Language recovery in polyglot aphasic patients

Ceyda Ceylan

12736554

UNIVERSITEIT VAN AMSTERDAM

BA Thesis Linguistics

Faculty of Humanities

University of Amsterdam

Supervised by Dr. A.T (Titia) Benders

27th of July 2022

Abstract

Aphasia is a well reported and researched language disorder. However, the same cannot be said on multilingual aphasia. This study aims to discover, through a literature review, whether claims made about multilingual aphasic recovery by Albert and Obler from their meta-analysis from 1978 still hold true with newer individual case studies. The role of first and second language regarding recovery and regression will be looked into as well as differential, or parallel, recovery and behavioural patterns observed in the third or other additional languages. A literature has been performed along with handpicking certain studies found in other reviews, totalling in nine case studies involved in this paper. It was discovered that other factors such as language dominance, at-ceiling performance and psychological factors such as language anxiety and emotional attachment play a role in recovery. For this reason, not much can be concluded as each case is unique and they cannot be generalised. Further research could help clinicians design the best possible treatment to better the lives of their patients by considering not only focusing on which language is used most dominantly by the patient and their environment, but also through taking into account the patients' emotional attachment to a language they speak.

Table of Contents

1. Introduction

It has not been long since the first attempts were being made to understand aphasia in multilingual individuals. Pitres (1895/1983) and Ribot (1882) began their studies on multilingual aphasia with anecdotal case studies. The question of whether variables such as age of acquisition (AoA) can help the recovery in these patients or what role it plays in the use of language has been the centre of attention in multilingual aphasiology (Kuzima et al, 2019). As previous literature mentions, early multilinguals seem to have an advantage over late multilinguals when learning new languages and retaining them (Martin et al, 2013). This evidence would go in line with Ribot's law which states that earlier acquired memories (including language) are more immune to brain damage. Pitres's law on the other hand set forth the notion that the premorbidly dominant language will be more immune in the case of brain damage, regardless of the age of acquisition of that language.

This review will mainly focus on the claims made by two other pioneers in multilingual aphasia research, Albert and Obler from their 1978 meta-analysis. Here, other variables besides AoA, such as proficiency, language use, language environment and psychological factors that play a role in the behaviour and recovery of language in multilingual aphasics. It is believed most individuals suffering from aphasia are actually multilingual (Roberts & Kiran, 2007; Ansaldo & Saidi, 2014), though no specific number or percentage has been brought forward. A look into how each language functions in the aphasics and what recovery patterns can reveal will be investigated. As well as the question of how reliable these older findings and claims are.

First, an introduction on multilingualism and its research in section 1.1, then a small refresher on the basics of aphasia in section 1.2. Following, in section two will be the aims and research questions that ends the introduction. Section three starts off by explaining the methods that were used in this paper. Directly after the methods, results will be discussed in section four followed up by the discussion in section five. Lastly, the conclusion will be presented in section six, with the references listed in section seven.

1.1 Multilingualism

To avoid confusion, a comment must be made about the use of the terms "multilingual" and "bilingual". Grosjean (1989 & 2013) uses the term bilingual, referring also to multilinguals. This paper will use the term "multilingual" or "polyglot" solely to refer to individuals speaking at least three or more languages as some of the literature use the terms "bilingual" and "multilingual" interchangeably. That will not be done; here we will refer to speakers of **at least** three languages. Grosjean (2013) describes a multilingual as someone who generally speaks at least two languages or more on a regular basis and communicates through spoken languages (Grosjean, 2013).

Grosjean (2013) further notes that half, if not more, of the world's population is multilingual. There is no concise data to back up this claim, yet it is clear that multilingualism appears in most countries, all age groups and all levels of society. Around 35% of Canada's population is bilingual. This number is smaller in the United States with about 18-20% of its population that speak two or more languages (Grosjean, 2013). There are a couple of factors leading to the growth of multilingualism. Speakers of minority languages often have no choice but to learn the majority language(s) as well, the same goes for people with an immigration background. The spread of some languages like English or Spanish internationally also contribute as they are considered as a valuable skill in social and work related fields (Cenoz, 2013).

Grosjean (1989) was also one of the first to spread the notion that a bilingual, or multilingual, is not two monolingual speakers in one person. This earlier notion had a negative impact as bilinguals and multilinguals were assumed and expected to be fully proficient in all their languages (Grosjean, 1989). Except, multilingualism should be also regarded as a sort of dynamic continuum, with many multilingual individuals shifting and altering their level of proficiency throughout life (Grosjean, 1989; Grosjean, 2013; Kroll et al., 2018). The change in a person's language configuration and proficiency is thus due to this fluctuating shift in language use and environment, aligning with Pitres's law. Variables such as age, whether individuals are early or late bilinguals have been reported to also significantly impact language abilities (Kiran and Roberts, 2010).

Somewhat part of this continuum is the theory put forward by Grosjean in 1989, which is called the Bilingual Mode Hypothesis. It explains how bilinguals, depending on their language environment can be on two modes of the continuum. One being the monolingual mode, where speakers are surrounded by monolingual speakers and thus suppress the other language(s). The

other is the bilingual mode where a person is surrounded by speakers of their L1, L2 or L3 languages and can comfortably switch between languages.

1.2 Aphasia

This review will devote itself to all forms of acquired aphasia. Aphasia is an acquired language disorder commonly caused by a sudden focal injury to parts of the left hemispheric areas of the brain after language has been fully developed. Aphasia affects the general language centre. It is often acquired through a stroke, also known as a cerebrovascular accident, and contributes to about 85% of aphasia causes (Bastiaanse, 2010; Bastiaanse & Prins, 2013; Goral & Hejazi, 2021). It will either disturb language production and/or comprehension as well as speech and writing. Aphasia can manifest in many different ways with people struggling more in one aspect than the other. Agrammatism is a common symptom affecting a person's grammar, for example. It is characterized by short speech including many content words such as nouns and unconjugated verbs, while lacking in sufficient function words such as articles and prepositions (Bastiaanse, 2010).

Aphasia is a language disorder that should be differentiated from speech disorders, as those who suffer from a speech disorder usually have spared language abilities such as comprehension and writing. It must be noted that it is not uncommon for patients with aphasia to have articulatory problems like those suffering from speech disorders. This can be the result of the paralysis of speech muscles due to the stroke (Bastiaanse, 2010).

Aphasia can either be the primary or secondary cause of problem in brain injuries. Previously it was mentioned that aphasia is a product of a focal injury to the brain, which can be caused by a stroke but also external factors like an accident. However, aphasia can also be caused and developed through diffuse injuries caused by, for example, dementia. We then speak of Primary Progressive Aphasia, which deteriorates language abilities over a longer period of time (Bastiaanse, 2010). Language disorders caused by schizophrenia and depression will also deteriorate and develop over a period of time (Bastiaanse & Prins, 2013). In the case of these illnesses, the language disorder is secondary, whereas concerning acquired aphasia due to a focal injury, these communication problems are primary.

