène	Word list		YES			YES		
	WLD		YES					
	Text	YES	YES	YES				
	TD	YES						
Alice	Word list	YES	YES	YES	YES	YES		
	WLD		YES		YES			
	Text	YES			YES			
	TD	YES						
Anne	Word list		YES	YES		YES		
	WLD		YES					
	Text	YES	YES	YES				
	TD	YES						

6.2.3 Limitations and Perspectives

There are, of course, some limitations to these analyses. As previously mentioned, the sample size of certain vowels is rather small. It would be of interest to collect larger samples of the vowels /ʊ/, /ɜː/ and /ɑː/ to ensure reliable comparisons. Nevertheless, although some vowel contrasts have fewer occurrences than others or are unbalanced, Pillai scores are robust even with unequal samples and the threshold recommended by Stanley & Sneller (2023) can mitigate problems of sample size.

As the items in the word list and text were chosen to reflect academic English in the Psychology domain, each item containing a vowel was not controlled for phonological context. As such, the impact of phonological context would be an area worth investigating in the future. For example, comparing the /æ/ - /ʌ/ contrast in a pre-nasal context and without. Although this study does not take phonological context into account, it does have the advantage of being representative of the kind of vocabulary a researcher would use at conferences.

Another issue is that Pillai scores measure the degree of overlap between two categories, but they do not give information about whether a given realisation matches the target. As Mairano et al. (2023, p.15) explains:

> [Pillai scores] may positively evaluate realisations that are completely off target. For instance, let us consider the English vowel contrast /iː/ — /ɪ/ ; if a learner consistently realised this as [iː] — [ɑː], the resulting Pillai score would be high since the two vowel categories are brightly distinct, but this would miss the fact that [ɑː] is completely off-target and would certainly not be well accepted by listeners as a realisation of /ɪ/.

Thus, in certain cases the Pillai scores may be high indicating a greater degree of separation despite the fact that the vowel being produced does not resemble the target. In addition to this, although Pillai scores have shown strong correlations with perceptions of nativelikeness and comprehensibility, they alone cannot inform us of the extent to which not distinguishing vowel contrasts reduces intelligibility and comprehensibility for listeners. That is why it is important to combine acoustic analysis with perception tasks.

6.3 Consonantal Realisations

As well as performing acoustic analyses on a number of vowel contrasts, the consonants /h/, /θ/ and /ð/ were selected for analysis on the basis of being difficult to acquire and produce for learners of English. This time, the analysis is of a descriptive rather than an acoustic nature in order to examine whether these consonants are indeed difficult to acquire for French speakers and, if so, which substitutions are used to replace them. Thus, as explained in 5.1.4, the different realisations of /h/, /θ/ and /ð/ were coded and extracted. We shall begin by discussing the realisation of /h/.

6.3.1 In Hertford, Hereford and Hampshire hurricanes hardly ever happen

The glottal fricative /h/ does not exist in Standard French, but, in theory, it is relatively easy to articulate given that it is akin to sighing. However, it has been described as difficult for French speakers by numerous authors (Kenworthy, 1987; Mah et al., 2016; Mees & Collins, 2013; Melnik & Peperkamp, 2019, 2021). One reason for this may be due to difficulty identifying /h/ in the speech flow as it is not perceptually salient. Typically, fricatives are defined by the turbulence generated at a specific point of articulation, where airflow is narrowed within the oral cavity (Ladefoged & Johnson, 2014). The glottal fricative, however, is articulated from the larynx, and as such it lacks significant constriction in the oral and pharyngeal cavities (Mah et al., 2016), thus produces less turbulence. Additionally, it is a voiceless consonant, in other words, it lacks vibration as it passes through the vocal tract. Its lack of turbulence and voicing contribute to making it difficult to detect for listeners acquiring a new L2 phoneme. If it is not easily perceived, learners may have difficulty categorising it and not know when to produce it.

Another reason for this difficulty may be attributed to orthography. Although the glottal fricative has a consistent orthographic representation <h>, which one might hope could reinforce its acquisition, it can also be represented in orthography but silent in production. In English /h/ is realised either word-initially or at the onset of stressed syllables, whereas in French <h> exists orthographically but is always silent. The fact that it is sometimes

pronounced in English and sometimes silent may confuse learners, particularly when <h> is always silent in their L1. For example, there are word-initial exceptions where <h> is silent in English (eg: *hour, honour, honest*), albeit relatively few, and it is often silent in digraphs such as <ch> (*chord*), <gh> (*ghost*) or <wh> (*white*). That said, in the digraph <wh> /h/ can also be realised and <w> silent (eg: *who, whole, whose, whom*). Thus, learners may be unsure whether to pronounce the glottal fricative when they see it in its written form.

As /h/ does not tend to be confused or substituted with any other phoneme, it will be discussed in terms of presence or absence, something which occurs in perception and production asymmetrically as Melnik & Peperkamp (2019, p.4) suggest:

> French speakers have difficulty perceiving /h/ when it is present but do not hallucinate it when it is absent. This asymmetry is reflected in their English production. That is, while they occasionally insert /h/ (e.g., hafter instead of after), they much more frequently omit /h/ (eadache instead of headache).

In our corpus tokens of /h/ occurred nine times in the word list and nine times in the text for a total of 18 occurrences per speaker. Only one token was excluded because one of the speakers omitted the word *who* when reading the text, which left 233 tokens in total. Overall, the [h] is produced nearly 50% of the time by the French Psychology researchers.

Table 6.5
Realisations of [h] across different tasks

Target /h/	**Word List**	**Text**	**WL + T**
Omitted	49% (57)	58% (67)	53% (124)
[h]	51% (60)	42% (49)	47% (109)

Note. Percentages are rounded off; numbers of occurrences are in brackets

However, it should be noted that there is considerable variability among speakers with some frequently producing [h] and others frequently omitting it.

Table 6.6
Realisations of [h] by different speakers

Participant	Word list	Text	WL+T
Paul	100% (9)	89% (8)	94% (17)
Hélène	100% (9)	67% (6)	83% (15)
Alice	89% (8)	75% (6)	82% (14)
Martin	78% (7)	67% (6)	72% (13)
Claire	78% (7)	56% (5)	67% (12)
Alain	44% (4)	67% (6)	56% (10)
Sophie	22% (2)	67% (6)	44% (8)
Julia	33% (3)	22% (2)	28% (5)
Charlotte	22% (2)	22% (2)	22% (4)
Jean	44% (4)	0% (0)	22% (4)
Louise	22% (2)	22% (2)	22% (4)
Anne	22% (2)	0% (0)	11% (2)
Marie	11% (1)	0% (0)	6% (1)

Note. Percentages are rounded off; numbers of occurrences are in brackets

Five speakers had [h] dominant patterns, six speakers mostly omitted the glottal fricative and two speakers omitted more than half of the glottal fricatives when reading the word list, but did the opposite when reading the text. It does seem, therefore, that this phoneme is difficult to acquire for French speakers of English. This could be due to its lack of perceptual salience, to orthography, or perhaps because it is a difficult articulatory habit to obtain. In addition, the variability among speakers could be related to proficiency or pronunciation aptitude.

As previously mentioned, the addition of an intrusive /h/, typically before words beginning with a vowel, is another observation regarding French speakers' L2 English (Capliez, 2011). Nevertheless, in our corpus, we only identified six occurrences produced by four speakers throughout both tasks. This may be noticeable or disconcerting for some listeners but it does not appear to be common.

6.3.2 Thirty-six thick silk threads

The picture is more complicated with the dental fricatives /θ/ and /ð/. Neither /θ/ nor /ð/ exist in French, in fact, they are relatively infrequent among the world's languages. Additionally, they are both represented by the same grapheme <th>. Thus, L2 learners

may be unaware that they are two different speech sounds that differ regarding voicing. The dental fricatives are also notoriously difficult in terms of articulation for L2 speakers, including French speakers (Capliez, 2011; Kenworthy, 1987; Mees & Collins, 2013; Tyler et al., 2019), most likely due to the fact that they require the tongue to be momentarily placed between the teeth as air passes through the vocal tract. As such, they are often substituted with other phonemes. For example, European French speakers are said to replace /θ/ with /s/ and /ð/ with /z/, whereas Canadian French speakers are more likely to replace /θ/ with /t/ and /ð/ with /d/ (Tyler et al., 2019).

The voiceless dental fricative /θ/ is relatively challenging to distinguish perceptually because it is not salient. In fact, research on phoneme identification indicates that L1 speakers and various L2 listeners frequently confuse the acoustically similar /f/ with /θ/, while less commonly mistaking it for /t/ or /s/ (Cutler et al., 2004; Tyler et al., 2019). According to Hanulikova and Weber (2010), it is quite unexpected that /f/ does not emerge as the most prevalent substitution in L2 English speech as opposed to /s/ or /t/, considering the acoustic resemblance with /f/ and the fact that /f/ is often present in the L1 phoneme inventory of the L2 speakers. In addition, the replacement of the voiceless (and voiced) dental fricatives is not limited to L2 speech; such substitutions are also found in various L1 English varieties, with noted occurrences of [f] in Cockney and of [t] in Irish English (Capliez, 2011; Wells, 1982a). Given that /θ/ is difficult to perceive, it may lead to a variety of substitutions in terms of production.

There were four occurrences of /θ/ in the word list and four in the text for a total of eight occurrences per speaker. One token was excluded from the text productions because it was difficult to identify and barely appeared on the spectrogram, leaving a total of 103 tokens. Overall, the voiceless dental fricative /θ/ is most often substituted with [t] or [f] and not, in fact, [s]. It should also be noted that the target [θ] was produced 50% of the time.

Table 6.7
Realisations of [θ] across different tasks

Target /θ/	Word list	Text	WL+T
[θ]	56% (29)	43% (22)	50% (51)
[f]	10% (5)	33% (17)	21% (22)
[t]	23% (12)	10% (5)	17% (17)
[s]	10% (5)	10% (5)	10% (10)
[ʃ]	1% (1)	2% (1)	2% (2)
[tʃ]	0% (0)	2% (1)	1% (1)

Note. Percentages are rounded off; numbers of occurrences are in brackets

Given the extremely low occurrences of [ʃ] and [tʃ], they are probably slips of the tongue rather than common substitutions. Interestingly, [s] is not the most common substitution and is, in fact, less frequent than [f] and [t]. However, there was a certain amount of interspeaker variability since the French Psychology researchers showed different substitution preferences.

Table 6.8
Realisations of [θ] across different tasks

Participant	[θ]	[f]	[t]	[s]	[ʃ]	[tʃ]
Paul	75% (6)			25% (2)		
Charlotte	38% (3)	38% (3)	12% (1)	12% (1)		
Marie		12% (1)	38% (3)	25% (2)	25% (2)	
Martin		100% (8)				
Jean	50% (4)	12% (1)	25% (2)	12% (1)		
Louise		50% (4)	38% (3)	12% (1)		
Alain	75% (6)		12% (1)	12% (1)		
Julia	63% (5)	12% (1)	25% (2)			
Claire	88% (7)			12% (1)		
Sophie	88% (7)	12% (1)				
Hélène	75% (6)		12% (1)	12% (1)		
Alice	71% (5)	14% (1)	14% (1)			
Anne	25% (2)	25% (2)	38% (3)			12% (1)

Note. Percentages are rounded off; numbers of occurrences are in brackets

Seven speakers had [θ] dominant patterns, one speaker had [f] dominant patterns and five speakers showed variable patterns. Thus, the target is often achieved by over half of the speakers. Interestingly though, the position of the voiceless dental fricative in the word appears to affect the substitutions made by the speakers. This contrasts with Hanulikova and

Weber's (2010) results since they found that substitutions were not word- or speaker-specific for German and Dutch speakers of English. Like the French speakers though, German and Dutch speakers produced the target more often than substitutions. However, it should be noted that Hanulikova and Weber (2010) only focused on word-initial /θ/ in their study.

At the syllable onset, the target [θ] is often achieved and the most common substitution is [t]. This effect is much stronger when the target occurs at the beginning of the word.

Table 6.9
Occurrences of [θ] at the onset

Word	[θ]	[t]	[f]	[ʃ]	[tʃ]	[s[
Theme	5	5	1	-	1	-
Therapeutic	7	5	1	-	-	-
Threshold	7	3	2	1	-	-
Healthy	9	-	3	1	-	-
Total	28	13	7	2	1	-

When [θ] occurs intervocalically, the target is preferred.

Table 6.10
Occurrences of intervocalic [θ]

Word	[θ]	[t]	[f]	[s[	[ʃ]	[tʃ]
Empathy	8	4	1	-	-	-

In coda position, [f] is the most popular substitution following the target [θ]:

Table 6.11
Occurrences of [θ] in coda position

Word	[θ]	[f]	[s]	[t[	[ʃ]	[tʃ]
Both	4	7	2	-	-	-
Forth	4	6	3	-	-	-
Strengths	7	1	5	-	-	-
Total	15	14	10	-	-	-

It is interesting to note that in the word *strengths* realisations of [s] overtake [f] realisations resulting in the simplification of the consonant cluster /θs/. This suggests that productions of the voiceless dental fricative are sensitive to phonotactic constraints. Indeed, productions may vary according to which substitution is the easiest to articulate in a particular context.

Of course, this merits more research. It would also be interesting to collect a larger sample size to investigate whether the same patterns occur as there are relatively low occurrences of /θ/ in our corpus.

6.3.3 The size of this prize is amazing though guys

The voiced dental fricative /ð/ is also difficult to articulate like its voiceless counterpart. They share the same place and manner of articulation and only differ in terms of voicing. Since /ð/ is voiced, it is more perceptually salient than /θ/, however, the literature indicates that French speakers substitute /ð/ with /z/ (Capliez, 2011; Kenworthy, 1987; Mees & Collins, 2013). This is probably due to articulatory difficulties as previously discussed. According to Tyler et al. (2019) however, French listeners actually categorise /ð/ as /v/ far more frequently than as /z/.

In our corpus, there were four occurrences of /ð/ in the word list and 32 in the text for a total of 36 occurrences per speaker. Twelve tokens were excluded from the text productions as it was too difficult to determine the realisations for different reasons; either the tokens hardly appeared on the spectrogram, there was external noise or the phoneme itself was omitted. This left a total of 456 tokens. Overall, the most frequent substitutions for /ð/ are /z/, /d/ and /v/.

Table 6.12
Realisations of /ð/ across different tasks

Target /ð/	Word List	Text	WL + T
[ð]	40% (21)	33% (133)	34% (154)
[z]	33% (17)	24% (96)	25% (113)
[d]	6% (3)	22% (91)	21% (94)
[v]	6% (3)	17% (68)	15% (71)
[f]	2% (1)	3% (12)	3% (13)
[θ]	9% (5)	0% (1)	1% (6)
[s]	4% (2)	1% (3)	1% (5)

Note. Percentages are rounded off; numbers of occurrences are in brackets

The infrequent occurrences of [f] [θ] and [s] are probably due to the speakers not fully engaging voicing since they share the same place and manner of articulation as /v/, /ð/ and

/z/ respectively. Although /z/ is a frequent substitution, /d/ and /v/ are also very popular. Once again the speakers had different substitution preferences, but the most frequent remain /z/, /d/ and /v/.

Table 6.13
Realisations of [ð] by speaker

Participant	**[ð]**	**[z]**	**[d]**	**[v]**	**[f]**	**[s]**	**[θ]**
Paul	44% (16)	50% (18)	6% (2)				
Charlotte	20% (7)	3% (2)	37% (13)	26% (9)	9% (3)	3% (1)	
Marie	8% (3)	39% (14)	25% (9)	11% (4)	17% (6)		
Martin	14% (5)	9% (3)		74% (26)	3% (1)		
Jean	9% (3)	77% (27)				9% (3)	6% (2)
Louise	25% (9)	3% (1)	67% (24)	3% (1)		3% (1)	
Alain	31% (11)	67% (24)					3% (1)
Julia	44% (16)	39% (14)	14% (5)	3% (1)			
Claire	42% (15)	11% (4)	8% (3)	25% (9)	8% (3)		3% (2)
Sophie	53% (18)	3% (1)	15% (5)	26% (9)			3% (1)
Hélène	67% (22)	3% (1)	30% (10)				
Alice	78% (25)	9% (3)	9% (3)	3% (1)			
Anne	11% (4)	3% (1)	56% (20)	31% (11)			

Note. Percentages are rounded off; numbers of occurrences are in brackets

Two speakers had [ð] dominant patterns, two speakers had [z] dominant patterns, one speaker had [d] dominant patterns, one speaker had [v] dominant patterns and seven speakers showed variable patterns. Thus, the voiced dental fricative displays more variability among speakers than the voiceless dental fricative. That said, like its voiceless counterpart, realisations of /ð/ seem to be affected by its position in the word. This is interesting because it suggests that articulation plays an important role in determining substitution choices. At the onset, /d/ is the second most popular substitution following the target.

Table 6.14
Occurrences of word-initial [ð]

Word	[ð]	[d]	[z]	[v]	[θ]	[s[	[f]
Than	5	5	1	-	-	-	-
That	16	20	8	5	-	1	-
The	29	29	26	2	-	-	-
Their	5	2	3	1	1	-	-
These	5	4	2	2	-	-	-
This	4	11	4	5	-	-	-
Those	14	5	5	2	-	-	-
Thus	7	3	1	1	-	1	-
Total	85	79	50	18	1	2	-

The target is a much more popular realisation followed by /z/ when /ð/ occurs intervocalically.

Table 6.15
Occurrences of intervocalic [ð]

Word	[ð]	[z]	[d]	[v]	[f]	[θ]	[s]
Either	8	3	2	-	-	-	-
Other	5	4	2	2	-	-	-
Together	8	2	2	1	-	-	-
Total	21	9	6	3	-	-	-

In coda position, /z/ is the most popular substitution followed by /v/.

Table 6.16
Occurrences of [ð] in coda position

Word	[z]	[v]	[ð]	[f]	[d]	[θ]	[s]
With	37	47	27	12	6	-	1
Withdrawal	4	2	4	1	1	1	-
Rhythm	3	-	8	-	1	1	-
Clothes	2	1	6	-	-	2	2
Algorithms	8	-	3	-	1	1	-
Total	54	50	48	13	9	5	3

It is also interesting to note that in the word *with* /v/ is the most popular substitution, but in the consonant clusters /ðm/, /ðz/ and /ðms/, the most popular substitution is /z/ resulting in a simplification strategy. It does, indeed, appear that many of the speakers

have a tendency to articulate the easiest phoneme in a given context rather than having a preferred substitution overall. Thus, articulation plays an important role in determining substitutions.

6.4 Summary

Although it would be remiss to generalise the findings of the study to all French speakers of English, we can draw some tentative conclusions. Having examined consonantal realisations of /h/, /θ/ and /ð/, we found that the glottal fricative /h/ is produced variably with half of the speakers omitting it more frequently than producing it. Thus, it appears to be a difficult phoneme to acquire for French speakers, which confirms difficulties described in the literature (Kenworthy, 1987; Mah et al., 2016; Mees & Collins, 2013; Melnik & Peperkamp, 2019, 2021).

Another interesting finding is that the dental fricatives /θ/ and /ð/ are not always substituted by the alveolar fricatives /s/ and /z/ as often suggested (Capliez, 2011; Kenworthy, 1987; Mees & Collins, 2013). Indeed, they are not always substituted at all given that the most frequent realisations were the targets themselves. However, substitutions seem to depend on phonological environment to a certain extent. At the syllable onset, the dental plosives /t/ and /d/ are more frequent substitutes, the targets tend to be substituted much less intervocalically and in the coda position the labiodental fricatives /f/ and /v/ are more popular substitutes, unless the target is found in a consonant cluster in which case the alveolar fricatives /s/ and /z/ are more popular. This differs somewhat from findings reported by Hanulikova and Weber (2010) who found that Dutch and German speakers' /θ/ substitutions were not word or speaker-specific. However, their study focused on word-initial /θ/, so they were unable to observe effects of phonological context.

In terms of intelligibility, the glottal fricative may merit attention in the classroom if it appears to hinder intelligibility for listeners since it is produced relatively infrequently. The dental fricatives do not have a high functional load but they do appear in many grammatical words, so may also be important to maintain. In our corpus, they are produced with both interspeaker and intraspeaker variability, therefore, it would be beneficial to investigate

whether certain substitutions impact intelligibility more than others. For example, the alveolar fricatives share less acoustic properties with the dental fricatives and may be more detrimental for intelligibility. On the other hand, they may simply affect perceptions of foreign-accentedness and be relatively easy to decode. Further research would be needed to confirm which substitutions are dentrimental for intelligibility and comprehensibility.

Another interesting perspective for future research would be to examine the acoustic properties of L2 dental fricative realisations. Hanulikova and Weber (2010) argue that the "labeling conventions of [θ]-substitutions as [t,s,f] might not sufficiently characterize L2-productions, at least concerning its acoustics. Rather, [θ]-substitutions seem to show gradient properties, exhibiting acoustic properties that are often in between those of [θ]-realizations and [t,s,f]-realizations" (p.5) Measuring the acoustic properties of /θ/ and /ð/ may offer precious insights into patterns of L2 acquisition.

Regarding vowels, the contrasts /ʊ/-/uː/, /ae/-/ɑː/, /ɪ/-/iː/ and /ʌ/-/ɜː/ do appear to be difficult for French speakers since Pillai scores revealed a significant amount of overlap for a majority of informants. This differs from Krzonowski et al. (2018) who found less than 10% overlap between the contrasts /æ/-/ʌ/-/ɑː/, although this may be due to the fact that they used a different measure of overlap and the speakers were English majors. That being said, it confirms the difficulties Krzonowski et al. (2018) found for the /ɪ/-/iː/ contrast. It should also be noted that there was considerable intraspeaker and interspeaker variation in our corpus.

Since different vowel contrasts have different functional loads, some may be more important to maintain than others. For instance, /ɪ/-/iː/ has a high functional load and may impact intelligibility more than /ʊ/-/uː/ despite the fact that more speakers failed to distinguish the latter contrast. In addition, while Pillai scores have been shown to be reliable indicators of intelligibility and comprehensibility, both acoustic measures and perceptual judgements have their downsides. As Mora (2021) suggests "when using perceptual measures of identification accuracy and goodness ratings, it is difficult to tell what exactly listeners are paying attention to...however...acoustic measures may be said to be less ecologically valid than native listeners' perceptual judgements and more time-consuming." (p.10). This reinforces the idea that using both acoustic measures in combination with listeners' perceptual judgements remains

most relevant methodological choice for our study.

Future studies of L2 vowel production may also wish to consider phonological environment as this can impact realisations. For example, French speakers may have a tendency to nasalise vowels occurring before nasal consonants, although this is yet to be confirmed. The relationship between pronunciation and orthography also merits investigation since English is orthographically opaque but also shares many orthographically transparent words with French. Mouquet and Mairano (2023a; 2023b) have already shown that orthography impacts French speakers' production of silent letters. It would also be beneficial to examine whether orthographically similar words in French and English are more impacted than dissimilar words and whether possible production differences impact intelligibility.

Part III

Processing French-Accented Speech: From Isolated Words to Speech

Chapter 7

An Experimental Protocol

When French Psychology researchers communicate in English at international conferences, they have to convey complex concepts in a foreign language in which they have varying degrees of fluency (lexical, syntactic, phonological). For communication to be successful, it is essential to be intelligible and comprehensible during these academic presentations. For this reason, we elaborated an experimental protocol in order to investigate how different listeners process French-accented speech. In the present study, L1 French and L1 English listeners evaluated the intelligibility and comprehensibility of the French Psychology researchers that were recorded as described in 4.3. Participants had to undergo three different listening tasks in order to compare their performances when listening to French-accented speech and Southern British English (SBE) speech. This chapter describes the protocol of the experiment. The perceptual experiment has also been the subject of an article by O'Callaghan et al. submitted in 2025 to the *Journal of Second Language Pronunciation*.

7.1 Influential Factors on Speech Perception

The aim of our perception experiment is to determine whether French-accented English impedes intelligibility and comprehensibility and, if so, for which listeners. On the one hand, an L2 accent may generate a high extraneous cognitive load, thus hindering intelligibility and comprehensibility. On the other hand, this same difficulty could be desirable from a cognitive point of view, as it may lead the listener to actively focus on processing speech and maintain attention. Does intelligibility depend on the interlocutor's L1 (whether it is the same L1 as the speaker or the same L1 as the language being spoken), on the

degree of foreign-accentedness or even on the type of oral production (from isolated words to speech)? Answering these questions can be useful in many ways, as it will allow us to better assess the importance of foreign-accentedness in academic communication and highlight elements of French-accented speech that can have a detrimental impact on intelligibility and comprehensibility.

7.1.1 L1, Accentedness and Cognitive Load

Since the seminal work of Derwing and Munro (1995a; 1995b; 1997; 2006; 2006), intelligibility scores have been calculated using the number of words a listener is able to recognise and comprehensibility has been measured by collecting perception of difficulty ratings (Munro & Derwing, 2015). They have demonstrated, time and again, that although intelligibility, comprehensibility and accentedness interact with each other, they are also partially independent constructs. Intelligibility scores can be high even when comprehensibility and accentedness ratings are severe. The ability to understand speech is clearly impacted even when words are successfully recognised.

Although speech can be decoded even when fragments of an utterance are missing from the speech signal (Janse & Ernestus, 2011), it is likely to render processing more difficult. Decoding a foreign accent might require excessive cognitive effort, which diminishes recognition and understanding. It could also affect the listener's attention levels. According to Cognitive Load Theory (Sweller et al., 1998), when learning a new skill or trying to complete a task, information is activated in the working memory and multiple cognitive resources are required for processing the information. As discussed in 2.1.1, if a foreign accent requires extensive processing, it may create a high extraneous cognitive load that may interfere with speech processing (Chandler & Sweller, 1991; Van Engen & Peelle, 2014). For instance, Munro & Derwing (1995b) discovered that L1 English listeners took more time to process Mandarin-accented speech compared to Canadian-accented English. However, the processing cost of French-accented speech has not yet been investigated.

Conversely, it has been shown that adding challenges to the learning experience can be advantageous, as it encourages the learner to engage with the information on a deeper level and with greater focus (Bjork & Bjork, 2011). For instance, Eitel et al. (2014) showed that

presenting participants with a disfluent text resulted in increased mental effort and improved performance on the transfer test compared with the same fluent text. If adding difficulty to a text can improve processing, it might also be relevant for foreign accents. Thus, one of the aims of the study is to investigate whether a foreign accent hinders speech understanding or promotes more extensive cognitive processing. The answer to the question may depend both on the degree of accentedness of the speaker and on the L1 of the listener.

As discussed in section 2.2, our L1 shapes the way we perceive speech and given that speakers of different L1s do not process language using the same strategies, they are likely to react differently when listening to the same stimuli. New L2 phonemes tend to be classified in relation to the L1. According to the perceptual models PAM-L2 (Best et al., 2007) and SLM (Flege, 1995; Flege et al., 2021), when a new phone is markedly different from L1 phones, a new category is more easily established. On the other hand, when it shares acoustic properties with existing L1 phones it is likely to be assimilated to those phones. Segmentation strategies also appear to be language-dependent and require prosodic cues. If listeners apply strategies that do not match what is produced in the speech signal, then they may face difficulties processing speech (Van Engen & Peelle, 2014). This applies both to L1 and L2 listeners. For this reason, sharing the same L1 may be beneficial for intelligibility and comprehensibility.

In section 3.3, we established the fact that French and English differ considerably in terms of their segmental and suprasegmental systems. The acoustic and descriptive analyses of the corpus of French Psychologists (see Chapter 6) also demonstrate that the informants did not distinguish vowel contrasts such as /ʊ/-/uː/, often omitted the glottal fricative and often substituted the dental fricatives. Variations such as these contribute to having a foreign accent. Accentedness can be defined as "a variety of speech that differs markedly and along multiple acoustic-phonetic dimensions from the pronunciation norms in the native talker community" (Bradlow & Bent, 2008, p.707). Yet, accents can vary from the norm in many different ways and this also depends on the speaker. Some L2 speakers may have a noticeable foreign accent, but it may not necessarily have a detrimental impact on intelligibility and comprehensibility. Consequently, we aim to examine how varying the degree of accentedness influences the constructs of intelligibility and comprehensibility.

7.1.2 Research Questions

As far as we are aware, varying the degree of French-accentedness has not yet been explored in previous studies. In addition, little work has been done on L2 English speech in an academic context. When it has, most studies have focused on the speech of international teaching assistants (ITAs), but not researchers themselves (Crowther et al., 2023). The aim of the present experiment is to examine how French-accentedness impacts intelligibility, comprehensibility and cognitive load. In doing so, we wish to answer the following questions.

1. Does intelligibility depend on the listener's L1?

   Intelligibility is facilitated when the listener has the same L1 as the speaker, whereas intelligibility may be reduced when the two speakers do not have the same L1 (Bent & Bradlow, 2003; Smith & Bisazza, 1982). Thus, it is expected that L1 French listeners will perform better at recognising words produced by L1 French speakers than by L1 English speakers, and vice versa for L1 English listeners.

2. Does intelligibility depend on the degree of accentedness of the speaker?

   Although sharing the same L1 has a facilitatory effect, we expect that varying the degree of accentedness will influence performances. The more marked the L2 accent, the more difficult it will be to decode, even for L1 French listeners.

3. What is the cognitive cost of decoding and parsing French-accented speech?

   Concerning the effect of foreign-accentedness on comprehensibility, there are two alternative hypotheses: foreign-accentedness may have a positive effect linked to greater cognitive engagement in the task (Bjork & Bjork, 2011) or a negative effect linked to an increase of extraneous cognitive load (Chandler & Sweller, 1991). Subjective ratings will allow us to assess this effect, which may also depend on the degree of accentedness.

7.2 Method

In order to answer the research questions, we developed a perceptual experiment. Participants were selected on the basis of their L1 and the experimental stimuli was chosen to reflect

three different accent conditions: a marked French accent, an unmarked French accent and a Southern British English (SBE) accent. The study was carefully constructed on Qualtrics (2025) and carried out online.

7.2.1 Participants

Since our study aims to compare how speakers of different L1s perceive speech, we recruited two profiles: 101 L1 English listeners and 61 L1 French listeners, among whom 66 men, 82 women, and 14 participants who chose not to specify their gender.

The L1 French speakers (20 men, 29 women, 12 not given) were required to have a B1 English level minimum, which was self-reported. In order to simulate an academic setting, the participants were Psychology PhD candidates, researchers, lecturers, post-doctoral researchers or clinical psychologists. They were recruited by contacting Psychology Departments across France and sometimes by word of mouth.

Due to difficulty accessing L1 English Psychology experts, the L1 English participants[8] (46 men, 53 women, 2 not given) who took part in the study were not necessarily specialised in Psychology. Instead, they were required to have a minimum of a Master's level of education and were recruited via the Prolific Academic website[9]. This platform allows researchers to specify recruitment conditions and post studies. Those who are interested and fit the requirements are then redirected via a link to the study, in this case to Qualtrics (2025). The researcher can verify whether the participants have successfully completed the study and, if so, can pay them via the platform. As a result, the L1 English listeners were paid for their participation.

In addition to this, both groups of listeners reported having no known hearing problems and were aged between 22 to 63 years. The mean age of participants was 36.4 years old (SD = 11.6). The experimental procedures were approved by the Research Ethics Committee of the University of Toulouse, France (Agreement n°2022-569) and all participants provided informed consent by ticking a box on Qualtrics (2025) before taking part in the study.

[8]The English listeners had a variety of different L1 English nationalities, but the majority came from the UK. Additionally, none of the L1 English participants were English/French bilinguals.

[9]For more information see: https://www.prolific.com/

7.2.2 Materials

As described in 4.3, 13 French Psychology researchers were recorded following the adapted PAC protocol, which aimed to simulate an academic setting. One of the conference presentations and items selected from the two reading tasks were chosen to serve as experimental stimuli. Three Southern British English (SBE) speakers were also recorded reading the word list and the text in order to provide another accent condition. One also read the transcribed extract of the conference presentation.

The items selected from the word list (see table 7.1 below) were chosen to include a variety of phonological considerations. All of the SBE phonemes are present except for /ʒ/ or /j/ and syllable number is varied with 13 monosyllabic words, 15 bisyllabic words, seven trisyllabic words, five words containing four syllables and two words containing five syllables. The majority of the items are nouns.

Table 7.1
Stimuli used in the isolated word recognition task

Household	Alcohol	Single	Tones
Storage	Rhythm	Strengths	Clothes
Peak	Species	Ego	Pitch
Grid	Look	Rural	Therapeutic
Efficacy	Verbal	Urban	Score
Disorder	Autism	Withdrawal	Alpha
Algorithms	Subtle	Vulnerability	Mask
Congruent	Spatial	Mate	Gaze
Height	Suicide	Parietal	Cohort
Nodes	Arousal	Superior	Employ
Software	Multivariate		

The introduction of an academic article by Budson et al. (2002) was transformed into a cloze test by removing a selection of items. Not all of the SBE phonemes are present in the experimental items, however, a balance had to be found between including a wide range of phonemes and ensuring that the missing words were sufficiently spaced out by at least five words. Seven items are monosyllabic, nine are bisyllabic, seven are trisyllabic and five contain four syllables. Again many of the items are nouns but there is a higher proportion

of verbs and adjectives. The missing words of the cloze test are indicated in bold.

1. Increasing attention has been focused on memory distortions in **patients** with various kinds of brain damage.

2. Research in this **area** has contributed to our understanding of normal memory function, memory failure in specific brain diseases and the occurrence of clinically relevant memory **distortions** in certain patient populations.

3. Memory distortions in patients with amnesia and **those** with probable Alzheimer's disease have recently been explored using experimental false recall and **recognition** paradigms.

4. False recognition occurs when people incorrectly claim to have previously **encountered** a novel item that is in some way related to a previously studied item.

5. Researchers have demonstrated **robust** levels of false recognition in **healthy** adults.

6. After **studying** lists of semantic associates (e.g. candy, **sour**, sugar, bitter, good, taste, and so forth) that all converge on a non-presented theme word or related lure (e.g. sweet), participants frequently intruded the related lure on free **recall** tests and made very high levels of false **alarms** to these words on recognition tests.

7. Studies using five study-test **trials** have shown that patients with amnesia made fewer false alarms to related lures than did **control** participants.

8. With repeated study–test trials, control participants **exhibited** increasing levels of true recognition together with decreasing levels of false recognition. Patients with amnesia also demonstrated **increased** true recognition but, in contrast to controls, showed no **evidence** of decreasing false recognition across trials.

9. **Interestingly**, patients with Korsakoff amnesia exhibited increased false recognition across trials, whereas patients with non-Korsakoff amnesia (e.g. those who suffered anoxia, encephalitis or other **types** of damage to their medial temporal structures) showed **fluctuating** levels of false recognition across trials.

10. Results were interpreted on the **basis** of the idea that true and false recognition depend on memory for two different kinds of information: specific details of a **prior** encounter with a particular item (item-specific recollection), and the general **meaning**, idea or gist conveyed by a collection of items.

11. As the items are presented in the association **paradigm**, a gist representation is developed, which may result in an **experience** of recollection or familiarity when either a studied item or a related lure is presented on a later recognition test.

12. Thus, in this paradigm, **accurate** recognition of previously studied items probably depends on **both** item-specific and gist information, whereas false recognition of related lure **words** depends on remembering gist but not item-specific information.

Once the items had been chosen, we reviewed the productions of the 13 French and three English speakers in order to select three versions of each item produced with either a marked French accent, an unmarked French accent or an SBE accent to serve as experimental stimuli. Our categorisation took into consideration the salience of the accent and incorporated the segmental phenomena analysed in Chapter 6. It was not always easy because some items (e.g. *mask*) were produced in a similar way by nearly all of the informants.

In order to verify the initial categorisation of the three accent conditions, a subjective perception pre-test was undertaken. Six L1 English listeners of different nationalities (English, American and Irish) heard the three different stimuli for each item. They could only listen to each stimulus once and were asked to assign one of the three accent categories to each stimulus.

There was a high level of agreement between participants regarding the sentences taken from the text. Only one sentence out of 12 caused disagreement because half of the participants inverted the initial categorisation of the two French accents. The stimulus was therefore changed in order to have more distinct categories of marked and unmarked French accent.

The isolated words caused more disagreement. We decided to change the stimuli when half of the participants disagreed with each other and/or with the initial categorisation. There were nine words out of 42 that were not validated, therefore, the stimuli were modified. In addition to these nine words, the two French accent conditions for the item *look* were inverted because the participants disagreed with the initial categorisation and so the categories were modified but the stimuli did not change. It is interesting to note that five out of the nine words that caused disagreement are monosyllabic (*mask, mate, tones, nodes, pitch*). This is probably due to the fact that it is difficult to judge the degree of foreign-accentedness on the basis of a single syllable. Furthermore, it is interesting to note that a few participants

inverted the unmarked French accent and the SBE accent for three of the nine words: *mask, mate, urban*. Once the modifications were made, the stimuli were incorporated into the perception tests.

Having the three different accent conditions as opposed to just two (SBE and French) can help evaluate the impact that different degrees of foreign-accentedness have on intelligibility. Although foreign-accentedness refers to speech that differs from L1 norms (Bradlow & Bent, 2008), L2 speech can differ to varying degrees, which may affect how easily the listeners can decode and recognise L2 speech. As previously mentioned, no studies have investigated varying the degree of French-accentedness, to our knowledge, yet it merits investigation.

7.2.3 Procedure

The experimental procedure consisted of three tasks followed by a questionnaire to provide information about the participants' education and language use. L1 French participants also answered questions about their level of English. The study took place online via the survey-building software, Qualtrics. The audio files were configured using HTML code and Javascript[10] so that they would only play once. Participants were instructed to perform the tasks in a quiet place and to use wired headphones or earphones.

Firstly, the participants had to recognise 42 isolated words (table 7.1). Since accent was varied as a within-subject variable, each participant had to recognise 14 words with a marked French accent, 14 with an unmarked French accent and 14 with an SBE accent. The accent condition was rotated across the stimuli using a Latin-square design, which meant that participants listened to different combinations of the accent conditions. This was done to avoid a word effect. Additionally, the stimuli were presented in a pseudo-random order to prevent the same speakers appearing sequentially. In order for the participants to familiarise themselves with the task, five practice words were presented at the beginning. Participants listened to each word only once and were instructed to write down the word that they heard. If they were unable to recognise the word, they were instructed to type "X". After listening to each word, a scale appeared on the screen and they were asked to rate their level of certainty

[10]Many thanks to Pierre-Vincent Paubel (CLLE UMR 5263, CNRS and Université Toulouse Jean Jaurès) who provided both the Javascript and HTML scripts used.

from one *Not certain at all* to five *Very certain* (von Hoyer et al., 2022). The Qualtrics survey was also configured to collect the participants' reaction times.

Secondly, participants had to complete a cloze test, which consisted in recognising 28 words in the context of 12 sentences. In each sentence, one or more words were deliberately missing. For this task, accent was altered again as a within-subject variable. Each participant heard the three different accent conditions according to the same rotation procedure as before in order to avoid word and sequential effects. One practice sentence was provided so that the participants could become accustomed to the new task modalities. This time, they were able to read each sentence while they listened to it, but each sentence contained one or more missing word(s). Participants were asked to fill in the missing word(s) by writing down what they heard and to type "X" if they could not identify the missing word(s).

The third and final perception task included speech comprehension and scalar ratings. Participants were asked to listen to a four-minute extract of a conference presentation and to answer six multiple-choice comprehension questions. After listening, participants were also instructed to provide ratings (see below) on nine-point Likert scales inspired by Leppink et al. (2013) and Munro and Derwing (1995a). This time, accent was a between-subject variable, which meant that participants either listened to a French accent or an SBE accent.