Moreover, aphasia can be branched into different syndromes (Bastiaanse & Prins, 2013). A few will be described. Firstly, Aphasia can be divided by fluency. Non-fluent aphasia include Broca's and Global aphasia, for example. Broca's aphasia is characterised by the inability to produce language with impaired repetition. Comprehension however is mostly

spared. Global aphasia is defined by the severe impairment of all major language functions, and both comprehension and production are seriously limited (Murduch, 2010). Fluent aphasia disorders are Wernicke's, Conduction and Anomic aphasia. The main feature is that production is relatively spared whereas comprehension is impaired, which is the opposite of Broca's. Repetition and word finding difficulties are the main characteristics of Conduction aphasia, whereas in the case of Anomic aphasia is classified when word finding difficulties is the primary deficit (Murdoch, 2010).

While symptoms and language problems will persist after acquiring aphasia, recovery and improvement is common. Usually, a spontaneous recovery occurs within the subacute phase(one to three months) after the incident. Yet, the chance of recovery it the highest in the acute phase (first few weeks) and slim after the chronic phase (after three months) (Bastiaanse, 2010). This does however not mean that the patient is fully recovered or that they regain their premorbid abilities. Therapy will continue until the patient has reached their independence in daily communication. Studies can look into what areas of recovery would benefit the patients the most based on the their type of aphasia and the language(s) spoken by the patient. Treatment using repetition could benefit, for example, a patient with conduction aphasia. In addition, these patients can visit aphasia centres to maintain their communication skills through additional therapy and by being in contact with other aphasics (Bastiaanse, 2010).

So how can aphasia play out in multilingualism? One point of view could be to reason that the same aphasia type and difficulties can be spread throughout all the languages of a multilingual aphasic, which would be a **parallel** pattern of impairment. That can however not be concluded as the norm as studies are very varied in results. Some studies have found **non-parallel** patterns of recovery, in which one language or linguistic area recovers better than the other and which still has certain difficulties not observed in the other language(s). For example, a recent study tested a Kurdish-Persian individual with Broca's aphasia and it was observed that her L1 (Kurdish) had recovered less than her L2 (Persian) (Mirdehghan, 2020).

Studies looking into multilingual aphasics and their language abilities and use following acquired aphasia are scarce and less clear in regards to recovery patterns compared to monolingual aphasia research. Some tendencies have been observed but cannot be concluded as the norm. These were made from a meta-analysis by Albert and Obler in 1978. The relation of this meta-analysis and this current study will be made clear in the aims of the study.

2. Aim of the current study

The focus of the current study will be on multilingual language recovery in patients following acquired aphasia. Doing so by testing the claims and observations made by a meta-analysis done in 1978 by Albert and Obler. This meta-analysis included a total of 108 case studies from the mid nineteenth century until 1977. This analysis included 50 cases of polyglots and 48 cases of bilinguals. The oldest polyglot case study included was one from 1875 and the most recent one was a case study conducted by the researchers themselves in 1977. Three case studies were conducted by the researchers in 1977. Albert and Obler's (1978) methodology was abstracting the data available in the 105 previously published case studies and adding their own data. From their research, certain tendencies emerged in the multilingual aphasics. These were that they were to: a) recover their first language better, b) recovery tended to be more non-parallel and c) the first language regressed more when the L2 later recovers. This is a 44 year old review of course, thus we cannot say for certain whether these tendencies are still observed as aphasia research has grown exponentially in the last couple of decades, with newer case studies usually using the same tests to assess proficiency. One of these is the Bilingual Aphasia Test, which is used to asses the languages of a bilingual or multilingual aphasic patients.

Additionally, the L3 and possible additional languages' behaviour after therapy will also be looked at, as even though Albert and Obler (1978) have looked at polyglots, no specific claims were made about the additional languages. Albert and Obler's (1978) analysis on multilinguals did not observe any tendencies relating to the patients' additional languages. That will be discussed in this review. In the form of a literature review, this study will look at and analyse experimental studies on multilingual aphasiology and discuss whether these aforementioned tendencies still hold true. That is to say that none of the case studies from Albert and Obler (1978) will be included in this review. We will rather, use it as a baseline to compare whether more recent studies can support the claims made in the old meta-analysis.

It is furthermore important and of interest to us all, as multilingualism seems to be the norm in the world and especially in Europe. A survey by the European Commission in 2012 revealed that over half of the European population (54%) is able to converse in at least one additional language and 25% are able to hold a conversation in two additional languages (European Commission, 2012). Yet, there are limited empirical studies in the field of aphasiology regarding language patterns of recovery in multilingual speakers. Thus a literature review on this specific group could serve as a comprehensive summary of empirical studies on multilingual aphasiology so far and aid future investigation. The investigation of this group of

patients suffering from this language disorder throughout the last couple of years would greatly enhance our knowledge of recovery patterns and their significance for language use in multilingual aphasic individuals. Additionally, it would also be important to investigate how variables other than just being multilingual can potentially influence the multilingual language use and recovery. The variables linking back to both Pitres's, such as language dominance, and Ribot's law, such as age of acquisition and memories of languages being immune to brain damage.

Further research would benefit clinical attempts to design the best possible interventions. Thus the research questions of this paper are as follows:

1. Will multilinguals recover their first language better than the other languages?
2. Do multilinguals show generally more non-parallel recovery patterns?
3. Will regression of the L1 be observed when the L2 later recovers?
4. What can be observed from the other languages after recovery?

3. Methods

This review searched case studies researching strictly aphasic multilinguals, meaning individuals who speak **at least** three languages. These cases also included a summary or description of all the languages spoken by the patients and their proficiency before and after recovery sessions. This is essential when it comes to measuring possible regression and/or recovery patterns in the languages in relation to the first and third research question. The information on premorbid language level and dominance is most often acquired through self-ratings and from family members.

3.1 Exclusion and Inclusion criteria

Given the questions posed in this paper, data and papers regarding the language behaviour on postmorbid aphasia with multilingual individuals have been included. The patients would need to have acquired aphasia, what type of aphasia or through what kind of accident (e.g cerebrovascular accident, traffic accident, etc.) does not pose an issue in this paper. Since case studies on strictly multilinguals are scare and limited, which does not allow the privilege of specifying on the type or cause of aphasia.

This study wanted to include an array of multilinguals, what languages the patients speak did not matter as we are not specifically looking at similar or different languages spoken by the individuals.

Studies were excluded based on whether the patients have any other neurocognitive issues that could influence the experiments and data. Furthermore, studies that could not be accessible or did not show the full-text were excluded along with peer reviews and dissertations.