Likert Scales

Please choose the category that applies to you:

1. While listening to the extract I invested...

   1 very low mental effort ... 9 very high mental effort

2. The extract I just listened to was...

   1 very easy to understand ... 9 very difficult to understand

3. While listening it was...

   1 very easy to recognise each word spoken ... 9 very difficult to recognise each word spoken

4. The speaker had...

   1 no foreign accent ... 9 a very strong foreign accent

5. Did the accent you just listened to make it easy or difficult to understand?

   1 easy ... 5 no impact ... 9 difficult

Previous studies have made use of multi-item scales to measure comprehensibility with high levels of reliability across items (Crowther et al., 2023). We decided therefore, to use multi-item scales to evaluate comprehensibility and to include scales to measure perceived mental effort and accentedness. The first scale on mental effort indicates whether the accent conditions induce high cognitive load (Leppink et al., 2013). Scales two and three provide different nuances of comprehensibility ratings and on scale four participants provide judgements of accentedness (Munro & Derwing, 1995a). The final scale focuses on judgements of how accentedness affects comprehensibility. Combining these different ratings permits a better overall understanding of how the participants react to the three accent conditions.

At the end of the survey, sociolinguistic metadata (age, gender, L1, languages spoken, etc.) was collected for each participant. L1 French participants also provided information about their level of English.

7.3 Optimising Data for Analysis

Once data had been collected, it needed to be prepared for statistical analysis. The first step involved deciding which answers to accept as correct for the word recognition tasks, then the data had to be organised in such a way that each participant had an average score and rating for each accent condition.

7.3.1 Choice of Accepted Answers

Since the two word recognition tasks required typing an answer, the answers had to be categorised into correct or incorrect responses. We made the decision to accept answers that were spelled incorrectly as correct answers as long as they fulfilled the following criteria:

1. The misspelling was clearly a typo (*alamr* accepted for *alarm*)
2. The misspelling mirrored the pronunciation (*autisum* accepted for *autism*)
3. The answer was a homophone of the target word (*peek* accepted for *peak*)
4. The answer did not resemble other words with different pronunciation (*nods* NOT accepted for *nodes*)

Initially, a third category was created for derivatives since the root word had been correctly recognised but the word recognition was not exact. For example, answering *employing* instead of *employ*. This constituted a grey area in which answers were neither correct nor completely dissimilar from the target. However, it was deemed too complex to incorporate this category into analysis, so derivatives were considered incorrect. All answers that were typed "X" or those that did not fit the criteria described above were, therefore, considered incorrect.

7.3.2 Processing the Raw Data

Several steps were undertaken to prepare the raw data for analysis. A Macro[11] was used in Excel to transform the answers in word form into numbers, with zero representing incorrect answers and one representing correct answers. Using the *psych* and *tidyverse* libraries in Rstudio, word recognition (task 1 and 2) and comprehension accuracy (task 3) scores were then converted into a percentage score and the means and medians were calculated for reaction times and certainty, comprehensibility and accentedness ratings so that each participant's scores, means and medians were recorded in a spreadsheet for each accent condition.

After examining the descriptive statistics using the *Jamovi* software, outliers were removed. We decided to remove outliers if they performed badly on two or more tasks. This was the case for four L1 English participants, who scored less than 20% overall on two out of three tasks. One participant scored zero in the second task and had clearly not been paying

[11]Thank you again to Pierre-Vincent Paubel (CLLE UMR 5263, CNRS and Université Toulouse Jean Jaurès) who created the Macro.

attention to the task. In addition to performing badly, two of the four participants did not correspond to the profile we were looking for since their first language was not actually English.

Although reaction times were collected as a means of evaluating the processing cost of listening to French-accented speech, they were not deemed reliable enough to be exploited for a variety of reasons. Firstly, they were measured in seconds rather than milliseconds, which may not be precise enough to capture differences. Secondly, they were measured from the first click to the last click on the page. Thus, participants may have reflected before actually clicking on the answer box and if this were the case, it would not have been taken into account. In addition, participants completed the perception tests online using different laptops and computers, which may have different latencies. For these reasons, we decided not to proceed with further analysis.

7.4 Summary

This chapter has provided the questions and motivations behind the perceptual study. Namely, the extent to which the L1, accentedness and cognitive load affect intelligibility and comprehensibility. Given that our L1 conditions the way we decode language, we believe that it strongly influences recognition and understanding. We also think that varying the degree of accentedness of the speech stimuli may impact the participants' performances since accentedness could increase cognitive load or raise the attention levels of the participants.

We have also outlined the procedure used for the study, which involved L1 French and L1 English participants completing three perception tests and giving scalar ratings of certainty, comprehensibility, cognitive load and accentedness. Finally, we discussed the criteria for accepting correct answers for the intelligibility tests and how data was prepared for subsequent analysis, which we present in the next chapter along with our results and interpretation.

Chapter 8

Is French-accented speech intelligible and comprehensible?

This chapter provides the results of our perceptual experiment comparing L1 French and L1 English listeners' performances when listening to French- and SBE-accented speech. The results shed light on the relationship between accentedness, intelligibility, comprehensibility and cognitive load.

8.1 Experimental Results

The three perception tasks evaluate different levels of intelligibility and comprehensibility. The first two tasks examine recognition at the word level, either isolated words or words in the context of sentences, and the third task focuses on understanding continuous speech. The results are examined below.

8.1.1 Isolated Word Recognition

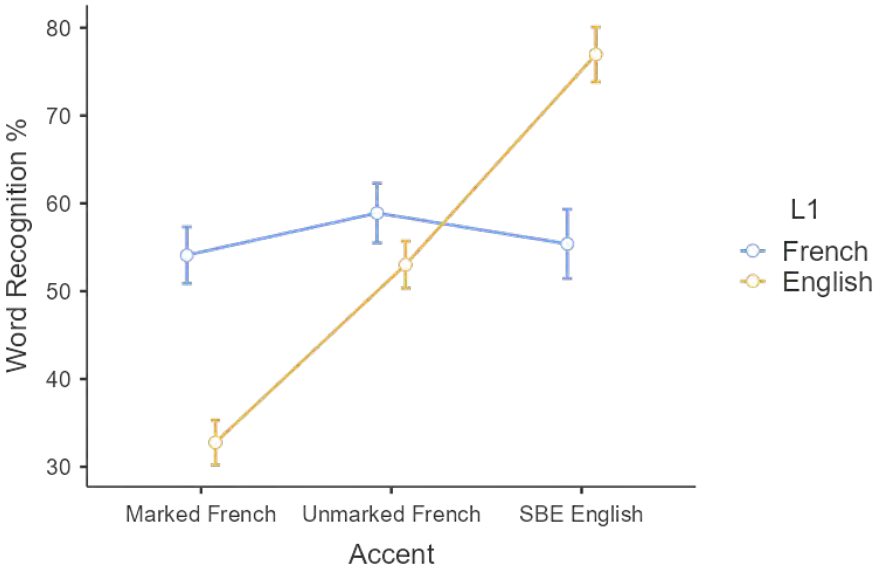
In order to determine the extent to which French-accentedness influences intelligibility and comprehensibility for different listeners, the data was analysed using a factorial ANOVA for mixed design with L1 as a between-subject variable, accent as a within-subject variable and word recognition accuracy as dependent variable. As a reminder, accuracy was measured by calculating the percentage of correctly recognised words.

Analysis showed that L1 did not have a significant main effect on the recognition score, $F(1,156) = 1.48$, $p = .226$, $\eta_p^2 = .009$. However, there was a significant main effect of accent on recognition, $F(2,312) = 112$, $p < .001$, $\eta_p^2 = .442$. A significant interaction between accent and L1 was also observed with a large effect size, $F(2,312) = 112$, $p < .001$, $\eta_p^2 = .419$.

Bonferroni pairwise comparisons showed no significant difference between French ($M = 58.9$, $SD = 14.1$) and English participants ($M = 53$, $SD = 13$) when they listened to an unmarked French accent, $p = .120$. However, French listeners ($M = 54.1$, $SD = 12.5$) recognised more isolated words than English listeners ($M = 32.8$, $SD = 12.9$) when exposed to a marked French accent, $p < .001$. Conversely, when exposed to an SBE accent, the pattern was reversed, $p < .001$, with English listeners ($M = 77$, $SD = 13.3$) recognising more words than French listeners ($M = 55.4$, $SD = 18.6$).

When comparing the effect of accent for each L1, French listeners performed similarly regardless of whether they heard French-accented or SBE-accented speech. In contrast, English listeners' performance varied significantly with accent. They performed poorly when listening to a marked French accent, better with an unmarked French accent and much better when listening to an SBE accent.

Figure 8.1
Mean percentages of isolated word recognition comparing L1 and accent interactions

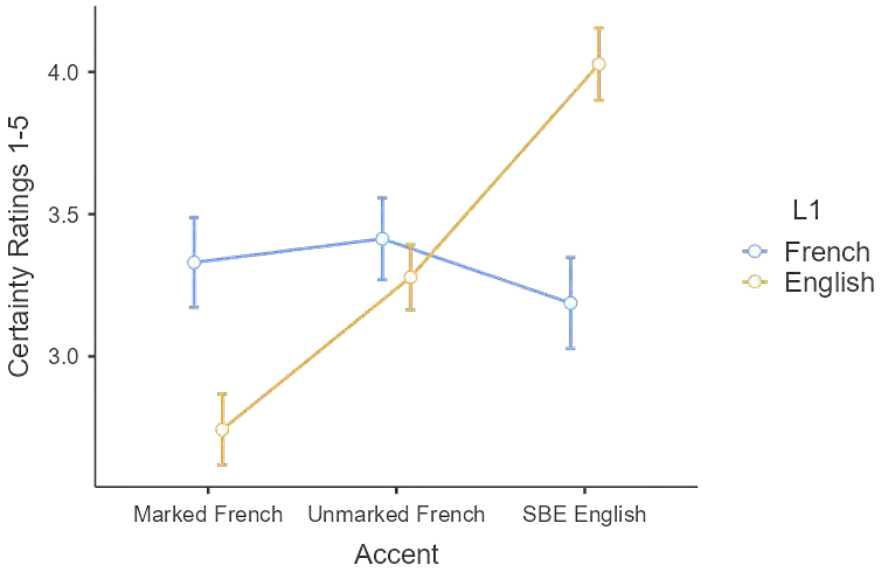


The certainty ratings, on the other hand, offered insight into how confident listeners felt about their responses. A second factorial ANOVA was performed. It should be noted that the analysis was conducted using the mean certainty ratings since they can be considered as an interval variable and used with parametric tests (Norman, 2010; Sullivan & Artino Jr, 2013). While it is true that some advocate using the median to analyse scalar ratings, the mean and median scores were very close and the data was normally distributed. As such, we decided to calculate the ANOVA using the mean rather than the median scores.

The results revealed an identical pattern for certainty ratings and word recognition. That is to say, L1 did not produce a significant main effect on recognition, $F(1,156) = .216$, $p = .645$, $\eta_p^2 = .001$. However, a significant main effect of accent on recognition was observed, $F(2,312) = 78.0$, $p < .001$, $\eta_p^2 = .333$. Accent and L1 also significantly interacted with a large effect size, $F(2, 312) = 127.1$, $p < .001$, $\eta_p^2 = .449$.

Again, Bonferroni pairwise comparisons indicated no significant difference between French ($M = 3.41$, $SD = 0.57$) and English ($M = 3.28$, $SD = 0.56$) participants listening to an unmarked French accent, $p = 1.00$. However, French listeners ($M = 3.33$, $SD = 0.59$) felt more certain of their response than English listeners ($M = 2.74$, $SD = 0.63$) when listening to a marked French accent, $p < .001$. By contrast, English listeners ($M = 4.03$, $SD = 0.54$) were more certain of their answer than French listeners ($M = 3.19$, $SD = 0.75$) when listening to an SBE accent, $p < .001$.

Figure 8.2
Mean certainty ratings on a scale from 1 to 5 comparing L1 and accent interactions



Overall, French listeners showed no significant difference in certainty when listening to a marked and unmarked French accent, however, they were less certain when listening to an SBE accent than an unmarked French accent, $p = .049$. Conversely, the English listeners' certainty varied greatly depending on the degree of accentedness since they gave low ratings after listening to a marked French accent ($M = 2.74$, $SD = 0.63$) and high ratings after listening to an SBE accent ($M = 4.03$, $SD = 0.54$). The results are consistent with those reported for isolated word recognition performance.

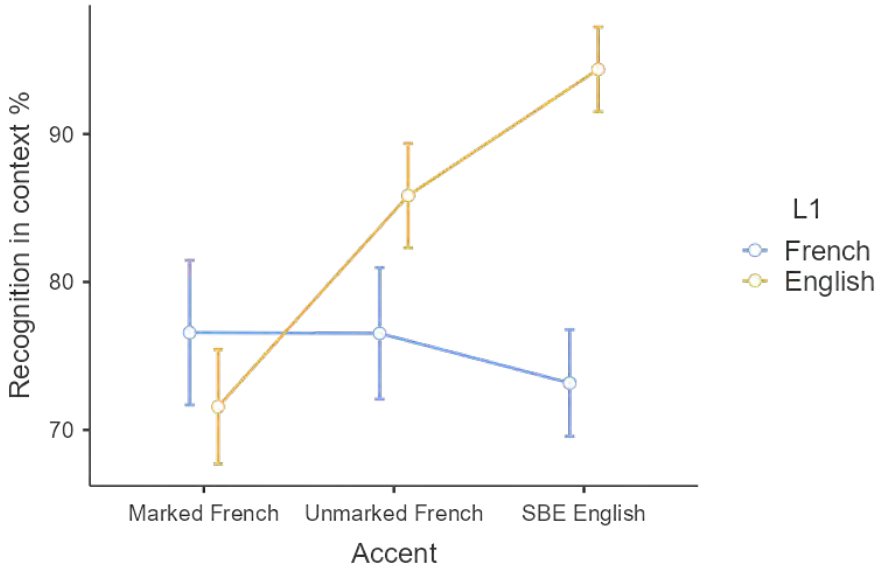
8.1.2 Recognition of Words in Context

The second perception task was analysed following the same criteria. Accuracy was measured by calculating the percentage of correctly recognised words and was implemented in a factorial ANOVA as a dependent variable. L1 was a between-subject variable and accent was a within-subject variable.

L1, $F(1, 156) = 16.8$, $p < .001$, $\eta_p^2 = .097$, and accent, $F(2, 312) = 18.6$, $p < .001$, $\eta_p^2 = .107$, had significant main effects. There was also a significant interaction between accent and L1 on word recognition in context, $F(2, 312) = 31.8$, $p < .001$, $\eta_p^2 = .169$. Bonferroni

pairwise comparisons revealed no significant difference between French (M = 76.6, SD = 16.2) and English participants (M = 71.6, SD = 21.0) when listening to a marked French accent, p = 1.00. By contrast, English listeners (M = 85.8, SD = 13.3) recognised more words than French listeners (M = 76.5, SD = 22.8) when listening to both an unmarked French accent, p = .022 and an SBE accent (M = 94.4, SD = 9.6 vs M = 73.2, SD = 19.5), p <.001.

Figure 8.3
Mean percentages of recognition for words in context comparing L1 and accent interactions



Overall, word recognition performance improved thanks to the context, with average scores exceeding 70%. This improvement appears to minimise performance differences between French and English listeners when hearing French-accented speech as English listeners do not perform as poorly when listening to a marked French accent. That being said, the effect of varying the accent on each L1 followed a pattern similar to that observed in the isolated word recognition task. French listeners' recognition performance remained relatively consistent across accents. In contrast, English listeners still performed significantly worse when listening to a marked French accent (p < .001), significantly better with an unmarked accent and significantly better still with an SBE accent (p < .001).

8.1.3 Speech Comprehension and Comprehensibility

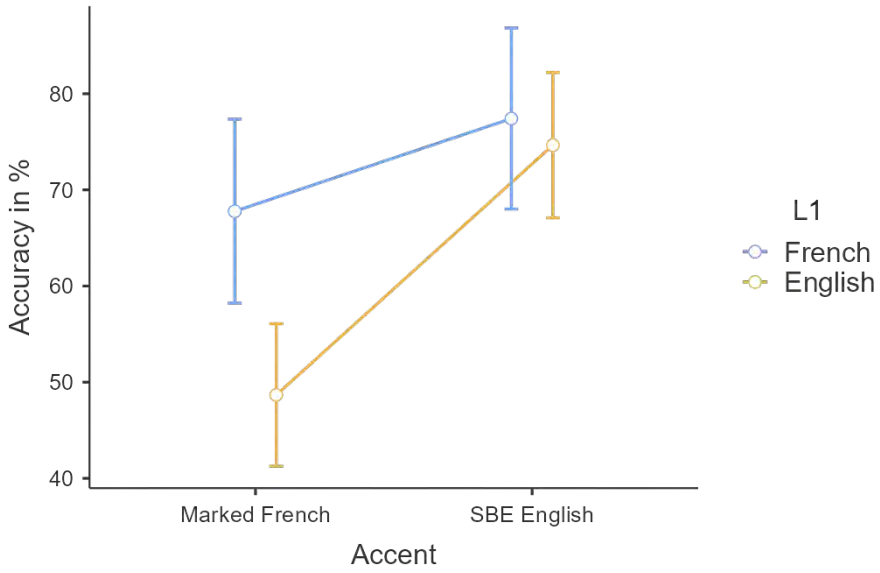
The third perception task involved both accuracy measures and subjective ratings. In order to measure comprehension accuracy, the number of correct answers to the multiple-choice questions was calculated. The scores were then converted into percentages. A factorial ANOVA with independent measures was then conducted with L1 as a between-subject variable and just two accent conditions as a between-subject variable, either a French or an SBE accent.

Firstly, analysis revealed a significant main effect of L1, $F(1, 155) = 6.39$, $p = .012$, $\eta_p^2 = .040$. It is interesting to note that French listeners performed better than English listeners overall in terms of comprehension accuracy. This may be due to the fact that the French listeners were all doctoral students and researchers in Psychology, whereas the English listeners were not specialised in Psychology. As a result, they may have been unfamiliar with the subject matter addressed in the conference excerpt.

Secondly, a significant main effect of accent was also identified $F(1, 155) = 16.9$, $p < .001$, $\eta_p^2 = .099$ indicating that performances were better when listening to SBE-accented speech as opposed to French-accented speech.

Finally, the interaction between L1 and accent was marginally significant, $F(1, 155) = 3.57$, $p = .061$, $\eta_p^2 = .022$. Once again, the French listeners' performances did not vary significantly depending on the accent, whereas the performances of the English listeners did. Their speech comprehension accuracy was significantly better when listening to an SBE accent compared with French-accented speech, $p < .001$.

Figure 8.4
Mean percentages of correct answers for the speech comprehension task comparing L1 and accent



The scalar ratings associated with the speech comprehension task were analysed one by one as each rating dealt with a different nuance. Participants had to give judgements on a nine-point scale inspired by Leppink et al. (2013) and Munro and Derwing (1995a). The table below displays the mean accuracy and ratings for the speech comprehension task.

Table 8.1 *Mean accuracy scores in percentages and mean scalar ratings from 1 to 9*

L1	Accent	Accuracy	Mental Effort	Ease of Understanding	Recognition Ease	Accentedness	Accent Impact
French	Marked French	67.8	6.93	6.83	6.73	7.90	6.90
	SBE English	77.4	6.03	4.48	3.77	3.74	3.06
English	Marked French	48.7	7.18	7.82	7.78	8.28	8.32
	SBE English	74.7	6.46	3.88	2.38	1.54	1.81

The participants first provided ratings on how much mental effort they invested in the task. No main effect of L1, $F(1, 155) = 1.20$, $p = .274$, $\eta_p^2 = .008$, or of interaction between L1 and accent was found $F(1, 155) = .085$, $p = .770$, $\eta_p^2 = .001$. However, there was a significant main effect of accent, $F(1, 155) = 7.02$, $p = .009$, $\eta_p^2 = .043$. French and English listeners

both reported investing a higher level of mental effort if they had listened to French-accented speech.

Participants then gave ease of understanding ratings. No main effect of L1 was identified, $F(1, 155) = .386$, $p = .535$, $\eta_p^2 = .002$. However, there was a significant effect of accent, $F(1, 155)$, $p < .001$, $\eta_p^2 = .409$ and a significant interaction effect between L1 and accent $F(1, 155)$, $p = .010$, $\eta_p^2 = .043$. Although interaction reached significance, pairwise comparisons showed that both French and English listeners judged French-accented speech more difficult to understand than SBE-accented speech, $p < .001$.

Participants were then asked how easy it was to recognise individual words. No main effect of L1 was observed, $F(1, 144) = .344$, $p = .558$, $\eta_p^2 = .002$. However, there was a significant effect of accent, $F(1, 144) = 197.5$, $p < .001$, $\eta_p^2 = .578$, and a significant interaction effect between L1 and accent, $F(1, 144) = 16.85$, $p < .001$, $\eta_p^2 = .105$. Despite the interaction effect, pairwise comparisons indicated that both groups of listeners reported having more difficulty recognising individual words if they had listened to French-accented speech, $p < .001$. Nevertheless, a significant difference was also found between French listeners and English listeners when they heard an SBE accent, $p = .009$, indicating that French listeners judge it more challenging to decode an SBE accent than English listeners.

The fourth scale required participants to rate the degree of accentedness of the speaker on a nine-point scale going from no foreign accent to strong foreign accent. There was a significant main effect of L1,$F(1, 155) = 10.1$, $p = .002$, $\eta_p^2 = .061$, a significant main effect of accent, $F(1, 155) = 362.8$, $p < .001$, $\eta_p^2 = .701$, and a significant interaction effect between L1 and accent, $F(1, 155)$, $p < .001$, $\eta_p^2 = .116$. As one might expect, English listeners judged French-accented speech as foreign-accented and SBE-accented speech as not foreign-accented, $p < .001$. This was also the case for many of the French listeners. However, their responses were less consistent when they heard SBE-accented speech. As a result, SBE-accented speech received higher ratings on the scale of foreign-accentedness from French listeners with a lot more variability.

Finally, the fifth scale examined the impact the accent had on ease of understanding. No main effect of L1 was observed, $F(1, 155) = .119$, $p = .265$, $\eta_p^2 = .001$. There was, however, a significant main effect of accent, $F(1, 155) = 449.31$, $p < .001$, $\eta_p^2 = .744$, as well as a

significant interaction effect between L1 and accent, $F(1, 155) = 30$, $p < .001$, $\eta_p^2 = .162$. Pairwise comparisons showed that French listeners found French-accented speech made it easier to understand than it did for English listeners, $p < .001$ and English listeners found SBE-accented speech made it easier to understand than it did for French listeners, $p = .002$, which explains the interaction effect. Overall though, French-accented speech was judged to make it more difficult to understand by both French and English listeners, $p < .001$.

8.2 Discussion

The results from the perception tests highlight several notable patterns. In particular, both the listeners' L1 and the speakers' accent play a role in determining the extent to which speech is intelligible and comprehensible. These factors interact to shape listeners' ability to process spoken language, suggesting that familiarity with an accent or shared linguistic background can facilitate understanding, whereas varying the degree of accentedness can demand higher processing costs.

8.2.1 What impact does L1 have on intelligibility?

We hypothesised that sharing the same L1 would facilitate intelligibility. In other words, French learners would perform better when listening to French-accented speech and English listeners would perform better when listening to SBE-accented speech. However, this was only partially true. English listeners did indeed follow this pattern, but French listeners did not. In fact, they did not perform significantly differently when varying the accent conditions in the two word recognition tasks and actually performed better when listening to SBE-accented speech in the comprehension task, although the difference did not reach statistical significance.

The benefit of sharing the same L1 observed in the English listeners is likely due to the way in which speakers of different L1s process language. As discussed in section 2.2, English and French listeners use different segmentation strategies. English listeners appear to segment speech at stressed syllables (Cutler et al., 1986; Cutler & Norris, 1988), while French listeners make use of each syllable boundary (Mehler et al., 1981). In addition, listeners of

different L1s are likely to categorise phonemes differently, leading to possible misidentification in some cases. For example, French listeners may not distinguish certain English vowel contrasts accurately (Heidlmayr et al., 2021; Iverson & Evans, 2009; Krzonowski et al., 2016), whereas English listeners may expect distinctions even when they are not produced. Mairano et al. (2019) found that acoustic measures of vowel contrasts correlated strongly with L1 judgements of nativelikeness. Listeners tend to process language through the prism of their L1 and, therefore, they may apply inappropriate decoding strategies to different varieties of speech. This may explain why English listeners performed poorly when hearing a marked French accent because it did not follow the expected segmental and suprasegmental patterns.

The findings for French listeners, on the other hand, do not align with studies that have demonstrated that L2 listeners find L2 speakers more intelligible than L1 speakers whether they share the same L1 or not (Bent & Bradlow, 2003; Matsuura, 2007; Smith & Bisazza, 1982). That being said, Bent and Bradlow (2003) found that proficiency played an important role in determining which speakers were perceived as intelligible. High-proficiency L2 speakers were judged the most intelligible even when the L2 listeners did not share the same L1. In addition, L1 speakers were found to be more intelligible than low-proficiency L2 speakers. In our study, having a marked French accent may impact listeners in a similar way by superseding the positive impact of sharing the same L1. Although sharing the same L1 can facilitate intelligibility, research has also shown that listeners often agree about which speakers are more or less intelligible (Munro et al., 2006; Smith & Rafiqzad, 1979; Strori et al., 2020) and this may depend on a variety of factors such as fluency, accentedness, proficiency, speech rate or voice quality.

8.2.2 What role does interphonology play?

Our study also investigated the impact that varying the degree of accentedness has on different listeners. It had relatively little impact on French listeners in the two word recognition tasks since they performed similarly regardless of accent, but they performed better when listening to an SBE accent in the speech comprehension task. However, English listeners were greatly impacted by altering the accent conditions. In all three tasks, their

performance was best with SBE speech and in the two word recognition tasks they performed better when listening to an unmarked French accent than a marked French accent. This indicates that foreign-accentedness has an inhibitory effect on intelligibility for English listeners, which can most likely be attributed to them applying L1 English processing strategies to L2 speech.

Another possible explanation may be attributed to the fact that a marked French accent may contain more high functional load errors, which could explain the difficulties faced by English listeners. As explained in section 3.2.2, functional load refers to the importance of different phonemic contrasts based on their acoustic similarity, whether they have numerous or frequent minimal pairs and whether the minimal pairs belong to the same lexical class. The higher the functional load, the more important the contrast is perceived to be and, therefore, the phonemic distinction should be preserved. Munro and Derwing (2006) showed that Cantonese-accented speech containing high functional load errors received harsher ratings of comprehensibility and accentedness than speech with low-functional load errors. This is probably because it requires the listener to invest more cognitive effort to decode speech.

Examining the incorrect answers to the perception tests allows insight into the link between interphonology and perception. Of course, when participants typed "X", we cannot know what they perceived, only that they were not able to recognise the word. However, when they wrote an incorrect answer, it reveals what they thought they heard. The items in table 8.1 below are examples of instances when a majority of participants misperceived the target word. Interestingly, the majority of the items come from the isolated word recognition task and are monosyllabic. Hearing only one isolated syllable clearly makes it more difficult to deduce the correct word, particularly when it deviates from the norm. That being said, items produced by SBE speakers were also misperceived.

Table 8.2
Examples of incorrect answers to the two word recognition tasks

Target Item	Marked French	Unmarked French	SBE
Pitch	Peach	Bitch/beach	
Gaze	Guess	Case/keys/kiss	
Score	Scar		
Grid	Greed	Quit/Great	Great
Mate	Met	Maid/made	
Peak	Thick	Pick	
Rhythm	Reason	Reason/risen	
Height		Hate	
Alcohol	Parkour		
Clothes	Closes		
Household		Household/assault	
Strengths	Stress		
Subtle	Certain		
Nodes	Notes	Notes	Nose
Withdrawal	Withdraw	Withdraw	
Tones	Tons/dance	Tons	Turns
Recall	Record	Record	
Accurate	Incorrect		

Some of the misperceptions echo the findings of the acoustic and descriptive analyses. For example, the /ɪ/-/iː/ contrast was misperceived several times (*pitch, grid, peak, rhythm*) and the voiced dental fricative was substituted with [z] (*clothes, rhythm*) leading to misperceptions. The consonant cluster in *strengths* was also simplified to [s]. Other misperceptions indicate phenomena such as the monophthongisation of the diphthongs /eɪ/ and /əʊ/ in *gaze, mate and tones*, not aspirating the voiceless plosives in *pitch, tones* or devoicing the voiced plosives in *gaze, nodes*. One of the misperceptions also appears to be due to misplacing stress in *accurate*.

It is clear that French-accentedness does impact intelligibility, particularly in the case of isolated word recognition. However, communication rarely consists of isolated words. In fact, one of the limits of the current study is that although Psychology-themed materials were used to simulate an academic setting, the first task consisted in recognising words with no context and all of the tasks involved listening only to audio materials. In reality, researchers at a

conference would also have access to visual aids, which would facilitate comprehension and alleviate some of the word recognition difficulties. That being said, although recognition and comprehension scores in tasks two and three were relatively high, comprehensibility and cognitive load ratings suggest that successful recognition and understanding sometimes requires considerable mental effort.

8.2.3 Is processing French-accented speech cognitively demanding?

Another aim of the study was to examine how accentedness affects cognitive load and whether processing French-accented speech comes at a cost or not. For this reason, participants provided a variety of subjective ratings. The certainty ratings (von Hoyer et al., 2022) associated with the isolated word recognition task followed a similar pattern to word recognition scores in that varying the degree of accentedness significantly affects English listeners' certainty. Additionally, there was little difference in certainty for French listeners hearing French-accented speech, however, they did feel less certain of their responses after hearing an SBE accent.

After completing the speech comprehension task, participants also provided cognitive load, comprehensibility and accentedness ratings (Leppink et al., 2013; Munro & Derwing, 1995a). Both French and English listeners reported investing more mental effort if they had heard the conference extract produced with a French accent. In terms of comprehensibility, both French and English listeners judged it more difficult to understand and to recognise individual words if they had heard French-accented speech. Interestingly, when asked if the accent they had listened to made it easy or difficult to understand, French listeners rated French-accented speech more positively than English listeners did and vice versa. Despite this, French-accented speech was still deemed more difficult overall. Finally, regarding foreign-accentedness ratings, the French accent condition was judged as strongly foreign-accented whereas the SBE accent condition was judged as not foreign-accented, which is unsurprising.

The results suggest that processing French-accented speech does indeed come at a cost for English listeners, whereas French listeners' responses vary depending on the task. For English listeners, a marked French accent appears to represent a high extraneous cognitive

load that degrades recognition and comprehension performances. Since extraneous cognitive load refers to the way information is presented (Sweller et al., 1998), a marked French accent may add additional difficulty to the task of decoding and understanding speech by diverging from the norm in sometimes unexpected ways.

Speech processing involves interactions between the working memory, which stores the information while it is being processed, and the long-term memory, which stores semantic and syntactic knowledge necessary for comprehension. The working memory has a limited capacity, which can become overwhelmed when the cognitive resources required to fulfil a task are too demanding (Baddeley & Hitch, 1994). If the listener is having difficulties decoding speech, associating the incoming speech signal with knowledge stored in the long-term memory also becomes more difficult and may require extensively navigating between the two systems.

Increasing listening effort has been shown to hamper speech perception (Van Engen & Peelle, 2014). Listeners tend to rely more heavily on prior knowledge and lean towards lexically-driven interpretations even when the acoustic signal indicates the contrary (Chiu et al., 2019). In the case of foreign-accentedness, processing times tend to be longer for L2 speech compared with L1 speech (Munro & Derwing, 1995b) indicating that an unfamiliar accent induces a high extraneous cognitive load.

Our study used subjective ratings to measure the impact of cognitive load, however, it would be beneficial to compare this with objective measures. We decided not to proceed with analysis of the reaction time data due to possible differences with the computer latencies of the participants, but it would be useful to do this in more controlled settings. In addition, methods such as eye-tracking may provide fruitful insights into the processing costs of speech perception (Colby & McMurray, 2021).

8.2.4 The Role of Context, Word Frequency and Familiarity

Although not part of our hypotheses, it is clear that context, word frequency and familiarity play a role in facilitating intelligible and comprehensible communication. Context allows listeners to use their semantic and syntactic knowledge, word frequency can facilitate or

inhibit word retrieval and familiarity with different accents, words, topics and situations can be highly beneficial in a range of communicative contexts.

Word frequency can significantly influence word recognition (Goldinger et al., 1989; Luce & Pisoni, 1998). In lexical decision tasks, high frequency words are generally categorised faster and with greater precision. For example, Bradlow and Pisoni (1999) created lists of easy and hard words based on frequency, familiarity and neighbourhood density. The authors found that intelligibility scores were higher for easy words compared with hard words. This could explain the relatively low isolated word recognition scores in our study. Since the items came from Xodabande and Xodabande's (2020) Psychology word list, which includes the most frequently used terms in Psychology publications, they do not occur as often in casual conversation. This may have prompted listeners to activate more common words in their mental lexicon while hindering the retrieval of less common words.

Another factor that can facilitate recognition and comprehension is the context. Contextual cues can speed up word retrieval and allow listeners to make use of top-down decoding strategies to compensate for unexpected or unfamiliar acoustic cues. In the second word recognition task, contextual information greatly facilitated recognition for both French and English listeners irrespective of the different accent conditions. The lowest mean performance scores for isolated words were 32.8% (English listeners) and 54.1% (French listeners), but increased to 71.6% (English listeners) and 73.2% (French listeners) and for words in context. This indicates that recognising and understanding speech successfully requires contextual cues.

Being familiar with a particular accent also aids recognition and comprehension (Derwing & Munro, 1997; Gass & Varonis, 1984; Bradlow et al., 1999). This might explain why the French listeners were not heavily impacted by varying the degree of accentedness since they are familiar with both French- and SBE-accented English. They would undoubtedly be accustomed to English spoken with a French accent, having heard it first at school and later in many workplace environments. Additionally, they would likely be acquainted with an SBE accent since it is frequently used as a pronunciation model in educational institutions across France (Amand & Moore-Mauroux, 2023). The English listeners, on the other hand, may not have been familiar enough with French-accented speech since they work and reside

in English-speaking countries. Familiarising oneself with different accents can be achieved through training though. Bradlow and Bent (2008) showed that English listeners were able to adapt to Chinese-accented speech over a short period of time. Bradlow et al. (2023) also showed that listeners do not need to be exposed to high levels of variability to improve as "single-talker/low-variability training with L2 speech recognition can be sufficient for cross-talker/cross-accent generalization" (p.1609). This further supports the idea that familiarity can facilitate intelligibility and comprehensibility. One possible bias, however, is that the listeners may have associated voices with accents across the three tasks. If a participant recognises a voice that they consider difficult, they may engage higher levels of concentration. We attempted to mitigate this possible effect by selecting items from the range of 13 French speakers.

Familiarity with the topic has also been proven to facilitate understanding. In fact, Gass and Varonis (1984) found it to be the most beneficial variable for understanding foreign-accented speech. The fact that the French listeners performed better than the English listeners in the speech comprehension task reinforces this idea. All of the French participants in our study were Psychology experts, whereas the English participants were not. Expertise has a considerable impact on the way information is processed as experts can overcome difficulties by engaging in compensatory processing (McNamara et al., 2002). Thus, having knowledge of the topic is clearly beneficial, although further research comparing experts and novices would be necessary to confirm this also applies to French-accented speech.

8.3 Summary

Results from the three perception tests along with scalar ratings show that both the speaker's accent and the listener's L1 influence the extent to which an utterance is intelligible and comprehensible. While sharing the same L1 can facilitate intelligibility and comprehensibility, this appears to have a stronger effect on the English listeners who were hearing their L1, whereas the French listeners' performances were similar regardless of accent. Varying the degree of accentedness also appears to inhibit intelligibility and comprehensibility more for the English listeners than the French listeners, although this may also be due to the fact that

the French listeners are familiar with the accents presented to them. The ratings of certainty, comprehensibility and perceived cognitive load indicate that listening to a marked French accent makes it more difficult to decode and understand speech, which in turn suggests that a marked foreign accent represents a high extraneous cognitive load rather than a desirable difficulty (Bjork, 1994; Bjork & Bjork, 2011).

Other factors such as word frequency, context and familiarity can also have beneficial or detrimental effects on intelligibility and comprehensibility. Since high frequency words are retrieved more quickly and accurately than low frequency words and the items in our study were Psychology terms, it may explain why the isolated word recognition task was so difficult. In addition, asking participants to recognise words in the context of sentences helped performance accuracy to increase substantially across accent conditions. Finally, familiarity with both French- and SBE-accented speech may explain why the French listeners did not perform significantly differently regardless of the accent they heard, while familiarity with the topic may explain why they were able to perform better than English listeners when listening to the conference extract as the French listeners were all Psychology experts.

Conclusion

By combining acoustic and descriptive analyses with accuracy scores and perceptual ratings, this dissertation has endeavoured to shed light on some of the intricate workings of intelligibility and comprehensibility and provide descriptions of French-accented speech. Our interdisciplinary approach has brought together methods typically used in corpus phonology and cognitive psychology to examine these issues, which can impact French Psychology researchers when communicating on an international stage. This reflexive approach was initially motivated by years of experience as an EFL teacher in France and then further developed as a member of an interdisciplinary research laboratory focused on Linguistics and Psychology. Participating in the *PICL!* project[12] alongside this dissertation also provided fruitful insights from an interphonological and cognitive perspective.

Main Contributions

This research has led to several contributions which have implications not only for the fields of L2 speech perception, production and acquisition, but also practical applications for pronunciation teaching as it can inform pedagogical practice.

Firstly, the Corpus of L2 Academic Psychology English contributes to the description of the French interphonological system, more specifically the production of monophthong vowels and the consonants /h/, /θ/ and /ð/. The interspeaker and intraspeaker variation observed in the corpus reflects typical patterns found in L2 speech, as L2 learners acquire phonological features in diverse ways. Given this variability, the goal is not to generalise findings to all French speakers of English but rather to identify and highlight recurring patterns and trends within our dataset.

[12] As discussed in 3.1.2, this project examined the impact of embodied phonology sessions on pronunciation performance and self-efficacy beliefs for Secondary School pupils.

The descriptive analyses revealed that the glottal fricative is subject to notable variation. When comparing productions, we found that half of the speakers in our corpus omitted it more frequently than they produced it. This confirms the idea that the glottal fricative is difficult to acquire and produce for French speakers. As such, it may merit attention in the classroom if it appears to impede understanding for listeners, as it is produced relatively infrequently.

The dental fricatives are also challenging to produce and as a result can be substituted with other phonemes. What is more interesting is that the realisations observed in our corpus seem to be very sensitive to the phonological environment in which they appear. That is to say that the dental plosives are more frequent substitutes at the onset, the targets are more popular intervocalically and the labiodental fricatives are more frequent in the coda position. Importantly though, the targets were the most frequent realisations overall. These findings suggest that dental fricative production is heavily influenced by phonotactic constraints and coarticulation. From a perceptual perspective, the dental fricatives do not have a high functional load but they are very frequent as they appear in many grammatical words, so they may impact intelligibility and comprehensibility.

In order to establish whether the informants distinguish between vowel contrasts acoustic analyses were performed. Pillai scores calculated on the monophthong vowels showed substantial overlap across speakers for the contrasts /ʊ/-/uː/, /ae/-/ɑː/, /ɪ/-/iː/ and /ʌ/-/ɜː/. It is interesting that the first three contrasts here are found on the periphery of the vowel space since Mairano et al. (2023) demonstrated that peripheral vowels correlate with judgements of nativelikeness and comprehensibility. In addition, research has shown that listeners of different L1s appear to have a perceptual bias towards peripheral vowels (Polka & Bohn, 2011). Thus, not distinguishing the contrasts could have implications for listeners, particularly if the contrasts have a high functional load as is the case with /ɪ/-/iː/.