Case studies would have to preferably research patients that have not received treatment for their aphasia before, and include both pre- and post-treatment testing results in order to compare recovery and answer the research questions. The other languages besides the L1 and L2 would also need to be tested or discussed in order to answer research question four. Though, we realise they have not all been included in each individual case study, there is no other choice but the select them as individual case studies on multilingual aphasia is scarce. Extracting as much information as possible from each case study is the goal.

3.2 Search strategy

Manual searches through the studies included within previous meta-analyses and systematic reviews were collected (Kuzmina et al., 2019; Lerman et al., 2020; KK Nair et al., 2021). When searching through the data set of these papers, the ones that mentioned patients speaking at least three or more languages were selected. A brief search into the abstract and patient details was performed for this. The sources were extracted from their references and found on either Google Scholar, the LLBA or UvA's CataloguePlus. These reviews and meta-analyses were those of Kuzmina et al. (2019), Lerman et al. (2020) and KK Nair et al. (2021).

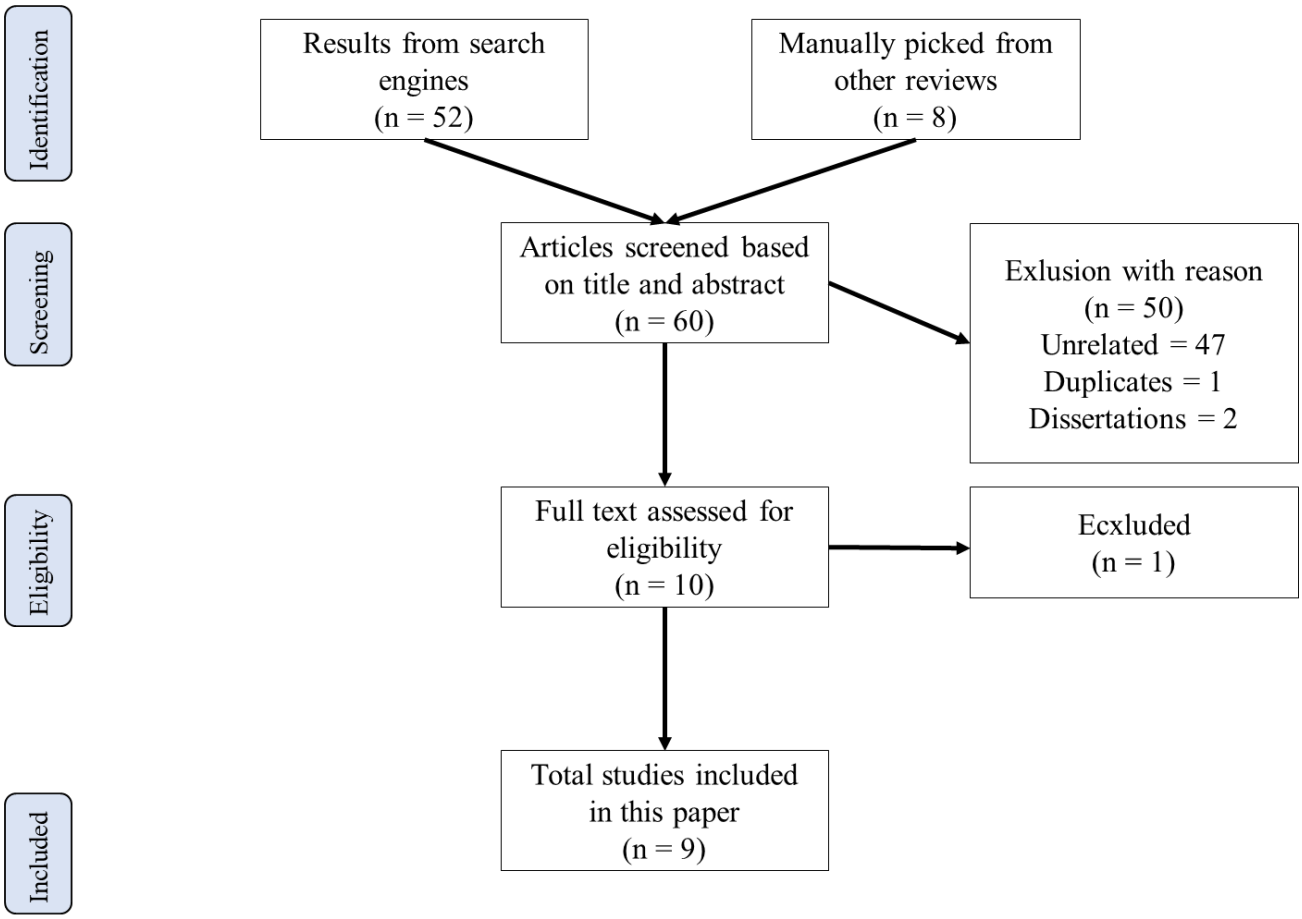

Figure 1. Flow diagram explaining the methodological process

Literature search was done additionally through the electronic databases: Google Scholar and the LLBA (Language and Linguistic Behaviour Abstracts). Keywords used to find relevant papers were: “aphasia” , “language impairment”, “L3”, “trilingual” and “third language” resulting in the following search: "aphasia AND ("language impairment" OR "L3" OR "trilingual" OR "third language")". The reason why only the L3 was used in the search terms was to ensure studies with patients that spoke at least three languages showed up. The term *multilingual* can be problematic, as it is also at times used interchangeably with the term *bilingual*, referring to people speaking only two languages. This has been observed in Goral and Lerman (2020) and Goral, Norvik and Jensen (2019).

The hand-picked way to find case studies seemed to be the most fruitful. Through this method, eight of the total nine studies were found. A literature search through the

aforementioned search engines resulted in 52 hits. Though almost all of them were unrelated for the purpose of this review. In the end, only one extra case study was found this way. The case studies were selected for their eligibility through first scanning the abstracts and then inspecting the methods and results section.

4. Results

The performed literature search resulted in the inclusion of nine papers. All these studies reported findings of multilingual aphasics with varying causes of aphasia and results of treatments. The following Table 1) illustrates the studies included in this review. It further specifies general information about the participants of the therapeutic focus of their recovery. There is no reason for the order in which the case studies are presented, it was randomized.