In short, the segmental phenomena under study do appear to be difficult to acquire and produce for French speakers. It is also important to take into account the impact this variation has on intelligibility. Although this dissertation does not proclaim to identify the specific features of French-accentedness that impede intelligibility, the common misperceptions exposed by the perceptual experiment can allow insight into possible difficulties. This of

course has its limitations as it only applies to instances when listeners thought they heard a different word, but can still be illuminating.

The /ɪ/-/iː/ contrast was the subject of a number of misperceptions, as were the dental fricatives, which were simplified to [z] and [s] in consonant clusters (*clothes, rhythm, strengths*). The monophthongisation of the diphthongs /eɪ/ and /əʊ/ also caused several misperceptions and the lack of aspiration or devoicing of plosives did too. Finally, one misperception was due to stress. Interestingly, apart from two items, all of the common misperceptions involved isolated words with segmental errors, many of which were monosyllabic, whereas one of the words in context consisted of lexical stress misplacement. These insights seem to suggest that high functional load contrasts such as /ɪ/-/iː/, which was not always distinct in the productions of the informants, do indeed impact word recognition. This supports previous studies (Munro & Derwing, 2006), which indicate that functional load plays an important role.

The perceptual experiment has also provided a better understanding of how French-accentedness affects intelligibility and comprehensibility. The degree of accentedness impacted English listeners more severely than French listeners. However, in the speech comprehension task both groups performed better and gave more positive ratings when listening to SBE-accented speech indicating that a marked French accent hinders speech processing. We examined several influential factors.

Sharing the same L1 has a facilitatory effect. This was particularly apparent for English listeners presumably because they were listening to their L1. When listeners process the incoming speech signal, they have certain expectations about the input. French-accentedness likely generated a mismatch between the English listeners' expectations and what was actually produced (Van Engen & Peelle, 2014). On the other hand, the French listeners who have access to both the phonological systems of French and English, would have benefitted from their experience with the two systems. This may explain why their performances were similar irrespective of accentedness.

Varying the degree of foreign-accentedness had a detrimental effect on English listeners. Performances and subjective ratings were always the lowest for the marked French accent condition. Thus, a marked French accent appears to create an extraneous cognitive load

rather than a desirable difficulty, which was particularly apparent in the speech comprehension task.

Although not directly tested, it is clear that word frequency, context and familiarity influence speech processing. Isolated word recognition accuracy was relatively low, which may have been due to the infrequent Psychology terminology that was used. Performances were much better for words in context than isolated words. Furthermore, the French listeners' familiarity with both accents (French and SBE) and with the Psychology domain may have facilitated their performances.

These findings have applications for teaching English pronunciation to French learners. As explained in 3.1, it is crucial to establish the goals of learners, which may differ depending on their needs and use of English. In the case of French Psychology researchers, they need to become intelligible speakers of English for international communication. Therefore, English classes for learners such as these can focus on communicative efficacy. While this research is far from providing a set of features that guarantee intelligible and comprehensible speech, it does indicate that accentedness and L1 interact and that functional load, familiarity, context and word frequency play important roles. Thus, highlighting contrasts with high functional loads and familiarising learners with different accents can help foster successful communication.

Limits and Future Prospects

In the future, the research carried out in this dissertation will be explored and extended to other aspects. Since the reading tasks were used for the perceptual experiment, we decided to focus the acoustic and descriptive analyses on these tasks. However, sociolinguistic studies comparing different speech styles have found production differences depending on the style. These studies mainly focus on L1 speech, whereas L2 speakers perhaps display less control over their ability to modulate speech depending on the formality of the task, however this could be confirmed (or not) by analysing the interview data and the conference presentations, which is intended for the future.

Another perspective which merits further investigation is the impact of the phonological environment on L2 productions. The dental fricative substitutions in our corpus were highly sensitive to phonological context and there may be patterns as yet undocumented for other speech sounds. Areas of interest could include vowels in nasal contexts since nasal vowels occur in French but not in English.

Lexical stress or other suprasegmental features also deserve attention in future studies on the intelligibility and comprehensibility of French-accented speech. It is often overlooked in perception studies, which have a tendency to focus on segmental discrimination or categorisation. Expanding on recent work investigating pauses, disfluencies and lexical stress, as well as our own contribution to the *PICL!* project, which explored teaching secondary school learners prosodic cues such as rhythm and lexical stress, might provide insight into the impact of suprasegmental features.

In our perceptual study, there were two participant profiles: English listeners hearing their L1 and French listeners hearing their L2. We now plan to investigate how other L2 listeners react when hearing French-accented speech since at international academic conferences, listeners come from around the world. L1 and accent interacted in our study, but the patterns for other L2 listeners hearing French-accented speech may be different. Additionally, more research should be done on languages other than English to see if the same phenomena arise.

While the findings of the perceptual study also indicated that a marked French accent generated perception difficulties in the three tasks, it is important to remember that the listeners only had access to the audio. At an international Psychology conference, the speakers would give presentations with visual aids, which would certainly alleviate the cost of speech processing. Further research could consider comparing the impact of French-accentedness in an audio-only and in combination with visuals. In addition, the listeners in our study provided subjective ratings of mental effort and comprehensibility, but it would be beneficial to compare the subjective ratings with objective measures such as reaction times or pupillometry.

Overall, the results are in line with the hypothesis that French-accentedness induces extraneous cognitive load and do not support the idea that it could constitute a desirable

difficulty under certain conditions. However, since the English listeners were not experts in the field, they may not have been able to engage in the deep processing that might be required when listening to a marked French accent. Thus, the difficulty in obtaining a sample of expert English speakers meant that this research question could not be fully answered. Additional studies would therefore be needed to provide a clearer answer to the question. Further research could, for example, compare the intelligibility and comprehensibility of French accented speech in L1 English speakers by varying both the degree of accent and expertise in the field of psychology. Comparing experts and novices would help to explore how expertise interacts with speech perception.

There are many avenues through which to continue extending our knowledge of French-accented speech as well as universal elements that constitute intelligible and comprehensible speech. One thing is clear, while French-accented speech can hinder speech processing, it is not necessarily an impediment to intelligibility and comprehensibility.

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APPENDICES

Appendix A

Extended Summary in French

L'anglais étant utilisé comme lingua franca dans le monde entier (Crystal, 2003), il existe de nombreux contextes dans lesquels il est essentiel d'être perçu comme un locuteur intelligible et compréhensible. Le monde académique constitue l'un de ces contextes (Altbach, 2013). Les chercheurs doivent non seulement partager leurs connaissances avec la communauté internationale, mais aussi être reconnus comme compétents et professionnels. Or, parler l'anglais – comme toute autre langue – suppose l'acquisition d'un nouveau système phonologique. Malgré de nombreuses années d'apprentissage, les locuteurs d'une deuxième langue (L2) atteignent rarement les normes de la prononciation native, les deux modèles les plus enseignés étant la Received Pronunciation (RP) et la General American (GA). La majorité des apprenants conservent donc un accent étranger, ce qui n'est pas problématique en soi, sauf lorsque cet accent nuit à l'intelligibilité et à la compréhension.

La légitimité des normes natives a d'ailleurs été remise en question. Des études montrent que la capacité à acquérir une prononciation proche de celle des natifs diminue avec l'âge, rendant cet objectif difficilement atteignable (Flege et al., 1995; Hakuta et al., 2003). De plus, dans un contexte où la majorité des utilisateurs de l'anglais sont désormais des locuteurs de L2, cet objectif peut sembler superflu pour des apprenants dont l'objectif principal est de se faire comprendre (Morley, 1991; Jenkins, 2000). Ainsi, la recherche s'est progressivement tournée vers l'identification des facteurs qui rendent la parole intelligible et compréhensible, plutôt que vers la quête d'une prononciation native (Jenkins, 2000; Levis, 2005, 2022; Munro & Derwing, 2015).

Une difficulté majeure pour les enseignants et chercheurs en anglais réside dans l'identification des variantes phonologiques susceptibles de compromettre l'intelligibilité et la compréhension. Cette thèse s'inscrit dans cette problématique et trouve sa motivation dans une double expérience : l'enseignement de l'anglais en France et le travail de recherche mené au sein du laboratoire CLLE. Ces deux perspectives ont permis de constater directement les difficultés rencontrées par les chercheurs français lorsqu'ils doivent communiquer en anglais. Au-delà de la simple transmission du savoir, émergent des enjeux liés à l'identité, au professionnalisme et à la perception des accents étrangers, alors même que l'objectif fondamental demeure la compréhension mutuelle.

Les causes des ruptures de communication sont multiples. Elles peuvent être liées à des difficultés de production et de perception (Cutler et al., 1986; Derwing & Munro, 1997; Jenkins, 2000), mais aussi à des facteurs environnementaux ou attitudinaux susceptibles d'influencer l'efficacité de la communication (Chiu & Neel, 2020; Munro, 1998; Pélissier & Ferragne, 2022). La première langue (L1) des interlocuteurs joue également un rôle déterminant : partager la même L1 ou être familier avec l'accent de la L2 facilite grandement la communication (Bent & Bradlow, 2003; Gass & Varonis, 1984; Matsuura, 2007; Smith & Bisazza, 1982). Le rôle de l'accent étranger – défini comme une prononciation nettement distincte des normes de la L1 (Bradlow & Bent, 2008) – reste cependant mal compris. C'est pourquoi la relation entre l'accent et la L1 mérite d'être étudiée. Il est possible que des énoncés intelligibles mobilisent néanmoins un effort cognitif considérable (Sweller et al., 1998), par exemple en allongeant les temps de traitement (Munro & Derwing, 1995b) ou en influençant les jugements de véracité (Lev-Ari & Keysar, 2010). Cet effort peut aussi, paradoxalement, renforcer l'attention des auditeurs et ainsi favoriser la compréhension (Bjork & Bjork, 2011). Les ressources cognitives requises pourraient varier selon le degré d'accent.

En ce qui concerne l'accent français en anglais L2, de nombreuses difficultés de prononciation ont été relevées (Capliez, 2011; Kenworthy, 1987; Mees & Collins, 2013; Rouaud et al., 2022), sans que l'on sache précisément lesquelles compromettent la communication. C'est pourquoi il est important d'étudier ce phénomène. L'enregistrement et l'analyse des productions de chercheurs français en psychologie permet de contribuer à la description du système

interphonologique français. Or, peu d'études se sont focalisées exclusivement sur l'intelligibilité des locuteurs français en anglais. L'objectif de la présente thèse est donc d'explorer les liens entre accent français, intelligibilité, compréhension et charge cognitive dans un contexte de communication scientifique, en combinant analyses acoustiques et tests perceptifs.

La thèse est organisée en trois parties. Dans la première, nous examinons le cadre théorique, dans la deuxième partie nous décrivons le corpus de psychologues français et dans la troisième partie, nous présentons l'expérience qui a été menée pour évaluer l'intelligibilité et la compréhensibilité des chercheurs français lorsqu'ils s'expriment en anglais L2.

Partie I

Chapitre 1

Les chercheurs français qui utilisent l'anglais dans un contexte académique sont confrontés à de nombreux défis. Ils doivent traiter des sujets complexes dans leur deuxième langue et non seulement être perçus comme compétents et professionnels, mais aussi être compris. Il est donc essentiel de trouver un équilibre entre l'amélioration de la prononciation et la reconnaissance des limites d'une prononciation de type natif. Cet équilibre peut être atteint en faisant de l'intelligibilité et de la compréhensibilité des objectifs prioritaires.

Dans ce chapitre, nous examinons les définitions de l'intelligibilité et de la compréhensibilité dans la littérature. Bien que ces notions fassent l'objet de nombreuses définitions, certaines convergences se dégagent. Nous nous appuyons notamment sur les travaux de Derwing et Munro (1995b; 2015), qui offrent des outils de mesure concrets. L'intelligibilité se définit comme le degré de compréhension réelle d'un énoncé, évalué à travers la performance des auditeurs lors de tests de reconnaissance. En revanche, la compréhensibilité renvoie à la perception subjective de la difficulté de compréhension d'un énoncé, mesurée à travers les jugements des auditeurs (Munro & Derwing, 1995b).

Les résultats des recherches antérieures sur l'intelligibilité et la compréhensibilité révèlent certaines tendances notables. Il est intéressant de noter que les locuteurs de L1 ne sont pas toujours les plus intelligibles pour les auditeurs de L2, tandis que les locuteurs de L2 partageant la même langue maternelle se comprennent souvent mieux entre eux. Toutefois, les auditeurs, quelle que soit leur L1, s'accordent généralement sur les locuteurs les plus intelligibles. Cette tendance suggère que des facteurs tels que la maîtrise de la langue jouent un rôle déterminant dans l'intelligibilité. Cependant, certains de ces facteurs restent encore à explorer.

Chapitre 2

La production de la parole est souvent ponctuée de lapsus ou altérée par des facteurs

externes tels que le bruit, obligeant ainsi les auditeurs à mobiliser en permanence leurs compétences perceptives pour décoder et comprendre le message. La recherche en perception de la parole permet de mieux comprendre l'impact de la production sur la perception. Elle contribue également à approfondir notre compréhension des différences perceptives entre locuteurs de langues maternelles variées et à expliquer pourquoi certains groupes de locuteurs de L2 produisent certaines variantes de prononciation.

Ce chapitre passe en revue les modèles cognitifs de la perception de la parole, qui décrivent les processus cérébraux impliqués dans le traitement du langage. Les modèles d'activation interactive expliquent notamment comment les auditeurs parviennent à reconnaître les mots malgré des signaux sonores altérés. Bien que leurs approches varient, les modèles de reconnaissance des mots s'accordent sur une interaction entre le traitement ascendant (*bottom-up*) et descendant (*top-down*), avec des degrés d'interaction variables.

Nous abordons également la question de la catégorisation phonologique et de la segmentation du signal sonore. Les recherches montrent que les auditeurs classent efficacement les sons de leur langue maternelle, mais s'appuient davantage sur des indices contextuels lorsque le signal acoustique est dégradé. La segmentation de la parole semble être un phénomène propre à chaque langue, où les indices prosodiques jouent un rôle clé. Ainsi, les voyelles, en raison de leur saillance, et les schémas prosodiques facilitent le décodage de la parole. Ces spécificités linguistiques influencent la manière dont la L1 façonne la perception et la segmentation des sons en L2.

L'aptitude innée des nourrissons à discriminer les contrastes phonologiques diminue au cours de la première année de vie, rendant cette discrimination spécifique à la langue maternelle. Cela explique les difficultés rencontrées par les locuteurs de L2 pour distinguer certains sons. Les modèles PAM-L2 et SLM suggèrent que les contrastes phonémiques absents de la L1 sont catégorisés différemment selon leur degré de similarité avec les sons de la langue maternelle. Les études présentées dans ce chapitre confirment cette hypothèse. En particulier, les recherches sur les auditeurs francophones montrent que les contrastes vocaliques et la fricative glottale de l'anglais L2 représentent des défis importants.

Chapitre 3

S'il est essentiel d'encourager les apprenants d'anglais à viser l'intelligibilité, il convient néanmoins de préciser ce que recouvre précisément cette notion. Cependant, malgré de nombreuses recherches sur le sujet (Jenkins, 2000; Munro & Derwing, 2015; Bradlow & Bent, 2008), il reste difficile de définir précisément ce qui constitue un discours intelligible. Il est probable qu'aucune réponse unique ne puisse être apportée à cette question. Toutefois, l'étude des productions des locuteurs permet de mieux cerner les éléments qui facilitent ou entravent la communication.

Dans ce chapitre, nous présentons les modèles de prononciation privilégiés en France. Nous soutenons que l'existence d'un modèle de référence peut aider les apprenants même si, d'un point de vue sociolinguistique, l'enseignement exclusif de la *Received Pronunciation* et de la *General American* ne reflète pas la diversité linguistique de l'anglais. Les apprenants peuvent plutôt être exposés à différentes variétés d'anglais, notamment à travers des activités de compréhension orale, afin d'enrichir leurs compétences perceptives. En outre, la recherche démontre que l'enseignement de la prononciation est efficace, donc l'expérimentation de nouvelles approches pédagogiques fondées sur la recherche devrait être encouragée.

Les études portant sur l'analyse des erreurs sont également abordées dans ce chapitre. Toutes les erreurs ne nuisent pas à l'intelligibilité et à la compréhensibilité. L'efficacité de la communication dépend notamment de la langue des interlocuteurs et des individus en question. De plus, certaines recherches indiquent que tous les segments phonétiques ne présentent pas le même degré de difficulté en termes d'intelligibilité et de compréhensibilité. Il est donc essentiel de prendre en compte la charge fonctionnelle (*functional load*) des contrastes phonémiques. Par ailleurs, l'usage du mauvais schéma accentuel peut entraver la compréhension chez les auditeurs anglophones.

En raison des différences significatives entre les systèmes phonologiques du français et de l'anglais, les apprenants francophones sont susceptibles de rencontrer des difficultés de production. La littérature indique qu'ils sont susceptibles de produire une grande variété d'erreurs et certains travaux récents suggèrent qu'ils sont fortement influencés par l'orthographe. Toutefois, toutes ces erreurs ne conduisent pas à une perte totale d'intelligibilité,

certaines contribuant seulement à la présence d'un accent étranger.

Partie II

Chapitre 4

Ce chapitre présente le corpus CO-LLAPSE que nous avons élaboré pour cette thèse dans le cadre du programme PAC. Nous abordons également les choix méthodologiques qui doivent être faits lors d'un travail sociolinguistique sur le terrain. Idéalement, les sociolinguistes cherchent à enregistrer les phénomènes de la manière la plus authentique possible, mais cela nécessite un accès privilégié à la communauté linguistique étudiée. C'est pourquoi, lors du recrutement des informateurs, il est utile d'utiliser la technique de « l'ami d'un ami ». Il est également important d'atténuer le paradoxe de l'observateur en mettant les informateurs à l'aise. Cela permet de garantir que les données seront aussi représentatives que possible, tout en reflétant la diversité des communautés de parole et des individus.

Le protocole PAC commun a été adapté pour cette thèse. Nous nous sommes inspirés notamment des sous-corpus sociolinguistique PAC-LVTI, interphonologique IPCE-IPAC et pédagogique PAC-ToE. Bien que les mêmes types de tâches (lecture et interaction) aient été utilisés, le matériel a été modifié pour simuler un environnement universitaire. Nous avons enregistré 13 chercheurs français. Ils devaient effectuer plusieurs tâches et remplir un questionnaire :

- la lecture d'un liste de mots de psychologie
- la lecture de l'introduction d'un article académique
- le partage des vidéos de communications en anglais lors d'un congrès international
- la conversation informelle avec l'enquêteur
- le questionnaire IPCE-IPAC

Les objectifs du protocole sont doubles : d'une part, enregistrer et rapporter les productions en anglais L2 de chercheurs en psychologie français L1 et, d'autre part, utiliser les tâches

de lecture pour fournir des stimuli permettant d'évaluer l'intelligibilité et la compréhensibilité de l'anglais L2 des locuteurs français. C'est pourquoi il convient de noter qu'en plus des 13 chercheurs français, trois locuteurs anglais avec un accent *Southern British English* (SBE) ont été enregistrés en lisant la même liste de mots et le même texte. L'un d'entre eux a également lu la transcription de l'extrait de conférence sélectionnée.

Une description du profil sociolinguistique des informateurs et de leur utilisation de l'anglais est fournie dans ce chapitre, ainsi que leurs pensées et sentiments sur la façon dont ils perçoivent l'utilisation de l'anglais dans le milieu universitaire.

Chapitre 5

Dans ce chapitre, nous discutons de toutes les mesures prises pour préparer les données sur les voyelles et les consonnes en vue de l'analyse, ainsi que des décisions méthodologiques qui ont été prises.

Tout d'abord, les enregistrements ont été transcrits orthographiquement selon la norme britannique en suivant les consignes du programme PAC. Ceci a été fait afin de correspondre à la norme choisie pour la production (SBE). Il est également important de suivre les mêmes conventions car cela rend les données comparables et facilite la transcription de phénomènes tels que les disfluences et les hésitations.