Table 1. Overview of studies included in this research

Study	Participant details	Languages	Cause of Aphasia	Aphasia Type	Methods	Therapy focus
Filiputti et al. (2002)	55/M[1]/RH[2]	L1 = Slovenian L2 = Italian L3 = Friulian L4 = English	Ischaemic CVA[3]	Wernicke's and temporary right hemisyndrome	Bilingual Aphasia Test and the Aachener Aphasia Test	Phonology Morphology Syntax Lexicon Semantics
Knoph, Lind and Simonsen (2015)	59/F/RH	L1 = Japanese L2 = English L3 = German L4 = Norwegian	Left hemisphere CVA	Moderate, non-fluent aphasia	Bilingual Aphasia Test and SFA (semantic feature analysis) therapy	Semantics Syntax
Goral, Naghibolhosseini and Connor (2013)	41/F/RH	L1 = Persian L2 = German L3 = English	CVA	Not mentioned but characterized by anomia, agrammatism and frequent rephrasing	Western Aphasia Battery and the constraint-induced aphasia treatment	Inhibition
Connor et al (2018)	65/M/*[4]	L1 = Dutch L2 = German L3 = French L4 = English L5 = Italian L6 = Norwegian L7 = Spanish	Left hemisphere CVA	Transcortical motor aphasia	Western Aphasia Battery, the Oral Reading for Language in Aphasia and the picture description task of the Bilingual Aphasia Test	Proficiency
Goral et al. (2012)	49/M/*	L1= Spanish/ Catalan[5] L2 = German L3 = French L4 = English	Ischaemic CVA	Non-fluent aphasia	Bilingual Aphasia Test and Picture-naming tasks	Proficiency
Goral, Levy, Obler and Cohen (2006)	46/M/RH	L1= Hebrew L2 = English L3 = French	Middle cerebral artery CVA	Non-fluent aphasia	Bilingual Aphasia Test and naturalistic conversations	Proficiency and cross-lexical connections
Goral, Levy and Kastl (2010)	49/M/RH	L1= Hebrew L2 = English L3 = French	Middle cerebral artery CVA	Mild non-fluent aphasia	Bilingual Aphasia Test	morphosyntax and language production rate
Mietsch, Meisel and Isel (2008)	48/M/RH	L1 = German L2 = English L3 = French	Ischaemic CVA	Mild to medium Wernicke's aphasia	Bilingual Aphasia Test	Word finding and semantic classification

Diéguez-Vide et al (2012)	20/M/*	L1 = Chinese L2 = Spanish L3 = Catalan	left frontoparietal intraparenchymal haemorrhage	Not mentioned	Bilingual Aphasia Battery	Recovery of typologically similar and dissimilar languages

[1] F & M referring to male or female.
[2] RH & LH referring to right or left handedness
[3] Cerebrovascular accident (stroke)
[4] Not mentioned in study
[5] This patients refers Spanish as well as Catalan as his first languages. No clear distinction was made in the study, apart from the fact that Catalan was used at home with family and friends while Spanish was used at school. He rated his comprehension and production in Spanish and Catalan the same, but stated his Spanish writing was better.

4.1 Evaluation of papers

The cases in Table 1 have already been selected for this review. The following evaluation criteria has been designed for them to be inclusive. In order to decide which papers have been included in the analysis of this review, a qualitative evaluation of each article was performed. This was done on the basis of whether the contents could answer the research questions asked. The cases were still included regardless of whether an article could only answer one or two of the questions asked. When this was the case, results would be analysed and discussed to put forward an answer to the proposed research questions if the given data would allow so.

Table 2 illustrates which papers can explicitly answer and support the claims made in the first three research question(s). The checkmarks mean that the claims made in the first three research questions related to Albert and Obler (1978) were observed in the case studies. The crosses mean the opposite, the claims could not be supported in the cases. The checkmarks on the row of RQ4 indicate that data on the other languages was available to make a judgement.

4.2 Observations

An immediate observation is that four out of the selected papers are led by the same researcher, Mira Goral. A professor and researcher who specializes in both aphasia and multilingualism. She was also involved in Connor et al.'s (2018) study, as a second author. Making her the most frequent researcher in this group of studies. Peggy Conner, who is also a professor and researcher specializing in aphasia and multilingualism, was likewise also an author in Goral's study in both 2012 and 2013, and led one herself in 2018. These researchers have thus worked together three times in this collection of studies. The cases that did not involve either of these two researchers were those of Filiputti et al. (2002), Knoph, Lind and Simonsen (2015), Miertsch, Meisel and Isel (2008) and Diéguez-Vide et al. (2012).

One notable observation seen in Table 1 is that both Goral et al. (2006) and Goral et al. (2010) seem to be studying the same patient. Based on the information given in both papers of the patient's background, languages and cause of lesion, it is safe to assume that this is the same patients being studied, but with different aims in each paper. The 2006 study (Goral et al.) researched lexical connections, while four years later in the 2010 (Goral et al.) paper looked into morphosyntax and speech rate. Though these articles and results may not be considered as independent data, they could be useful to investigate whether recovery patterns of the same patients, four years apart, occur in different linguistic domains.

It can also be observed that only two of the nine patients are women. This is surprising, as the rate of women with aphasia is higher than that of men (Sharma et al., 2019). Interestingly, no further information was found on handedness of three patients (those in Connor et al., 2019; Goral et al., 2012 and Diéguez-Vide et al., 2012). It would have been interesting to find a couple of case studies with left handed patients, as they are more likely to have a better chance of recovery (Bastiaanse & Prins, 2013).

Lastly, according to the National Health Service (NHS, 2019) most stroke accidents occur in individuals over the age of 55 years. Yet, one in four stroke cases occur in younger people (NHS, 2019) and two out of seven patients in this review acquired aphasia at quite a young age. This can be observed in Diéguez-Vide et al.'s (2012) case study. In which a young student suffered from a frontoparietal intraparenchymal haemorrhage, a bleeding in the brain. This bleeding causes a pool of blood to form, which is called a hematoma, which had to be extracted after surgery. Diéguez-Vide et al.'s (2012) patient is also the only individual that does not speak English. The rest of the studies all include a patients that is either a second language speaker of English or has listed it as one of their additional languages. Goral et al.'s (2013) study also researched a patient that acquired aphasia at a young age. This woman suffered from a CVA at the age of 28, but studied her 13 years later. These case studies stand out, as these patients are the only individuals that acquired aphasia in the prime of their lives.

4.3 Data extraction

Each study has been investigated separately in order to be able to answer the research question(s). An answer to the research question(s) was considered by looking at the results of the articles and analysing whether they could answer the current paper's research questions. The studies have not been be strictly compared with each other, yet observations were described and discussed whenever they occur.

Table 2. Research question(s) answered in each paper

	RQ1	RQ2	RQ3	RQ4
Filiputti et al. (2002)	✗	✓	✓	✓
Knoph, Lind and Simonsen (2015)	✗	✓	✓	✓
Goral, Naghibolhosseini and Connor (2013)	✗	✗	✓	✗
Connor et al (2018)	✗	✗	✗	✓
Goral et al. (2012)	✓	✓	✗	✓
Goral, Levy, Obler and Cohen (2006)	✓	✓	✗	✓
Goral, Levy and Kastl (2010)	✗	✓	✗	✓
Miertsch, Meisel and Isel (2008)	✗	✗	✗	✓
Diéguez-Vide et al (2012)	✓	✓	✗	✓

To summarise, a total of three studies show support for the L1 being recovered the best compared to the other languages as questioned in research question one. The rest of the case studies, six of them, could not support the first claim made by Albert and Obler (1978). As for their second claim, that multilinguals generally show more non-parallel recovery patterns, a total of six cases can provide support for it. While the three left over could not. Then for the third claim, that the L1 regresses when the L2 recovers, only three of the case studies included in this review can lend support to the claim. The leftover six cases could not support Albert and Obler's (1978) claim. As for the fourth research question created during the making of this review, only one case could not be used to help answer the question: what can be observed from the other languages after recovery? This was because Goral, Naghibolhosseini and Connor (2013) did not test their patient's third language.