Les voyelles monophtongues et les consonnes /h/, /θ/ et /ð/ ont ensuite été segmentées et annotées manuellement selon la norme (SBE). L'annotation manuelle a été choisie car elle est plus précise que les méthodes automatiques. Une fois cette étape terminée, les valeurs formantiques des voyelles ont été extraites au milieu de leur réalisation afin d'éviter les effets de co-articulation et les réalisations consonantiques ont été extraites, à l'aide de scripts dans *Praat*.

Enfin, les réalisations de voyelles ont été normalisées pour permettre une meilleure comparaison entre les locuteurs. La méthode de Lobanov a été utilisée car elle s'est avérée très efficace pour réduire les différences anatomiques tout en conservant les variations phonémiques et sociolinguistiques.

Chapitre 6

Le français et l'anglais diffèrent considérablement en termes de systèmes phonologiques et articulatoires, ce qui a conduit à la création d'un système interphonologique français qui diffère des normes de l'anglais L1. Ce chapitre vise à décrire certaines caractéristiques du système interphonologique des chercheurs français. Il s'agit de la distinction des contrastes vocaliques monophtongues et de la réalisation des phonèmes consonantiques /h/, /θ/ et /ð/. Les scores de Pillai ont été calculés pour les paires de voyelles afin d'évaluer dans quelle mesure les locuteurs distinguent les contrastes vocaliques en production. Les réalisations consonantiques ont été enregistrées afin de comparer les réalisations cibles avec les substitutions et/ou les omissions. Les résultats sont discutés à la lumière d'observations et d'études antérieures.

Après avoir examiné les réalisations consonantiques de /h/, /θ/ et /ð/, nous avons constaté que la fricative glottale /h/ est produite de façon variable, la moitié des locuteurs l'omettant plus fréquemment qu'ils ne la produisent. Il semble donc qu'il s'agisse d'un phonème difficile à acquérir pour les locuteurs français. Il est également intéressant de noter que les fricatives dentales /θ/ et /ð/ ne sont pas toujours substituées par les fricatives alvéolaires /s/ et /z/. En effet, elles ne sont pas toujours substituées du tout étant donné que les réalisations les plus fréquentes étaient les cibles elles-mêmes. Cependant, les substitutions semblent dépendre de l'environnement phonologique dans une certaine mesure. En début de syllabe, les plosives dentales /t/ et /d/ sont les substituts les plus fréquents, les cibles tendent à être substituées beaucoup moins en position intervocalique et en position de coda, les fricatives labiodentales /f/ et /v/ sont les substituts les plus populaires, à moins que la cible ne se trouve dans un groupe consonantique, auquel cas les fricatives alvéolaires /s/ et /z/ sont plus populaires.

En termes d'intelligibilité, la fricative glottale peut mériter une attention particulière en classe si elle semble entraver l'intelligibilité pour les auditeurs, car elle est produite relativement rarement. Les fricatives dentales n'ont pas une charge fonctionnelle élevée, mais elles apparaissent dans de nombreux mots grammaticaux et peuvent donc être importantes à maintenir. Dans notre corpus, elles sont produites avec une variabilité à la fois entre

les locuteurs et au sein d'un même locuteur, il serait donc utile d'étudier si certaines substitutions ont plus d'impact sur l'intelligibilité que d'autres. Par exemple, les fricatives alvéolaires partagent moins de propriétés acoustiques avec les fricatives dentales et peuvent être plus préjudiciables à l'intelligibilité. D'un autre côté, elles peuvent simplement affecter la perception de l'accent étranger et être relativement faciles à décoder. Des recherches supplémentaires seraient nécessaires pour confirmer quelles substitutions sont préjudiciables à l'intelligibilité et à la compréhension.

En ce qui concerne les voyelles, la mesure des distances acoustiques permet de quantifier la distance entre les catégories de voyelles putatives (Nycz & Hall-Lew, 2014). Cette méthode est traditionnellement utilisée par les sociolinguistes pour déterminer si les changements de voyelles prennent la forme de fusions ou de scissions dans différentes variétés, souvent de la L1. Les variétés de L2 - quant à eux - ont fait l'objet de travaux récents (Mairano et al., 2019, 2023; Mora, 2021). En évaluant les productions des locuteurs de L2 à l'aide de mesures objectives, tels que les scores Pillai, il est possible de voir si de nouvelles catégories phonologiques ont été développées pour différentes catégories de voyelles.

Nous avons calculé les scores Pillai pour les voyelles monophtongues produites par nos locuteurs francophones. Les contrastes /ʊ/- /uː/, /ae/- /ɑː/, /ɪ/ - /iː/ et /ʌ/ - /ɜː/ semblent être difficiles pour les locuteurs français puisque les scores de Pillai ont révélé une quantité significative de chevauchement pour une majorité d'informateurs. Cela dit, les productions varient considérablement d'un locuteur à l'autre et au sein d'un même locuteur. Étant donné que les différents contrastes vocaliques ont des charges fonctionnelles différentes, certains peuvent être plus importants à maintenir que d'autres. Par exemple, /ɪ/ - /iː/ a une charge fonctionnelle élevée et peut avoir un impact plus important sur l'intelligibilité que /ʊ/- /uː/, même si davantage de locuteurs n'ont pas réussi à distinguer ce dernier contraste. En outre, bien que les scores de Pillai se soient révélés être des indicateurs fiables de l'intelligibilité et de la compréhension, les mesures acoustiques et les jugements perceptifs ont tous deux leurs inconvénients. Lorsqu'on utilise des mesures perceptives, il est difficile de savoir sur quoi les auditeurs focalisent et les mesures acoustiques peuvent être considérées moins valables d'un point de vue écologique (Mora, 2021). Cela renforce l'idée que l'utilisation des deux mesures acoustiques en combinaison avec les jugements perceptuels des auditeurs reste la meilleure

solution.

Partie III

Chapitre 7

Lorsque les chercheurs français en psychologie communiquent en anglais lors de conférences internationales, ils doivent transmettre des concepts complexes dans une langue étrangère qu'ils maîtrisent à des degrés divers (lexical, syntaxique, phonologique). Pour que la communication soit réussie, il est essentiel d'être intelligible et compréhensible lors de ces communications académiques. C'est pourquoi nous avons élaboré un protocole expérimental afin d'étudier l'impact de l'accent français sur l'intelligibilité et la compréhensibilité auprès de différents auditeurs.

Ce chapitre présente les questions de recherche et les motivations qui sous-tendent cette étude. À notre connaissance, la variation du degré d'accent français n'a pas encore été explorée dans les travaux antérieurs. De plus, les recherches portant sur le discours en anglais L2 dans un contexte universitaire restent limitées. Lorsqu'elles existent, elles se concentrent principalement sur le discours des assistants d'enseignement internationaux (ITAs), et non sur celui des chercheurs eux-mêmes (Crowther et al., 2023). Cette étude vise ainsi à examiner dans quelle mesure la L1, l'accent et la charge cognitive influencent l'intelligibilité et la compréhensibilité. Étant donné que la langue maternelle façonne le processus de décodage linguistique, nous supposons qu'elle exerce une influence significative sur la reconnaissance et la compréhension. Nous émettons également l'hypothèse que la variation du degré d'accent des stimuli vocaux peut affecter les performances des participants, soit en augmentant la charge cognitive, soit en renforçant leur attention.

Nous décrivons également la procédure utilisée pour l'étude. D'abord, les stimuli sont issus du corpus CO-LLAPSE ainsi que l'enregistrement de trois locuteurs anglophones avec un accent *Southern British English* (SBE). Ils comprennent donc trois conditions d'accent : un accent français marqué, un accent français non marqué et un accent SBE. La catégorisation de ces accents a été préalablement validée par six auditeurs anglophones.

Une fois les stimuli validés, nous avons recruté 162 participants francophones et anglophones qui ont effectué trois tâches de perception en reconnaissance de mots isolés, de mots

insérés dans des phrases, et de compréhension du discours. Nous avons également recueilli des jugements perceptifs de la certitude, de la compréhensibilité, de la charge cognitive et du degré d'accent.

Enfin, ce chapitre examine les critères d'acceptation des réponses correctes dans les tests d'intelligibilité ainsi que les procédures de traitement des données en vue de leur analyse ultérieure.

Chapitre 8

Ce chapitre présente les résultats de l'expérimentation perceptive. Nous avons émis l'hypothèse que le fait de partager la même L1 faciliterait l'intelligibilité. En d'autres termes, les apprenants français obtiendraient de meilleurs résultats lorsqu'ils écouteraient un discours à l'accent français et les auditeurs anglais obtiendraient de meilleurs résultats lorsqu'ils écouteraient un discours à l'accent SBE. Cependant, cela ne s'est avéré que partiellement vrai. Les auditeurs anglais ont effectivement suivi ce modèle, mais pas les auditeurs français. En fait, ils n'ont pas obtenu de résultats significativement différents en variant les conditions d'accent dans les deux tâches de reconnaissance de mots et ont en fait obtenu de meilleurs résultats en écoutant un accent SBE dans la tâche de compréhension, bien que la différence n'ait pas atteint le seuil de signification statistique.

Notre étude a également examiné l'impact de la variation du degré d'accent sur différents auditeurs. L'impact a été relativement faible sur les auditeurs français dans les deux tâches de reconnaissance de mots, puisqu'ils ont obtenu des résultats similaires quel que soit l'accent, mais ils ont obtenu de meilleurs résultats lorsqu'ils ont écouté un accent SBE dans la tâche de compréhension de la parole. En revanche, les auditeurs anglais ont été très impactés par la modification des conditions d'accent. Dans les trois tâches, leurs performances étaient meilleures avec l'accent SBE et dans les deux tâches de reconnaissance de mots, ils ont obtenu de meilleurs résultats en écoutant un accent français non marqué qu'un accent français marqué. Cela indique que l'accent étranger a un effet inhibiteur sur l'intelligibilité pour les auditeurs anglais, ce qui peut très probablement être attribué au fait qu'ils appliquent des stratégies de traitement de l'anglais L1 à la parole L2.

Un autre objectif de l'étude était d'examiner comment l'accent affecte la charge cognitive et si le traitement de la accent français a un coût ou non. C'est pourquoi les participants ont fourni diverses évaluations subjectives. Les jugements de certitude associées à la tâche de reconnaissance de mots isolés ont suivi un schéma similaire à celui des jugements de reconnaissance de mots, en ce sens que la variation du degré d'accent affecte de manière significative la certitude des auditeurs anglais. En outre, il y avait peu de différence de certitude pour les auditeurs français qui entendaient un discours avec un accent français, mais ils se sentaient moins sûrs de leurs réponses après avoir entendu un accent SBE.

Après avoir effectué la tâche de compréhension de la parole, les participants ont également fourni des évaluations de la charge cognitive, de la compréhensibilité et de degré d'accent (Derwing & Munro, 2015; Leppink et al., 2013). Les auditeurs français et anglais ont déclaré avoir investi plus d'efforts mentaux s'ils avaient entendu l'extrait de conférence produit avec un accent français. Concernant la compréhensibilité, les auditeurs français et anglais ont jugé qu'il était plus difficile de comprendre et de reconnaître les mots individuels s'ils avaient entendu un discours avec un accent français. Il est intéressant de noter que lorsqu'on leur a demandé si l'accent qu'ils avaient écouté rendait leur compréhension facile ou difficile, les auditeurs français ont évalué l'accent français plus positivement que les auditeurs anglais, et vice versa. Malgré cela, l'accent français a été jugé plus difficile dans l'ensemble. Enfin, en ce qui concerne les évaluations de l'accent étranger, l'accent français a été jugé comme fortement étranger, tandis que l'accent SBE a été jugé comme non étranger, ce qui n'est pas surprenant.

Tant l'accent du locuteur que la langue maternelle de l'auditeur influencent le degré d'intelligibilité et de compréhension d'un énoncé. Bien que partager la même langue maternelle puisse faciliter ces aspects, cet effet semble être plus marqué chez les auditeurs de L1 que chez ceux de L2. De plus, lorsqu'on varie le degré d'accent, il semble entraver davantage l'intelligibilité et la compréhension pour les auditeurs de L1 que pour ceux de L2, bien que cela puisse également s'expliquer par le fait que les auditeurs français sont familiers avec les deux accents qui leur sont présentés. Les évaluations de certitude, de compréhensibilité et de charge cognitive indiquent que l'écoute d'un accent français fortement marqué rend le décodage et la compréhension plus difficiles. Cela suggère qu'un accent étranger marqué

représente une charge cognitive extrinsèque élevée plutôt qu'une difficulté désirable.

D'autres facteurs, tels que la fréquence des mots, le contexte et la familiarité, peuvent également avoir des effets bénéfiques ou néfastes sur l'intelligibilité et la compréhension. Étant donné que les mots à fréquence élevée sont récupérés plus rapidement et avec plus de précision que les mots à faible fréquence, et que les termes de notre étude étaient issus du domaine de la psychologie, cela pourrait expliquer pourquoi la tâche de reconnaissance de mots isolés était si difficile. Par ailleurs, demander aux participants de reconnaître des mots dans le contexte de phrases a permis d'améliorer considérablement les performances, quelle que soit la condition d'accent. Enfin, la familiarité avec les accents français et SBE pourrait expliquer pourquoi les auditeurs français n'ont pas obtenu de résultats significativement différents selon l'accent entendu, et la familiarité avec le sujet pourrait expliquer pourquoi ils ont mieux performé que les auditeurs anglophones lors de l'écoute de l'extrait de conférence, étant donné que tous les auditeurs français étaient des experts en psychologie.

Conclusion

En combinant des analyses acoustiques et descriptives avec des performances et des jugements perceptifs, cette thèse s'est efforcée de mettre en lumière les liens complexes de l'intelligibilité et de la compréhensibilité et de fournir des descriptions de l'accent français en anglais L2. Notre approche interdisciplinaire a réuni des méthodes typiquement utilisées en phonologie de corpus et en psychologie cognitive pour examiner ces questions, qui peuvent avoir un impact sur les chercheurs en psychologie française lorsqu'ils communiquent à l'international. Cette approche réflexive a été initialement motivée par des années d'expérience en tant qu'enseignant d'anglais langue étrangère en France, puis développée en tant que membre d'un laboratoire de recherche interdisciplinaire axé sur la linguistique et la psychologie. En participant au projet *PICL!* (voir 3.1) parallèlement à cette thèse a également fourni des informations fructueuses d'un point de vue interphonologique et cognitif.

Cette recherche a conduit à plusieurs contributions, qui ont des implications non seulement dans les domaines de la perception, de la production et de l'acquisition de la parole en L2, mais aussi des applications pratiques pour l'enseignement de la prononciation, car elle peut informer la pratique pédagogique.

Premièrement, le corpus des chercheurs en psychologie français contribue à la description du système interphonologique français, plus particulièrement la production des voyelles monophtongues et des consonnes /h/, /θ/ et /ð/. Les variations entre locuteurs et au sein d'un même locuteur observées dans le corpus reflètent les schémas typiques que l'on trouve dans le discours d'une L2, car les apprenants d'une L2 acquièrent les caractéristiques phonologiques de diverses manières. Compte tenu de cette variabilité, l'objectif n'est pas de généraliser les résultats à tous les locuteurs francophones de l'anglais, mais plutôt d'identifier et de mettre en évidence des modèles et des tendances récurrents dans notre ensemble de données.

Les analyses descriptives ont révélé que la fricative glottale est sujette à des variations notables. En comparant les productions, nous avons constaté que la moitié des locuteurs l'omettent plus souvent qu'ils ne la produisent. Cela confirme l'idée que la fricative glottale est difficile à acquérir et à produire pour les francophones. En tant que telle, elle peut mériter

une attention particulière en classe si elle semble gêner la compréhension des auditeurs, étant donné qu'elle est produite relativement rarement.

Les fricatives dentales sont également difficiles à produire et peuvent donc être remplacées par d'autres phonèmes. Ce qui est plus intéressant, c'est que les réalisations observées dans notre corpus semblent être très sensibles à l'environnement phonologique dans lequel elles apparaissent. C'est-à-dire que les plosives dentales sont des substituts plus fréquents à l'attaque, les cibles sont plus populaires en position intervocalique et les fricatives labiodentales sont plus fréquentes en position de coda. Il est toutefois important de noter que les cibles sont les réalisations les plus fréquentes dans l'ensemble. Ces résultats suggèrent que la production de fricatives dentales est fortement influencée par les contraintes phonotactiques et la coarticulation. D'un point de vue perceptif, les fricatives dentales n'ont pas une charge fonctionnelle élevée, mais elles sont très fréquentes car elles apparaissent dans de nombreux mots grammaticaux, et peuvent donc avoir un impact sur l'intelligibilité et la compréhension.

Afin de déterminer si les informateurs font la distinction entre les contrastes vocaliques, des analyses acoustiques ont été réalisées. Les scores de Pillai calculés sur les voyelles monophtongues ont montré un chevauchement substantiel entre les locuteurs pour les contrastes /ʊ/- /uː/, /ae/- /ɑː/, /ɪ/ - /iː/ et /ʌ/ - /ɜː/. Il est intéressant de constater que les trois premiers contrastes se trouvent à la périphérie de l'espace vocalique, car Mairano et al. (2023) a démontré que les voyelles périphériques sont en corrélation avec les jugements de ressemblance avec la langue maternelle et de compréhensibilité. En outre, des recherches ont montré que les auditeurs de différentes L1 semblent avoir un biais perceptuel en faveur des voyelles périphériques (Polka & Bohn, 2011). Le fait de ne pas distinguer les contrastes pourrait donc avoir des conséquences pour les auditeurs, en particulier si les contrastes ont une charge fonctionnelle élevée, comme c'est le cas pour /ɪ/ - /iː/.

En résumé, les phénomènes segmentaux étudiés semblent bien être difficiles à acquérir et à produire pour les locuteurs francophones. Il est également important de prendre en compte l'impact de cette variation sur l'intelligibilité. Bien que cette thèse ne vise pas à identifier les caractéristiques spécifiques de l'accent français qui entravent l'intelligibilité, les erreurs perceptives communes mises en évidence par l'expérience perceptive peuvent donner un aperçu des difficultés possibles. Cette méthode a bien sûr ses limites, car elle ne s'applique

qu'aux cas où les auditeurs ont cru entendre un mot différent, mais elle peut tout de même être éclairante.

Le contraste /ɪ/ - /iː/ a fait l'objet d'un certain nombre de erreurs perceptives, tout comme les fricatives dentales, qui ont été simplifiées en [z], [v] et [s] dans les groupes de consonnes (*clothes, rhythm, strengths*). La monophtongisation des diphtongues /eɪ/ et /əʊ/ a également été à l'origine de plusieurs erreurs de perception, tout comme l'absence d'aspiration ou de dévoisement des plosives. Enfin, une erreur perceptive était due au stress. Il est intéressant de noter qu'à l'exception de deux éléments, toutes les erreurs de perception concernaient des mots isolés avec des erreurs segmentales, dont beaucoup étaient monosyllabiques, alors que l'un des mots en contexte consistait en un mauvais placement de l'accent lexical. Ces observations semblent suggérer que les contrastes à forte charge fonctionnelle tels que /ɪ/ - /iː/, qui n'étaient pas toujours distincts dans les productions des informateurs, ont effectivement un impact sur la reconnaissance des mots.

L'expérience perceptive a également permis de mieux comprendre comment l'accent français affecte l'intelligibilité et la compréhensibilité. Varier le degré d'accent a eu un impact plus important sur les auditeurs anglophones que sur les auditeurs francophones. Cependant, dans la tâche de compréhension de la parole, les deux groupes ont obtenu de meilleurs résultats et ont donné des évaluations plus positives lorsqu'ils ont écouté l'accent SBE, ce qui indique qu'un accent français marqué entrave la perception de la parole. Nous avons examiné plusieurs facteurs qui peuvent avoir une influence.

Le fait de partager la même L1 a un effet facilitateur. Cet effet était particulièrement évident pour les auditeurs anglophones, probablement parce qu'ils écoutaient leur L1. Lorsque les auditeurs traitent le signal acoustique entrant, ils ont certaines attentes concernant l'entrée. L'accent français a probablement entraîné un décalage entre les attentes des auditeurs anglophones et ce qui a été produit (Van Engen & Peelle, 2014). En revanche, les auditeurs français, qui ont accès aux systèmes phonologiques du français et de l'anglais, auraient bénéficié de leur expérience des deux systèmes. Cela pourrait expliquer pourquoi leurs performances étaient similaires, indépendamment de l'accentuation.