5. Discussion

This literature review set out to explore whether the claims made by Albert and Obler's (1978) meta-analysis can be supported by more recent case studies. These were:

1. Will multilinguals recover their first language better than the other languages?
2. Do multilinguals show generally more non-parallel recovery patterns?
3. Will regression of the L1 be observed when the L2 later recovers?

All these case studies included multilinguals, described as polyglots by Albert and Obler (1978), speaking at least three languages or more. Since the 1978 analysis (Albert and Obler) only included the L1 and L2 in their claims whilst still studying polyglots, an additional research question was produced. This research question included multilinguals' other languages to analyse in post recovery language behaviour:

4. What can be observed from the other languages after recovery?

Observing Table 2. Research question(s) answered in each paper once again, it can be striking to see such mixed results. For example, RQ1 (whether the L1 recovers the best) was shown to be supported only three times. The same goes for R3 (L1 regresses after the L2 recovers), only three studies can support this. For RQ2, whether recovery is generally non-parallel, mixed results are observable. Through six cases are in favour of the question and show non-parallel recovery, there are still three cases left where this was not the case. Additionally, in all case studies were the all the languages spoken by the participant, rather than just two, tested and analysed. This allowed us to answer RQ4. Except for Goral et al. (2013), they did not test their participant's L2 (German), instead testing language abilities (action naming, description and narration) in Persian (L1) and English (L3) after having been treated in these two languages as well.

5.1 Regarding Language dominance and Regression

The cases that disagree with the claim made in the first research question (whether the L1 recovers better than the other languages), and those that agree with the claim made in the third research question (L1 will regress when the L2 recovers) will be discussed. The reason why these two claims, and whether they are supported by the case studies, are discussed in the same

paragraph is because they are somewhat related. There are two ends of the spectrum when it comes to these claims, L1 improvement and L1 regression.

5.1.1 The role of Age of Acquisition and Language Dominance

In both cases mentioned below, language dominance and the environment of the patients have played a crucial role in the recovery process. This begs the question whether L1 should always be considered as the language of highest proficiency purely bases on age of acquisition and whether Ribot's (1822) law, which again states that the earlier acquired memories (including languages) are more resistant to brain damage and attrition, can be applied to certain cases.

The participant in the Filiputti et al.'s (2002) case, E.G (redacted for anonymity), had not used his L1 mother tongue (Slovenian) since the age of 21. He had exclusively spoken this language up until he had to go to primary school at age six where he had to learn Italian, which was the teaching language. Other than Italian, E.G had also started learning Friulian at the age of 11, his L3, informally with his friends. At the age of 21, E.G emigrated to Canada and learned English as his L4 whilst still communicating in Italian with his wife at home. Interestingly, it was observed that he scored significantly worse in Slovenian (L1) compared to his other languages. It can be argued that this could have been the result of a heritage language never being fully developed, leading to language attrition in adulthood. Testing was performed in Italian (L2), primarily to improve his Italian morphology. While Italian performance in all domains seemed to be improving, the same cannot be said for his L1 Slovenian. The Slovenian version of the BAT (Bilingual Aphasia Test) was also still under development during the first assessment so it cannot be compared to the other first assessments. The L1 was shown to be decreasing in scores from the second to third assessment, which supports the second claim made by Albert and Obler (1978) according to which the L1 regresses when the L2 begins to recover.

Yet, scores on the syntax part of the assessment stayed at a constant value over the two assessment periods. This observation can be justified by considering that syntax is part of procedural knowledge, knowledge that is not consciously accessible, in language acquisition. Which was also observed in Tschirren et al. (2010) in which AoA seemed to also have an affect on syntactic processing in bilinguals' recovery following a stroke.

The same phenomenon of L1 regression can be observed in Goral et al.'s (2013) patient. Her self-rated proficiency of her languages, particularly that of her L1 Persian, contradicted with her test results. Though she claimed to be proficient in all of her three languages, see Table

1. She also stated that she had not attempted to produce any German (L2) or Persian (L1) since her CVA. The L2 German was not tested for, thus her L3 English will be considered when analysing the first (L1 recovers better than other languages) and third (L1 regresses when L2 recovers) research questions. Her English (L3) abilities stayed superior even after treatment. Suggesting that Ribot's (1882) law, stating that earliest acquired memories including language will be more immune to brain damage, may not always be upheld by certain case studies. This case also shows how unreliable self-ratings can be and that they should be taken with a grain of salt. If her languages would be ordered based on proficiency rather than age of acquisition, her L1 would then be English, Persian L2 and German L3.

5.1.2 At ceiling performance

The cases covered below can reason their support against L1 improvement. Can we really consider an L1, that is the most proficient before and after evaluation, as the best recovered language? All cases discussed below disagreed with the first claim and third claim made by Albert and Obler (1978), except for Knoph, Lind and Simonson's (2015) case. Only a small regression was observed in one of the subtest, lending support for the third claim however small it may be.

Regarding the patient of Knoph, Lind and Simonsen's (2015) study. She grew up in Japan and later moved to Norway where she now lives, treatment was therefore also in Norwegian (her L4). Though it was already clear that her L1 Japanese was the most proficient pre- and post-treatment, no significant improvements were observed compared to her other languages. Yet, some decreases were observed. A significant decrease of complex sentences was noticeable as her sentences also become less complete in Japanese. There was also a markable decrease in her Japanese speech tempo after treatment while it increased in her English (L2), agreeing with RQ3 (L1 regresses when the L2 recovers). This lack of improvement in her L1 could be due to several reasons. Her insignificant improvement in the L1 could also be due to the simple fact that she was already just too proficient in Japanese, which resulted in at ceiling performances in both pre- and post-treatment. Because of this, no significant improvements could be observed and her other languages were more noticeable in their improvements. It would seem her L1 has reached a plateau, in which no visible progress can be made and observed.

Miertsch, Meisel and Isel's (2008) patients, BL, shows the same patterns. He is a native German speaker and learnt English, L2, at the age of ten and French, L3, at the age of thirteen.

After graduating and receiving his PhD in Germany, he had started using English for everyday work life as he had also published many literary work in English. BL lived and worked in Paris at the end of the 1980s and rated his proficiency in both his L2 and L3 as 'very good'. Results reveal that his L1 still scored the highest compared to his L2 and L3. Though, again like the last case, his L2 scored significantly better possibly due to the at ceiling performance in his L1, German. And though his English (L2) significantly improved, no regression was observed in his first language, opposing the claim made in RQ3 (L1 regresses when L2 recovers). BL's German could also have reached a plateau like in Knoph, Lind and Simonsen's (2015) patient, in which no markedly improvements could be observed. It should be mentioned that prior to this study, BL had already received intensive language training to improve his German. That is unfortunate for the purpose of this review, as it would have been better to test the patients in their acute stage with no prior treatment.

It was mentioned before in the methods that Goral's team investigated the same participant in two separate studies, four years apart from each other. Interestingly, based on the results of each paper it can be observed that the participant, EC, scored better in his L1 Hebrew only during the testing in 2006. This could be due to the fact that there was a shorter period between his aphasia onset and recovery when EC was tested in 2006 on lexical interference and word translation, being tested in his acute stage. Resulting in a clearer spontaneous recovery in his most proficient language. He had even self-reported that Hebrew (L1) was rarely used before and after the stroke occurred, going back to the argument of how unreliable self-reports can be. Goral's testing in also 2006 included four hour treatment session in all three of his languages (L1 Hebrew, L2 English and L3 French) while the study in 2010 focused on whether cross-language generalisation was possible in morphosyntax and speech rates when being treated in only his L2 English. By this time he had already recovered most of his L1, thus the lack of improvement seen in his Hebrew in the 2010 study as no cross-language generalisations were found either. Here we again see the at ceiling performance phenomenon that explains why his Hebrew had not scored better compared to his English and French. And though EC's L2 (English) recovered in many aspects in the 2010 paper, no regression of his Hebrew was observed.

Connor et al.'s (2018) patient, DN, is an outlier in this discussion. Though Dutch is his native language spoken since birth and is still surrounded by Dutch in his environment, the L1 mysteriously did not recover the best. Dutch was the language of treatment and proficiency was measured by calculating the correct information units per minute (CIU/min). Post treatment

results show that French, DN's L3, had scored higher than Dutch. No regression in Dutch was observed either when German (L2) started to improve after treatment. Based on the data and DN's background, no explanation on why his L3 seemed to have scored the best can be made unfortunately.

5.2 Regarding a general non-parallel recovery

In three of the included case studies was a pattern of parallel recovery observed. These were in the case studies of Goral et al. (2013), Connor et al. (2018) and Miertsch, Meisel and Isel (2008). Why was this the case only in these three case studies? Some patterns were observed and tried to use in reasoning to answer the aforementioned question.

In Goral et al.'s (2013) case, both parallel and differential (non-parallel) patterns of recovery were observed. The participant showed a parallel within-language recovery pattern, as her English improved immensely after receiving treatment in English as well as her Persian after receiving Persian treatment. Both these language recovered significantly at the same time due to the patient receiving both of her languages' treatment. However, differential patterns were also observed as this patient would show more signs of error in English after receiving treatment in Persian. Thus, actually showing a more general non-parallel recovery.

In Connor et al.'s (2018) case, DN showed partial parallel recovery in his result. Mainly in his languages of higher proficiency other than Dutch, which were French, English, Italian and German. These languages all showed significant improvements after treatment in Dutch, resulting in parallel recovery as a possible result of cross-language generalisation. Previous research (Kohnert, 2004) would suggest that this could be due to linguistic similarities within these languages, yet Connor et al. (2018) supported evidence that parallel recovery would be greater in languages of similar proficiency no matter the linguistic distance. As one could say that Italian and Spanish are linguistically similar languages, yet DN did not gain significant results in his Spanish as it is one of his least proficient languages. This could be supported and argued by previous findings also showing that bilinguals' and multilinguals' lexical access is known to be greatly non-selective. Especially in the case of highly proficient multilingual speakers (Kroll, Bobb, Misra and Guo, 2008). Hoshino and Kroll (2008) even presented evidence for non-selective lexical access in multilinguals that speak languages of different scripts, in which the Japanese-English bilinguals named cognates pictures faster than control pictures.

Miertsch, Meisel and Isel's (2008) patient BL only showed parallel improvement in between his treated L3 (French) and his untreated L2 (English). A reason for this could be that treatment focused on the lexical and semantic levels of all these languages. Seeing that the untreated L2 significantly improved with the treatment of the L3 could support models of bilingual word recognition, even in multilinguals, and that these languages share the same semantic-conceptual memory. The reason no parallel improvement was observed in his first languages as well, German, could be due to what was already mentioned, his German performance was already at ceiling for clear improvements to be observed.

5.3 Regarding the language behaviour of the additional languages

Research question four was created to discover how additional languages, meaning either the L3 or another, would behave after recovery. Some interesting similarities within these nine case studies regarding the additional languages (L3+) were observed and will be analysed. Only a couple will be discussed and these all involve psychological factors regarding language use after or even before recovery. Some of these similarities are related to the emotional attachment of a language leading to recovery, while on the other side of the coin there are psychological factors such as anxiety preventing recovery. These will be discussed in the section below.

5.3.1 Positive emotions

The cases below have been selected for their interestingly shared phenomenon of positive outlooks on languages the patients would like to preserve. These include patients that have high emotional attachment to an additional language beside their L1 and L2 to want to recover and preserve. This begs the question whether a new "law" should be created and investigated, to be remembered alongside Ribot's and Pitres's law. One that involves a statement about how emotional attachment and high levels of motivations that could help preserve a language after brain damage.

In Filiputti et al.'s (2002) case, Italian was chosen by the patient and his family since it was the most used language in EG's daily life. Though, E.G's Friulian (L3) scored the best compared to all of his other languages on morphology and other domains (phonology, lexicon, syntax and semantics). EG considered Friulian as an important feature of his social life, using it daily with friends despite it not being the dominant language. It can be believed that his high emotional attachment to Friulian could be the reason behind his exceptional recovery.

The same argument can be used with Miertsch, Meisel and Isel's (2008) study. The study began 8 years post onset when BL was 58 years old, and the language of treatment was in his L3 (French). Though he still stayed more proficient in his first language (German), French (L3) showed signs of a significant recovery. This could partly be due to the patient's very strong emotional attachment to the language as he had stated before testing. BL had made strong personal relationships in France during his time there and had come to appreciate French culture and literature. This appreciation and attachment to the language and its culture gave BL a starting point in his road to recovery of his L3.

5.3.2 Negative emotions

The opposite of the previous section will be discussed here. This case was selected as it opposes the emotions felt by the participants discussed above. Here the participant experiences negative emotions regarding their L3 language use. An opposite law could be created here as well, that languages associated with negative emotions, such as insecurity, would not be recovered as quickly compared to the languages that do not have a negative attachment.