La variation du degré d'accent étranger a eu un effet négatif sur les auditeurs anglophones. Les performances et les jugements subjectifs ont toujours été les plus faibles dans la condition

« accent français marqué ». Ainsi, un accent français marqué semble créer une charge cognitive supplémentaire plutôt qu'une difficulté désirable, ce qui était particulièrement évident dans la tâche de compréhension de la parole.

Bien qu'ils n'aient pas été directement testés, la fréquence des mots, le contexte et la familiarité influencent le traitement de la parole. La performance de reconnaissance des mots isolés était relativement faible, ce qui peut être dû à la terminologie peu fréquente utilisée en psychologie. Les performances étaient meilleures pour les mots en contexte que pour les mots isolés. En outre, la familiarité des auditeurs français avec les deux accents (français et SBE) et avec le domaine de la psychologie peut avoir facilité leurs performances.

Ces résultats ont des applications pour l'enseignement de la prononciation de l'anglais aux apprenants français. Bien que cette recherche soit loin de fournir un ensemble de caractéristiques garantissant un discours intelligible et compréhensible, elle indique que l'accent et la L1 interagissent et que la charge fonctionnelle, la familiarité, le contexte et la fréquence des mots jouent un rôle important. Ainsi, la mise en évidence de contrastes à forte charge fonctionnelle et la familiarisation des apprenants avec différents accents peuvent contribuer à une communication réussie. Il est crucial d'établir les objectifs des apprenants, qui peuvent varier en fonction de leurs besoins et de leur utilisation de l'anglais. Dans le cas des chercheurs français en psychologie, ils doivent devenir des locuteurs intelligibles de l'anglais pour communiquer à l'international.

A l'avenir, les recherches menées dans le cadre de cette thèse vont être explorées et étendues à d'autres aspects. Les tâches de lecture ayant été utilisées pour l'expérience perceptive, il a été décidé de concentrer les analyses acoustiques et descriptives sur ces tâches, mais des études sociolinguistiques comparant différents styles de parole ont mis en évidence des différences de production en fonction du style. Ces études se concentrent principalement sur la parole L1, alors que les locuteurs L2 ont peut-être moins de contrôle sur leur capacité à moduler leur discours en fonction de la formalité de la tâche, mais cela pourrait être confirmé (ou non) par l'analyse des données des entretiens et du reste des présentations de la conférence, ce qui est prévu pour l'avenir.

L'impact de l'environnement phonologique sur les productions en L2 est une autre perspective qui mérite d'être étudiée plus en détail. Les substitutions de fricatives dentaires dans

notre corpus étaient très sensibles au contexte phonologique et il pourrait y avoir d'autres phonèmes qui sont sensibles à la variation dans d'autres contextes. Par exemple, les voyelles dans des contextes nasaux puisque les voyelles nasales existent en français mais pas en anglais.

L'accent lexical ou d'autres caractéristiques suprasegmentales méritent également d'être pris en compte dans les futures études sur l'intelligibilité et la compréhensibilité de l'accent français. Ils sont souvent négligés dans les études de perception, qui ont tendance à se concentrer sur la discrimination ou la catégorisation segmentale. L'approfondissement des travaux récents (comme dans le projet *PICL!*) sur les pauses, les disfluences et l'accent lexical pourrait permettre de mieux comprendre l'impact des caractéristiques suprasegmentales.

Dans notre étude perceptive, il y avait deux profils de participants : des auditeurs anglais écoutant leur L1 et des auditeurs français écoutant leur L2. Nous voulons désormais étudier comment d'autres auditeurs L2 réagissent lorsqu'ils entendent un discours avec un accent français, étant donné que lors de conférences universitaires internationales, les auditeurs viennent du monde entier. La L1 et l'accent ont interagi dans notre étude, mais les modèles pour d'autres auditeurs L2 peuvent être différents. Il conviendrait également d'effectuer davantage de recherches sur des langues autres que l'anglais pour voir si les mêmes phénomènes se produisent.

Si les résultats de l'étude perceptive indiquent également qu'un accent français marqué génère des difficultés de perception dans les trois tâches, il est important de rappeler que les auditeurs n'avaient accès qu'à l'audio. Lors d'une conférence internationale de psychologie, les orateurs feraient des présentations avec des supports visuels, ce qui réduirait certainement le coût du traitement de la parole. D'autres recherches pourraient envisager de comparer l'impact de l'accent français dans une présentation audio uniquement et en combinaison avec des supports visuels. En outre, les auditeurs ont fourni leurs jugements subjectifs de l'effort mental et de la compréhensibilité, mais il serait utile de comparer les jugements subjectifs avec des mesures objectives telles que les temps de réaction ou la pupillométrie.

Dans l'ensemble, les résultats sont conformes à l'hypothèse selon laquelle l'accent français induit une charge cognitive supplémentaire et ne soutiennent pas l'idée que l'accent français pourrait constituer une difficulté désirable dans certaines conditions. Cependant, comme les auditeurs anglophones n'étaient pas des experts en psychologie, ils n'ont peut-être pas

été en mesure d'effectuer le traitement approfondi qui pourrait être nécessaire à l'écoute d'un accent français marqué. Ainsi, la difficulté d'obtenir un échantillon d'anglophones experts n'a pas permis de répondre pleinement à cette question de recherche. Des études supplémentaires seraient donc nécessaires pour apporter une réponse plus claire à la question. D'autres recherches pourraient, par exemple, comparer l'intelligibilité et la compréhensibilité de l'accent français chez des auditeurs anglophones en variant à la fois le degré d'accent et l'expertise dans le domaine de la psychologie. La comparaison entre experts et novices permettrait d'explorer la manière dont l'expertise interagit avec la perception de la parole. Ainsi, il existe de nombreuses pistes pour continuer à étendre nos connaissances sur l'accent français et sur ce qui constitue une parole intelligible et compréhensible.

Appendix B

CO-LLAPSE Protocol in full

Table B.1
Psychology Word List, O'Callaghan (2025)

1) Household	36) Schizophrenia	71) Score	106) Spatial
2) Inhibitory	37) Beta	72) Auditory	107) Database
3) Threshold	38) Placebo	73) Disorder	108) Ratings
4) Alcohol	39) Ego	74) Cortex	109) Mate
5) Horizontal	40) Validity*	75) Autism	110) Facial
6) Priming	41) Clinical	76) Withdrawal	111) Fixation
7) Switching	42) Linear	77) Activation	112) Gaze
8) Single	43) Symptoms	78) Valence	113) Ideation
9) Lingering*	44) Infants	79) Demographic	114) Psychosis
10) Correlation	45) Pitch	80) Alpha	115) Height
11) Cognitive	46) Amygdala	81) Magnitude	116) Gyrus
12) Capture	47) Likert	82) Span	117) Hyperactivity
13) Personality	48) Grid	83) Algorithms	118) Psychiatric
14) Perceptual	49) Rural	84) Haptic	119) Suicide
15) Patient	50) Book*	85) Gamma	120) Diagnosis
16) Tactile	51) Look*	86) Somatic	121) Minus
17) Tinnitus	52) Cue	87) Cluster	122) Mindfulness
18) Tones	53) Mood	88) Frontal	123) Parietal
19) Schema	54) Abuse	89) Robust	124) Anova
20) Specific	55) Acuity	90) Drugs	125) Emotional
21) Split-brain	56) Recruited	91) Muscle	126) Cohort
22) Study	57) Therapeutic	92) Vulnerability	127) Nodes
23) Storage	58) Illusion	93) Subtle	128) Burnout
24) Rhythm	59) Temporal	94) Mask	129) Arousal
25) Stimulus	60) Sessions	95) Classroom	130) Discounting
26) Trait	61) Sensory	96) Narcissism	131) Questionnaire
27) Spectral	62) Reference	97) Saccade	132) Multivariate
28) Strengths	63) Empathy	98) Graph	133) Impaired
29) Clothes*	64) Psychometric	99) Onset	134) Software
30) Texts*	65) Efficacy	100) Neuroticism	135) Peer
31) Feedback	66) Versus	101) Optimal	136) Superior
32) Median	67) Verbal	102) Congruent	137) Hemisphere
33) Peak	68) Maternal	103) Chronic	138) Neuronal
34) Species	69) Interpersonal	104) Foraging	139) Employ*
35) Esteem	70) Urban	105) Baseline	140) Coitus*

Note. * Items not in Xodabande's list

Psychology Text Task, O'Callaghan (2025)

Increasing attention has been focused on memory distortions in patients with various kinds of brain damage. Research in this area has contributed to our understanding of normal memory function, memory failure in specific brain diseases and the occurrence of clinically relevant memory distortions in certain patient populations. Memory distortions in patients with amnesia and those with probable Alzheimer's disease have recently been explored using experimental false recall and recognition paradigms. False recognition occurs when people incorrectly claim to have previously encountered a novel item that is in some way related to a previously studied item. Researchers have demonstrated robust levels of false recognition in healthy adults. After studying lists of semantic associates (e.g. candy, sour, sugar, bitter, good, taste, and so forth) that all converge on a non-presented theme word or related lure (e.g. sweet), participants frequently intruded the related lure on free recall tests and made very high levels of false alarms to these words on recognition tests. Studies using five study-test trials have shown that patients with amnesia made fewer false alarms to related lures than did control participants. With repeated study–test trials, control participants exhibited increasing levels of true recognition together with decreasing levels of false recognition. Patients with amnesia also demonstrated increased true recognition but, in contrast to controls, showed no evidence of decreasing false recognition across trials. Interestingly, patients with Korsakoff amnesia exhibited increased false recognition across trials, whereas patients with non-Korsakoff amnesia (e.g. those who suffered anoxia, encephalitis or other types of damage to their medial temporal structures) showed fluctuating levels of false recognition across trials. Results were interpreted on the basis of the idea that true and false recognition depend on memory for two different kinds of information: specific details of a prior encounter with a particular item (item-specific recollection), and the general meaning, idea or gist conveyed by a collection of items. As the items are presented in the association paradigm, a gist representation is developed, which may result in an experience of recollection or familiarity when either a studied item or a related lure is presented on a later recognition test. Thus, in this paradigm, accurate recognition of previously studied items probably depends on both item-specific and gist information, whereas false recognition of related lure words depends on remembering gist but not item-specific information.

Discussion Questions, O'Callaghan (2025)

Questions related to work

Could you tell me about your work?

Could you explain your domain of expertise/research topic?

When was the last time that you had to present your work in public?

Do you enjoy your job?

Questions related to language use

Do you often use English for your research?

Do you feel comfortable speaking about your work in English?

Do you have any anecdotes about using English at a conference?

If you did not need to speak English for work and research purposes, would you have studied the language anyway?

Do you use English in your free time?

Have you ever been to an English speaking country?

Question related to hobbies

What do you do in your free time? (sport, music, etc...)

Do you enjoy travelling?

Do you like learning about other cultures?

Do you like learning languages?

The IPCE-IPAC Questionnaire

Section 1 General Information

Date of birth

Place of birth (city, country)

Current place of residence (city, country)

Previous countries of residence (if any). For each, please specify the number of years lived there.

Education

- Secondary School/ Middle School
- College / High School
- BA / BSc (3 years of study)
- MA MSc (5 years of study)
- PHD (8 years of study)

Profession

Previous professions (if any). For each, please provide the number of years.

Section 2 Family

Mother's (or carer 1's) date of birth

Father's (or carer 2's) date of birth

Partner's date of birth

Mother's (or carer 1's) place of birth

Father's (or carer 2's) place of birth

Partner's place of birth

Mother's (or carer 1's) education

Father's (or carer 2's) education

Partner's education

Mother's (or carer 1's) profession

Father's (or carer 2's) profession

Partner's profession

Mother's (or carer 1's) native language

Which language(s) does/did your mother (or carer 1) speak with you?

Father's (or carer 2's) native language

Which language(s) does/did your father (or carer 2) speak with you?

Partner's native language

Which language(s) does/did your partner speak with you?

Section 3 Languages you speak

Which is/are your native language(s)?

French

Spanish

Portuguese

Italian

German

Dutch/Flemish

Polish

Russian

Arabic

Chinese

Japanese

Other

Please rate your level of English

	Elementary	Intermediate	Advanced	Like a native
Reading				
Writing				
Listening				
Speaking				

Do you speak any other non-native languages?

	Elementary	Intermediate	Advanced	Like a native
French				
Spanish				
Portuguese				
Italian				
German				
Dutch/Flemish				
Polish				
Russian				
Arabic				
Chinese				
Japanese				
Other				

How often do you use English?

	Never	Rarely	Weekly	Daily
Reading				
Writing				
Listening				
Speaking				

How old were you when you first started learning English?

For how many years did you learn English (at school or elsewhere)?

People who played an important role for your English (tick as many as needed)

Parent(s) / carer(s)

Grandparent(s)

Sister(s) / Brother(s)

Aunt(s) / Uncle(s)

Cousin(s)

Teacher(s)

Friends(s) / Classmate(s)

Other:

How would you describe your pronunciation of English?

I sound like a native

I have a good pronunciation with a light foreign accent

I have an intelligible pronunciation with an evident foreign accent

I have a poor pronunciation and a strong foreign accent.

Did you ever receive any training in English pronunciation?

Phonetic transcriptions

Minimal pairs (e.g. feet - fit)

Explanations about where to put you mouth for the 'th' sound

Other:

What is your goal with respect to English pronunciation?

I would like to sound like a native

I want my English to be intelligible, but I do not care about sounding like a foreigner

I do not care about pronunciation

Which variety of English is your model when you speak?

British English

American English

Other:

Which variety of English do you understand more easily?

British English

American English

Other:

Section 4 Hobbies

How often do you travel abroad?

Never

Less than once a year

Once a year

2-5 times a year

6 or more times a year

Do you use English when you travel abroad?

Always

Often

Sometimes

Never

Have you received any musical training?

Yes - professional training

Yes - as a hobby

No

Regardless of whether you've received musical training or not, do you play a musical instrument?

Yes

No

Regardless of whether you've received musical training or not, do you sing?

Yes

No

Appendix C

MANOVA Output and threshold calculations

Table C.1
/æ/ - /aː/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,16072145	0,17340484	0,23637233
Charlotte	0,30286766	0,02711142	0,23637233
Marie	0,01083238	0,89680684	0,23637233
Martin	0,14053119	0,21993846	0,23637233
Jean	0,13345487	0,23873268	0,23637233
Louise	0,14006629	0,22113106	0,23637233
Alain	0,15301698	0,18999713	0,23637233
Julia	0,09720551	0,35965738	0,23637233
Claire	0,18112339	0,13557658	0,23637233
Sophie	0,01933133	0,82266499	0,23637233
Hélène	0,09832528	0,35522125	0,23637233
Alice	0,0499348	0,59914799	0,23637233
Anne	0,09833133	0,35519742	0,23637233

Table C.2
/æ/ - /e/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,30722333	0,00234309	0,15101566
Charlotte	0,21419915	0,01873511	0,15101566
Marie	0,13892062	0,08476424	0,15101566
Martin	0,54675032	2,1358E-06	0,15101566
Jean	0,40190405	0,00020736	0,15101566
Louise	0,32333405	0,00158919	0,15101566
Alain	0,59773802	2,9812E-07	0,15101566
Julia	0,47950325	2,0936E-05	0,15101566
Claire	0,82771863	2,5E-13	0,15101566
Sophie	0,40496982	0,0001905	0,15101566
Hélène	0,51622943	6,2597E-06	0,15101566
Alice	0,42956285	9,4936E-05	0,15101566
Anne	0,45243826	4,8322E-05	0,15101566

Table C.3
/æ/ - /ʌ/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,74946618	6,115E-08	0,20135421
Charlotte	0,4174273	0,00152828	0,20135421
Marie	0,22675687	0,04568702	0,20135421
Martin	0,39133508	0,00258547	0,20135421
Jean	0,52905973	0,00011901	0,20135421
Louise	0,33535329	0,00743174	0,20135421
Alain	0,42986081	0,0011797	0,20135421
Julia	0,48145381	0,00037796	0,20135421
Claire	0,69366542	6,8289E-07	0,20135421
Sophie	0,39292914	0,00250537	0,20135421
Hélène	0,37152497	0,00379714	0,20135421
Alice	0,24276502	0,03554414	0,20135421
Anne	0,55694315	5,7215E-05	0,20135421

Table C.4
/ɪ/ - /iː/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,12611568	0,00780445	0,07248752
Charlotte	0,51123916	6,419E-12	0,07248752
Marie	0,01384414	0,60539688	0,07248752
Martin	0,10921029	0,01555632	0,07248752
Jean	0,10513575	0,01833402	0,07248752
Louise	0,11638488	0,01162714	0,07248752
Alain	0,00435529	0,85459045	0,07248752
Julia	0,0035742	0,87906049	0,07248752
Claire	0,054004	0,13552356	0,07248752
Sophie	0,12360113	0,00865496	0,07248752
Hélène	0,39016768	1,8517E-08	0,07248752
Alice	0,01405713	0,60070743	0,07248752
Anne	0,0345284	0,2822423	0,07248752

Table C.5
/ɒ/ - /ɔː/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,2130908	0,13042453	0,27182818
Charlotte	0,04058825	0,7031416	0,27182818
Marie	0,12757197	0,31347411	0,27182818
Martin	0,10531421	0,3883288	0,27182818
Jean	0,09819203	0,41540296	0,27182818
Louise	0,08864829	0,45428784	0,27182818
Alain	0,13551988	0,29001307	0,27182818
Julia	0,27775889	0,06292145	0,27182818
Claire	0,2649604	0,07305354	0,27182818
Sophie	0,22882605	0,10984871	0,27182818
Hélène	0,01189152	0,90331524	0,27182818
Alice	0,15556711	0,23757663	0,27182818
Anne	0,08055659	0,48973658	0,27182818

Table C.6
/ʌ/ - /ɜː/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,34948811	0,06111658	0,33978523
Charlotte	0,27331289	0,12553317	0,33978523
Marie	0,14669422	0,3565993	0,33978523
Martin	0,18479004	0,2650035	0,33978523
Jean	0,20487184	0,22534159	0,33978523
Louise	0,04395548	0,74663401	0,33978523
Alain	0,34255368	0,06547748	0,33978523
Julia	0,22380779	0,19266388	0,33978523
Claire	0,28295388	0,1150949	0,33978523
Sophie	0,57333328	0,00394073	0,33978523
Hélène	0,75701825	0,00010144	0,33978523
Alice	0,13113156	0,40105242	0,33978523
Anne	0,47057367	0,01602271	0,33978523

Table C.7
/ʊ/ - /uː/ Contrast Word List Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,54302143	0,01992871	0,4181972
Charlotte	0,09612246	0,60332036	0,4181972
Marie	0,25022484	0,2369492	0,4181972
Martin	0,50089025	0,03097279	0,4181972
Jean	0,1468293	0,45204291	0,4181972
Louise	0,56597486	0,01540191	0,4181972
Alain	0,1548697	0,43114005	0,4181972
Julia	0,45220342	0,04932835	0,4181972
Claire	0,30600586	0,16098263	0,4181972
Sophie	0,20828438	0,31106136	0,4181972
Hélène	0,47869302	0,03850062	0,4181972
Alice	0,34305706	0,12235965	0,4181972
Anne	0,45090279	0,04991674	0,4181972

Table C.8
/æ/ - /aː/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,41956955	0,01416498	0,23637233
Charlotte	0,43107564	0,01184025	0,23637233
Marie	0,37908672	0,0258085	0,23637233
Martin	0,22334658	0,17748639	0,23637233
Jean	0,14876456	0,37083408	0,23637233
Louise	0,37883536	0,02590112	0,23637233
Alain	0,17832659	0,28083749	0,23637233
Julia	0,54274002	0,001634	0,23637233
Claire	0,20198836	0,22182164	0,23637233
Sophie	0,23819087	0,15115604	0,23637233
Hélène	0,11524002	0,49631579	0,23637233
Alice	0,121422	0,47129118	0,23637233
Anne	0,1761116	0,28693495	0,23637233