In the case of Diéguez-Vide et al.'s (2012) patient, WL, he had suffered from a large acute haemorrhagic stroke at the age of twenty. Prior to the accident, WL had reportedly been proficient in all his languages (L1 Mandarin; L2 Spanish; L3 Catalan). WL started learning Spanish in China at the age of nine and moved to Catalonia at the age of sixteen, where he had also started learning Catalan. Though it was quickly noticeable how uncomfortable WL was with being tested in Catalan, his L3. WL refused to speak Catalan in the verbal expression test, causing the researchers to halt this planned test. He again did not wish to participate in the written naming test regarding Catalan, and preferred to respond in Spanish. The researchers planned a longitudinal study several times, however this was not possible to carry out as WL did not wish to cooperate. WL showed potential signs of **linguist anxiety** which is not uncommon in aphasics and even dates back to aphasics in the 1940s (Cahana-Amitay et al, 2011). Cahana-Amitay et al. (2011) describe linguistic anxiety as the concern about one's impaired language performance. It could be especially bad in WL's case as he was just a twenty year old student when the accident happened, disrupting parts of his daily life and education.

5.4 Limitations and further research

This review came with its fair share of limitations. First of all, it is impossible to compare the outcomes of a review that included 50 individual case studies to a review that only included nine case studies. Quantitative wise, it did not make sense. A much larger pool of participants would be needed to truly compare the results and find whether they still support the three claims. It is also hard to take those claims made by Albert and Obler (1978) serious, as most of the studies they included lacked full details on either the results or methodology.

Second, there were not a lot of case studies found of this field found in general let alone the ones that met the criteria of this study. This made it harder to make generalisation based from the limited results. Though, the smaller pool of case studies did make it possible to observe smaller details that would have otherwise been overlooked in lets say a meta-analysis that includes more case studies. It was made clear that individual case studies on multilingual aphasic individuals are scarce and often labelled together with bilingual studies. What could be the reason behind this? It was observed that these previous reviews (Lerman, Goral & Obler, 2020; Kuzmina et al., 2019; KK Nair et al., 2021) did not differentiate bi- and multilingual aphasics in their reviews. Some of the case studies in the present review were included in theirs. It would be interesting to investigate why no distinction is made between bi- and multilingual aphasics, seeing as Albert and Obler (1978) felt the need to make claims about these two groups of people separately. It could perhaps be due to the simple fact that not a lot of attention has been given to "true" multilinguals, speakers of three or more languages, as previous literature has often grouped bi- and multilinguals together.

Another limitation was that the studies included were all very heterogeneous. Tendencies could perhaps have been easier to observe if all the case studies were somewhat similar. These similarities could have been that all cases spoke exactly three languages, were all tested in one of their languages, and were tested in their acute stages (four to six weeks post-onset), etc. Yet, even though these cases were very different from each other, patterns could still be observed.

Regarding future directions related to the review, it would be helpful to try to find participants in their acute stage of recovery for research. This way there are no biases as some of the patients in this study have already been treated in their first language before the start of the study. For a possible future review, it would be interesting to explore the differences between bi- and multilingual aphasics in their recovery as they have often been grouped together in previous research (Lerman, Goral & Obler, 2020; Kuzmina et al., 2019; KK Nair et al., 2021).

Regardless of the outcome of this study or any future study, it is important to consider the needs and the best possible outcome of treatment for the patients and their families. We hope more studies on multilingual aphasia recovery will become available and expands our understanding of language recovery in this population.

6. Conclusion

This study set out to investigate specific language behaviour in the recovery process of multilingual aphasics using three claims made by Albert and Obler in 1978 with more recent case studies. These claims were that multilingual aphasics: a) recover their first language better compared to their other languages, b) tended to have more non-parallel recovery and c) show signs of L1 regression when the L2 later recovers. Mixed results were observed in the first three research questions, thus a definite conclusion cannot be made. It seems that the first language does not necessarily always recovers the best compared to the other languages, opposing Ribot's law, and that it does not always regress after recovering the second language. In one case, a patient's negative emotions dominated over Pitres's law, suggesting that a new law about positive and negative emotions about ones language use could be constructed. Factors that could influence were found to be language dominance and at ceiling performance. Not all case studies tested their participants in their acute stages post-accident either. A shared semantic-lexical conceptual memory could explain parallel recovery with balanced and skilled multilinguals, yet more researched should be done in order to make claims like this. We believe that future research on multilingual aphasia would immensely improve not only the field of aphasiology, but also the lives of hundreds of patients suffering from this disorder.

7. References

"Europeans and their languages, a survey co-ordinated by the European Commission" (PDF). European Commission. Archived (PDF) from the original on 5 February 2016. Retrieved 15 November 2016.

Ansaldo, A. I., & Saidi, L. G. (2014). Aphasia Therapy in the Age of Globalisation: Cross-Linguistic Therapy Effects in Bilingual Aphasia. *Behavioural Neurology*, 2014, 603085–10. https://doi.org/10.1155/2014/603085

Bastiaanse, R. (2010). *Afasie.* Houten: Bohn Stafleu van Loghum.

Bastiaanse, R., & Prins, R. (2013). Aphasia. In L. Cummings (Ed.), *The Cambridge Handbook of Communication Disorders* (Cambridge Handbooks in Language and Linguistics). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139108683.016

Cahana-Amitay, D., Albert, M. L., Pyun, S.-B., Westwood, A., Jenkins, T., Wolford, S., & Finley, M. (2011). Language as a stressor in aphasia. *Aphasiology, 25*(5), 593–614. https://doi.org/10.1080/02687038.2010.541469

Cenoz, J. (2013). Defining Multilingualism. *Annual Review of Applied Linguistics, 33*(Mar), 3–18. https://doi.org/10.1017/S026719051300007X

Conner, P. S., Goral, M., Anema, I., Borodkin, K., Haendler, Y., Knoph, M., … Moeyaert, M. (2018). The role of language proficiency and linguistic distance in cross-linguistic treatment effects in aphasia. *Clinical Linguistics & Phonetics, 32*(8), 739–757. https://doi.org/10.1080/02699206.2018.143572

Diéguez-Vide, F., Gich-Fullà, J., Puig-Alcántara, J., Sánchez-Benavides, G., & Peña-Casanova, J. (2012). Chinese–Spanish–Catalan trilingual aphasia: A case study. *Journal of Neurolinguistics, 25*(6), 630–641. https://doi.org/10.1016/j.jneuroling.2012.01.002

Filiputti, D., Tavano, A., Vorano, L., De Luca, G., & Fabbro, F. (2002). Nonparellel recovery of languages in a quadrilingual aphasic patient. *The International Journal of Bilingualism : Cross-Disciplinary, Cross-Linguistic Studies of Language Behaviour, 6*(4), 395–410. https://doi.org/10.1177/13670069020060040201

Goral, M., & Hejazi, Z. (2021). Aphasia in Multilingual Patients. *Current Neurology and Neuroscience Reports, 21*(11), 60–60. https://doi.org/10.1007/s11910-021-01148-5

Goral, M., & Lerman, A. (2020). Variables and mechanisms affecting response to language treatment in multilingual people with aphasia. *Behavioral Sciences, 10*(9), 1–. https://doi.org/10.3390/BS10090144

Goral, M., Levy, E. S., Obler, L. K., & Cohen, E. (2006). Cross-language lexical connections in the mental lexicon: Evidence from a case of trilingual aphasia. *Brain and Language, 98*(2), 235–247. https://doi.org/10.1016/j.bandl.2006.05.004

Goral, M., Naghibolhosseini, M., & Conner, P. S. (2014). Asymmetric inhibitory treatment effects in multilingual aphasia. *Cognitive Neuropsychology, 30*(7-8), 564–577. https://doi.org/10.1080/02643294.2013.878692

Goral, M., Norvik, M., & Jensen, B. U. (2019). Variation in language mixing in multilingual aphasia. *Clinical Linguistics & Phonetics, 33*(10-11), 915–929. https://doi.org/10.1080/02699206.2019.1584646

Goral, M., Rosas, J., Conner, P. S., Maul, K. K., & Obler, L. K. (2012). Effects of language proficiency and language of the environment on aphasia therapy in a multilingual. *Journal of Neurolinguistics, 25*(6), 538–551. https://doi.org/10.1016/j.jneuroling.2011.06.001

Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Brain and Language*, *36*(1), 3–15. https://doi.org/10.1016/0093-934X(89)90048-5

Grosjean, F., Li, P., Bialystok, E., Barac, R., Groot, A. M. B. de, Manchón, R., & Yip, V. (2013). *The psycholinguistics of bilingualism*. Hoboken: Wiley-Blackwell/John Wiley & Sons.

Hoshino, N., & Kroll, J. F. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition, 106*(1), 501–511. https://doi.org/10.1016/j.cognition.2007.02.001

Kiran, S., and Roberts, P. M. (2010). Semantic feature analysis treatment in Spanish–English and French–English bilingual aphasia. *Aphasiology 24*,231–261. doi:10.1080/02687030902958365

KK Nair, V., Rayner, T., Siyambalapitiya, S., & Biedermann, B. (2021). Domain-general cognitive control and domain-specific language control in bilingual aphasia: A systematic quantitative literature review. *Journal of Neurolinguistics, 60*, 101021–. https://doi.org/10.1016/j.jneuroling.2021.101021

Knoph, M. I. N., Lind, M., & Simonsen, H. G. (2015). Semantic feature analysis targeting verbs in a quadrilingual speaker with aphasia. *Aphasiology, 29*(12), 1473–1496. https://doi.org/10.1080/02687038.2015.1049583

Kohnert, K. (2004). Cognitive and cognate-based treatments for bilingual aphasia: A case study. *Brain and Language, 91*(3), 294–302. https://doi.org/10.1016/j.bandl.2004.04.001

Kroll, J. F., Bobb, S. C., Misra, M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. *Acta Psychologica, 128*(3), 416–430. https://doi.org/10.1016/j.actpsy.2008.02.001

Kroll, J. F., Dussias, P. E., & Bajo, M. T. (2018). Language Use Across International Contexts: Shaping the Minds of L2 Speakers. *Annual Review of Applied Linguistics*, 38, 60–79. https://doi.org/10.1017/S0267190518000119

Kuzmina, E., Goral, M., Norvik, M., & Weekes, B. S. (2019). What influences language impairment in bilingual aphasia? A meta-analytic review. *Frontiers in Psychology, 10*, 445–445. https://doi.org/10.3389/fpsyg.2019.00445

Lerman, A., Goral, M., & Obler, L. K. (2020). The complex relationship between pre-stroke and post-stroke language abilities in multilingual individuals with aphasia. *Aphasiology, 34(*11), 1319–1340. https://doi.org/10.1080/02687038.2019.1673303

Martin, C. D., Strijkers, K., Santesteban, M., Escera, C., Hartsuiker, R. J., & Costa, A. (2013). The impact of early bilingualism on controlling a language learned late: an ERP study. *Frontiers in Psychology*, *4*, 815–815. https://doi.org/10.3389/fpsyg.2013.00815

Miertsch, B., Meisel, J. M., & Isel, F. (2009). Non-treated languages in aphasia therapy of polyglots benefit from improvement in the treated language. *Journal of Neurolinguistics*, *22(*2), 135–150. https://doi.org/10.1016/j.jneuroling.2008.07.003

Mirdehghan, M., farokhnezhad, Z., Akbari, M. (2020). A Case Study of Bilingual Aphasia (in Comparing the Usage of Content and Function Words): A Kurdish-Persian Case. *Journal of Iranian Dialects Linguistics*, 4(2), 113-132. doi: 10.22099/jill.2020.33471.1131

Moon, J., & Jiang, N. (2012). Non-selective lexical access in different-script bilinguals. *Bilingualism (Cambridge, England)*, *15*(1), 173–180. https://doi.org/10.1017/S1366728911000022

Murdoch, B. E. (2010*). Acquired speech and language disorders : a neuroanatomical and functional neurological approach* (2nd ed). Chichester: Wiley & Sons.

National Health Service. (2019, August). *Conditions/Stroke/Causes.* https://www.nhs.uk/conditions/stroke/causes/

Pitres, A. (1895/1983). "Aphasia in polyglots," in *Readings on Aphasia in Bilinguals and Polyglots*, ed M. Paradis (Montreal, QC: Marcel Didier), 26-49

Ribot, T. A. (1882). *Diseases of Memory: An Essay in the Positive Psychology.* New York, NY: Appleton.

Roberts, P. M., and Kiran, S. (2007) "Assessment and treatment of bilingual aphasia and bilingual anomia:, in *Ramos Speech and Language Disorders in Bilinguals*, eds A. Ardila and E. Ramos (New York, NY: Nova Science), 109-130

Sharma, S., Briley, P. M., Wright, H. H., Perry, J. L., Fang, X., & Ellis, C. (2019). Gender differences in aphasia outcomes: evidence from the AphasiaBank. *International Journal of Language & Communication Disorders*, *54*(5), 806–813. https://doi.org/10.1111/1460-6984.12486

Tschirren, M., Laganaro, M., Michel, P., Martory, M.-D., Di Pietro, M., Abutalebi, J., & Annoni, J.-M. (2011). Language and syntactic impairment following stroke in late bilingual aphasics. *Brain and Language*, *119*(3), 238–242. https://doi.org/10.1016/j.bandl.2011.05.008