Table C.9
/æ/ - /e/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,36035796	0,00228563	0,15101566
Charlotte	0,25088847	0,02461066	0,15101566
Marie	0,17878228	0,09375042	0,15101566
Martin	0,55077542	9,6487E-06	0,15101566
Jean	0,40190406	0,0008181	0,15101566
Louise	0,43550378	0,00033596	0,15101566
Alain	0,64015737	2,9679E-07	0,15101566
Julia	0,49950266	5,2057E-05	0,15101566
Claire	0,82912223	2,2355E-12	0,15101566
Sophie	0,40535855	0,00074847	0,15101566
Hélène	0,51624552	3,0651E-05	0,15101566
Alice	0,42961013	0,00039433	0,15101566
Anne	0,46645469	0,00014047	0,15101566

Table C.10
/æ/ - /ʌ/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,75057428	4,0249E-07	0,20135421
Charlotte	0,41792903	0,00533144	0,20135421
Marie	0,242323	0,08905149	0,20135421
Martin	0,41752841	0,00537164	0,20135421
Jean	0,56548822	0,00021019	0,20135421
Louise	0,34934146	0,01783172	0,20135421
Alain	0,48712727	0,00132677	0,20135421
Julia	0,53125506	0,00048934	0,20135421
Claire	0,71306665	1,9699E-06	0,20135421
Sophie	0,3996953	0,00746187	0,20135421
Hélène	0,39785712	0,00771416	0,20135421
Alice	0,31086472	0,03294904	0,20135421
Anne	0,64929909	1,8996E-05	0,20135421

Table C.11
/ɪ/ - /iː/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,36991092	3,197E-07	0,07248752
Charlotte	0,55562194	1,6011E-12	0,07248752
Marie	0,0166608	0,75271129	0,07248752
Martin	0,20837348	0,00081299	0,07248752
Jean	0,18214694	0,00243737	0,07248752
Louise	0,19694996	0,00131877	0,07248752
Alain	0,03698838	0,44113694	0,07248752
Julia	0,01375775	0,80356028	0,07248752
Claire	0,14470551	0,010818	0,07248752
Sophie	0,19382958	0,00150284	0,07248752
Hélène	0,43934279	5,4914E-09	0,07248752
Alice	0,11251311	0,03618291	0,07248752
Anne	0,13474532	0,01583552	0,07248752

Table C.12
/ɒ/ - /ɔː/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,47497262	0,01406054	0,27182818
Charlotte	0,28686248	0,15564487	0,28613493
Marie	0,31141264	0,10472456	0,27182818
Martin	0,38450467	0,04617683	0,27182818
Jean	0,40222248	0,03719394	0,27182818
Louise	0,47817585	0,01342477	0,27182818
Alain	0,29609139	0,12262052	0,27182818
Julia	0,52513116	0,00655717	0,27182818
Claire	0,4696641	0,01517072	0,27182818
Sophie	0,28053708	0,14325719	0,27182818
Hélène	0,41564737	0,03141144	0,27182818
Alice	0,39315899	0,04158499	0,27182818
Anne	0,4307962	0,02581694	0,27182818

Table C.13
/ʌ/ - /ɜː/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,72587459	0,00108815	0,33978523
Charlotte	0,54069726	0,02141628	0,33978523
Marie	0,37829938	0,11536972	0,33978523
Martin	0,21065235	0,39930548	0,33978523
Jean	0,22723048	0,35963059	0,33978523
Louise	0,65410635	0,00421071	0,33978523
Alain	0,39665534	0,09802753	0,33978523
Julia	0,60139674	0,00953747	0,33978523
Claire	0,37629683	0,11739616	0,33978523
Sophie	0,65121706	0,00441835	0,33978523
Hélène	0,81679942	0,00010179	0,33978523
Alice	0,15131453	0,56271271	0,33978523
Anne	0,56502576	0,01571614	0,33978523

Table C.14
/ʊ/ - /uː/ Contrast Word List Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,54657168	0,05831546	0,4181972
Charlotte	0,15905862	0,65020166	0,4181972
Marie	0,25924218	0,41688004	0,4181972
Martin	0,56940512	0,04690837	0,4181972
Jean	0,18455429	0,58663927	0,4181972
Louise	0,65837624	0,01746988	0,4181972
Alain	0,33416507	0,27834798	0,4181972
Julia	0,58692916	0,03934294	0,4181972
Claire	0,38654368	0,20169837	0,4181972
Sophie	0,20860977	0,52894729	0,4181972
Hélène	0,47919907	0,10381303	0,4181972
Alice	0,56095388	0,05091825	0,4181972
Anne	0,67574794	0,01394998	0,4181972

Table C.15
/æ/ - /ɑː/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,6821341	1,8871E-06	0,2090986
Charlotte	0,34314591	0,006451	0,20135421
Marie	0,23576539	0,04540536	0,2090986
Martin	0,23369183	0,04100544	0,20135421
Jean	0,28702166	0,01725504	0,20135421
Louise	0,32458467	0,00901262	0,20135421
Alain	0,19196649	0,10666168	0,22652349
Julia	0,18154958	0,09986478	0,2090986
Claire	0,46047415	0,00044684	0,19416299
Sophie	0,49998971	0,0002442	0,20135421
Hélène	0,13727881	0,18302498	0,2090986
Alice	0,38914558	0,00269931	0,20135421
Anne	0,13727881	0,18302498	0,2090986

Table C.16
/æ/ - /e/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,1339279	0,00394304	0,06795705
Charlotte	0,1859924	0,00032697	0,06711807
Marie	0,24634437	1,8671E-05	0,06795705
Martin	0,23247138	3,7683E-05	0,06795705
Jean	0,21917804	7,2988E-05	0,06795705
Louise	0,1115177	0,00936757	0,06629956
Alain	0,41881626	8,4347E-10	0,06795705
Julia	0,3948688	3,9922E-09	0,06795705
Claire	0,4254104	9,4605E-10	0,06969953
Sophie	0,34001544	1,1273E-07	0,06795705
Hélène	0,36537974	1,9863E-08	0,06711807
Alice	0,17436291	0,00056856	0,06711807
Anne	0,36537974	1,9863E-08	0,06711807

Table C.17
/æ/ - /ʌ/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,45853191	2,9562E-05	0,14693415
Charlotte	0,23428062	0,01222219	0,15101566
Marie	0,59086278	6,1646E-07	0,15533039
Martin	0,57298199	5,219E-07	0,14693415
Jean	0,29469818	0,00264469	0,14693415
Louise	0,14086432	0,07569197	0,14693415
Alain	0,39436232	0,00032765	0,15533039
Julia	0,47209872	1,9204E-05	0,14693415
Claire	0,54064777	1,805E-06	0,14693415
Sophie	0,34788276	0,00069749	0,14693415
Hélène	0,58122074	3,7476E-07	0,14693415
Alice	0,20015224	0,02509695	0,15101566
Anne	0,58122074	3,7476E-07	0,14693415

Table C.18
/ɪ/ - /iː/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,02718099	0,11654664	0,03419222
Charlotte	0,12995064	2,7262E-05	0,03530236
Marie	0,00513818	0,67603627	0,0350746
Martin	0,00488598	0,68581808	0,03462779
Jean	0,06017026	0,00815289	0,03440863
Louise	0,05323377	0,01223326	0,03314978
Alain	0,00370258	0,75014994	0,03440863
Julia	0,03319015	0,07561215	0,03484977
Claire	0,03433176	0,07153362	0,03530236
Sophie	0,03102152	0,09409354	0,0355331
Hélène	0,02654791	0,12595711	0,03462779
Alice	0,0530691	0,01629412	0,03530236
Anne	0,02654791	0,12595711	0,03462779

Table C.19
/ɒ/ - /ɔː/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,44017618	6,9638E-05	0,15101566
Charlotte	0,307547	0,00092772	0,13259911
Marie	0,00546424	0,90608151	0,13939907
Martin	0,25477134	0,00582193	0,14306746
Jean	0,20763523	0,01349322	0,13591409
Louise	0,30729477	0,00194681	0,14693415
Alain	0,19342341	0,02087474	0,13939907
Julia	0,36653107	0,00021474	0,13591409
Claire	0,4337907	3,5776E-05	0,13939907
Sophie	0,6563872	2,6139E-09	0,13591409
Hélène	0,34581497	0,00073605	0,14693415
Alice	0,5459926	9,9678E-07	0,14306746
Anne	0,34581497	0,00073605	0,14693415

Table C.20
/ʌ/ - /ɜː/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,42454199	0,00100039	0,19416299
Charlotte	0,06583476	0,45695413	0,2090986
Marie	0,43022612	0,00117066	0,20135421
Martin	0,45172736	0,00040453	0,18746771
Jean	0,30505403	0,01057762	0,19416299
Louise	0,0358638	0,63347557	0,19416299
Alain	0,45489644	0,00050815	0,19416299
Julia	0,25275629	0,02619862	0,19416299
Claire	0,17039779	0,10627688	0,20135421
Sophie	0,0216325	0,76080824	0,19416299
Hélène	0,29696276	0,01222444	0,19416299
Alice	0,04962446	0,55692331	0,2090986
Anne	0,29696276	0,01222444	0,19416299

Table C.21
/ʊ/ - /uː/ Contrast Text Tokens

Speaker	Pillai score	p-value	Threshold
Paul	0,03282672	0,86053651	0,45304697
Charlotte	0,01656252	0,92759929	0,45304697
Marie	0,06378832	0,74333271	0,45304697
Martin	0,1450965	0,49388625	0,45304697
Jean	0,13384246	0,52382474	0,45304697
Louise	0,04502004	0,81278214	0,45304697
Alain	0,17840915	0,41300012	0,45304697
Julia	0,04735575	0,80387473	0,45304697
Claire	0,57276176	0,02177788	0,45304697
Sophie	0,15388431	0,47144807	0,45304697
Hélène	0,10435917	0,60897921	0,45304697
Alice	0,16253925	0,49187852	0,49423306
Anne	0,10435917	0,60897921	0,45304697

Table C.22
/æ/ - /ɑː/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,68340763	1,0436E-05	0,2090986
Charlotte	0,35011499	0,01760519	0,20135421
Marie	0,26591467	0,07355451	0,2090986
Martin	0,35603537	0,01595462	0,20135421
Jean	0,36278119	0,01424319	0,20135421
Louise	0,4100368	0,00617534	0,20135421
Alain	0,23237772	0,14376331	0,22652349
Julia	0,18243375	0,20976457	0,2090986
Claire	0,46113958	0,00171109	0,19416299
Sophie	0,50861166	0,0008262	0,20135421
Hélène	0,21447942	0,1430684	0,2090986
Alice	0,41771068	0,00535332	0,20135421
Anne	0,36980228	0,01263772	0,20135421

Table C.23
/æ/ - /e/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,13410265	0,01165097	0,06795705
Charlotte	0,18602828	0,00116135	0,06711807
Marie	0,25277738	5,6844E-05	0,06795705
Martin	0,24642021	7,7532E-05	0,06795705
Jean	0,23298777	0,00014793	0,06795705
Louise	0,15785257	0,00369761	0,06629956
Alain	0,43057554	2,3844E-09	0,06795705
Julia	0,40158841	1,5225E-08	0,06795705
Claire	0,43123815	3,9633E-09	0,06969953
Sophie	0,36213358	1,6416E-07	0,06795705
Hélène	0,44056387	9,2598E-10	0,06711807
Alice	0,19484314	0,00077946	0,06711807
Anne	0,45534051	2,4919E-10	0,06629956

Table C.24
/æ/ - /ʌ/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,45868026	0,0001311	0,14693415
Charlotte	0,25616754	0,01936025	0,14693415
Marie	0,59987657	2,4518E-06	0,15533039
Martin	0,60754705	7,3785E-07	0,14693415
Jean	0,34029365	0,00300918	0,14693415
Louise	0,19849514	0,05994495	0,14693415
Alain	0,45501164	0,00026057	0,15533039
Julia	0,47212885	8,7679E-05	0,14693415
Claire	0,5425007	8,8031E-06	0,14693415
Sophie	0,38147723	0,00109116	0,14693415
Hélène	0,58588786	1,761E-06	0,14693415
Alice	0,20540951	0,05836036	0,15101566
Anne	0,41299371	0,00037002	0,14306746

Table C.25
/ɪ/ - /iː/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,25145687	9,1043E-10	0,03419222
Charlotte	0,30303416	9,554E-12	0,03530236
Marie	0,02183816	0,34141599	0,0350746
Martin	0,14407068	2,6484E-05	0,03462779
Jean	0,22122437	2,0819E-08	0,03440863
Louise	0,32675578	1,0529E-13	0,03314978
Alain	0,23208865	7,2198E-09	0,03440863
Julia	0,22453317	1,71E-08	0,03462779
Claire	0,10788798	0,0006487	0,03530236
Sophie	0,36650892	1,017E-14	0,0355331
Hélène	0,27204649	1,2717E-10	0,03440863
Alice	0,29697168	1,8117E-11	0,03530236
Anne	0,20163994	2,0905E-07	0,03530236

Table C.26
/ɒ/ - /ɔː/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,45626314	0,00014077	0,14693415
Charlotte	0,50669914	1,0668E-05	0,13591409
Marie	0,3308792	0,00257843	0,13939907
Martin	0,48008488	5,0248E-05	0,14306746
Jean	0,41102763	0,00023615	0,13591409
Louise	0,5913209	1,4221E-06	0,14693415
Alain	0,4823172	3,4119E-05	0,13939907
Julia	0,47994807	2,6935E-05	0,13591409
Claire	0,61770143	1,8951E-07	0,13939907
Sophie	0,66475137	1,155E-08	0,13591409
Hélène	0,54913516	6,9557E-06	0,14693415
Alice	0,6771064	1,7867E-08	0,14306746
Anne	0,5351154	5,4418E-06	0,13939907

Table C.27
/ʌ/ - /ɜː/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,70542838	1,4675E-06	0,19416299
Charlotte	0,31361403	0,03157864	0,20135421
Marie	0,53760736	0,00042043	0,20135421
Martin	0,52252423	0,00029757	0,18746771
Jean	0,36239535	0,01165219	0,19416299
Louise	0,57655038	0,0001045	0,19416299
Alain	0,68108673	3,7459E-06	0,19416299
Julia	0,54285736	0,00025508	0,19416299
Claire	0,45402119	0,00264385	0,20135421
Sophie	0,39581037	0,00633433	0,19416299
Hélène	0,56939774	0,00012706	0,19416299
Alice	0,68337818	1,0446E-05	0,2090986
Anne	0,44519817	0,00239179	0,19416299

Table C.28
/ʊ/ - /uː/ Contrast Text Tokens and Duration

Speaker	Pillai score	p-value	Threshold
Paul	0,03479528	0,9600079	0,45304697
Charlotte	0,09345494	0,84199697	0,45304697
Marie	0,21329849	0,56600712	0,45304697
Martin	0,13259168	0,75186097	0,45304697
Jean	0,71289894	0,01466829	0,45304697
Louise	0,13514327	0,74588981	0,45304697
Alain	0,21242557	0,56794058	0,45304697
Julia	0,05718246	0,91912931	0,45304697
Claire	0,5980851	0,05283412	0,45304697
Sophie	0,41553379	0,20875353	0,45304697
Hélène	0,161373	0,68450617	0,45304697
Alice	0,21518122	0,61316785	0,49423306
Anne	0,08133232	0,88870327	0,49423306

Appendix D

Experimental Protocol in full

Table D.1
Stimuli used in the isolated word recognition task

Household	Alcohol	Single	Tones
Storage	Rhythm	Strengths	Clothes
Peak	Species	Ego	Pitch
Grid	Look	Rural	Therapeutic
Efficacy	Verbal	Urban	Score
Disorder	Autism	Withdrawal	Alpha
Algorithms	Subtle	Vulnerability	Mask
Congruent	Spatial	Mate	Gaze
Height	Suicide	Parietal	Cohort
Nodes	Arousal	Superior	Employ
Software	Multivariate		

Certainty Ratings

How certain do you feel about having recognised the last word?

Not certain at all - Not very certain - A little certain - Fairly certain - Very certain

Stimuli sentences used for recognising words in context

1. Increasing attention has been focused on memory distortions in **patients** with various kinds of brain damage.

2. Research in this **area** has contributed to our understanding of normal memory function, memory failure in specific brain diseases and the occurrence of clinically relevant memory **distortions** in certain patient populations.

3. Memory distortions in patients with amnesia and **those** with probable Alzheimer's disease have recently been explored using experimental false recall and **recognition** paradigms.

4. False recognition occurs when people incorrectly claim to have previously **encountered** a novel item that is in some way related to a previously studied item.

5. Researchers have demonstrated **robust** levels of false recognition in **healthy** adults.

6. After **studying** lists of semantic associates (e.g. candy, **sour**, sugar, bitter, good, taste, and so forth) that all converge on a non-presented theme word or related lure (e.g. sweet), participants frequently intruded the related lure on free **recall** tests and made very high levels of false **alarms** to these words on recognition tests.

7. Studies using five study-test **trials** have shown that patients with amnesia made fewer false alarms to related lures than did **control** participants.

8. With repeated study–test trials, control participants **exhibited** increasing levels of true recognition together with decreasing levels of false recognition. Patients with amnesia also demonstrated **increased** true recognition but, in contrast to controls, showed no **evidence** of decreasing false recognition across trials.

9. **Interestingly**, patients with Korsakoff amnesia exhibited increased false recognition across trials, whereas patients with non-Korsakoff amnesia (e.g. those who suffered anoxia, encephalitis or other **types** of damage to their medial temporal structures) showed **fluctuating** levels of false recognition across trials.

10. Results were interpreted on the **basis** of the idea that true and false recognition depend on memory for two different kinds of information: specific details of a **prior** encounter with a particular item (item-specific recollection), and the general **meaning**, idea or gist conveyed by a collection of items.

11. As the items are presented in the association **paradigm**, a gist representation is developed, which may result in an **experience** of recollection or familiarity when either a studied item or a related lure is presented on a later recognition test.

12. Thus, in this paradigm, **accurate** recognition of previously studied items probably depends on **both** item-specific and gist information, whereas false recognition of related lure **words** depends on remembering gist but not item-specific information.

Comprehension Multiple Choice Questions

1. Which of the following sentences gives the best description of the extract you've just listened to?
    - The speaker presents a study about the relationship between humans and vehicles
    - The speaker presents a study about which groups of pedestrians make the best street crossing decisions
    - The speaker presents a study about helping pedestrians cross the road using speed data
2. What does the researcher propose in order to overcome difficulties in crossing the road?
    - Displaying the speed of the oncoming vehicle on the car
    - Improving perceptual motor skills through specialised training
    - Taking more time to estimate the speed of the oncoming vehicle
3. How were the participants divided into groups?
    - By height and experimental condition
    - By age and experimental condition
    - By native language and experimental condition
4. What did participants see in the video clips?
    - A car turning on a crossroad with no driver inside
    - A car coming towards a crossroad with no communication from the driver
    - A car parked in the single lane with the presence of a crossroad
5. What did the participants in the E.H.M.I condition of the study have to do?
    - Watch the video of an oncoming vehicle and decide when to cross the road
    - Watch the video of an oncoming vehicle and report the speed of the vehicle
    - Watch the video, decide when to cross and report the speed
6. How did the participants indicate when it became unsafe to cross the road?
    - They had to press the space bar
    - They had to tell the researcher
    - They had to stop the video

Likert Scales

Please choose the category that applies to you:

1. While listening to the extract I invested...

   1 very low mental effort ... 9 very high mental effort

2. The extract I just listened to was...

   1 very easy to understand ... 9 very difficult to understand

3. While listening it was...

   1 very easy to recognise each word spoken ... 9 very difficult to recognise each word spoken

4. The speaker had...

   1 no foreign accent ... 9 a very strong foreign accent

5. Did the accent you just listened to make it easy or difficult to understand?

   1 easy ... 5 no impact ... 9 difficult