Phonetics, Phonology and Prosody of Code-Switching: A Scoping Review

by

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Abstract

Despite growing interest in bilingual phonetics, limited attention has been given to the phonetic characteristics of code-switching. To inspire and direct future research, this study presents a scoping review of the phonetics and phonology (including prosody) of code-switching. The review aims to identify the language combinations studied and describe the demographic and bilingualism-related characteristics of the participant populations. Furthermore, it intends to outline common experimental methods used to elicit phonetic data and identify the segmental and suprasegmental features investigated. Two researchers systematically searched 7 academic databases, following the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocol (PRISMA-P). Additionally, sources were identified through mailing lists and social media outreach. A total of 54 relevant studies were included in the final analysis. The review reveals a strong bias toward studies involving Spanish-English bilinguals, particularly in North America. It also shows a predominant focus on segmental analyses, specifically voice onset time in word-initial voiceless consonants. In contrast, studies investigating suprasegmental features such as intonation remain scarce. Findings also indicate limited information on the influence of the matrix and embedded language on each other at the phonetic level. Finally, a terminological consensus on code-switching is yet to be reached, mirroring trends across code-switching research more generally. Based on these findings, the study offers recommendations such as diversifying language combinations, exploring underrepresented phonetic features, and improving reporting of participant demographic data. These recommendations may be used to refine and expand future research on the phonetics, phonology and prosody of code-switching.

Keywords: code-switching, phonetics and phonology, prosody, bilingual phonetics, Voice Onset Time

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Go raibh míle maith agaibh.

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List of Abbreviations

2	second person
3	third person
ADV	adverb
COP	copula
DEM	demonstrative
EMPH	emphatic
EXCL	exclamative
IMP	imperative
NEG	negation
NEUT	neuter
PRED	predicative
PREP	preposition
PRON	pronoun
PRS	present
SG	singular
V	verb

1. Introduction

This scoping review explores the phonetics, phonology, and prosody of code-switching, and has been conducted in accordance with the Joanna Briggs Institute (JBI) methodology for scoping reviews. The rationale and objectives presented in this section are slightly modified versions of those presented in the pre-registered protocol for this scoping review, which can be found on OSF (https://osf.io/qrdjz/).

1.1 Rationale

Phonetic research on bilingualism has experienced a surge in scholarly attention in recent years (Bullock, 2009), following a growth in immersion experiences such as study abroad programmes and intensive language immersion. Within this expanding body of work, research on phonetics, phonology and prosody has centred on phenomena such as phonetic drift, features such as Voice Onset Time (VOT), and prosodic processing (Bongiovanni et al., 2015; Chang, 2013). Within phonetic drift research, for example, short-term improvements towards 'native-like' norms are often underpinned by the Speech Learning Model (SLM) proposed by Flege (1995). This model focuses on how learners of a second language (L2) perceive and produce speech sounds in the L2. The SLM focuses on the interaction between learners' first language (L1) and L2 phonetic systems, and how the interaction influences the attainment of an accurate, or 'native-like' L2 pronunciation. This is the only model to be used, and by default liberally, as an L2 framework for L1 phonetic changes. Similar models have only recently been suggested concerning prosody in L2 learning (L2 Intonation Learning theory (LILt) (Mennen et al., 2015). These models suggest a shared phonetic and prosodic space in which L1 and L2 sounds exist and have been found to influence each other within the first 4 weeks of immersion (Chang, 2013). Many of these studies have focused on early-stage late sequential language learners. However, future research should aim to broaden its focus to encompass all bilingual populations. Therefore, populations such as balanced bilinguals and heritage speakers should also receive attention in research on the phonetics of bilingualism.

This current study, a scoping review, aims to map the available literature on an aspect of phonetic research on bilingualism which has not been widely addressed. Specifically, this scoping review concerns the phonetics, phonology and prosody of code-switching. Code-switching refers to bilingual[1] speakers using more than one language in the same interaction. This switching may occur at the word, clausal, sentential or conversation level (Deuchar, 2012). Code-switching can be broadly[2] categorised as intra- and interclausal in which a

[1] Unless otherwise stated, we use the term bilingual in this protocol to refer also to tri- and multilingual.
[2] A broad categorisation is offered here. However, many other categorisations also exist, such as congruent lexicalisation, backflagging and tag-switching (Musyken, 2000). Furthermore, code-switching can also occur within a single word, such as in intraword switching (e.g., a root and an affix). For more on intraword code-switching see Stefanich et al. (2019).

language switch occurs within a clause or between two clauses (Parafita Couto et al., 2023). Examples of intra- and interclausal switching are respectively as follows:

In these examples, bold text is used for produced utterances, with normal **bold text** indicating Irish and ***italic bold*** text representing English. A gloss is provided under each produced utterance in a smaller font, while the translation is provided at the bottom in regular text surrounded by single quotation marks (‘…’):

(1) [Irish-English] [Intraclausal]

Ó tá sin go hálainn, tá sé *beautiful*

Ó	**tá**	**sin**	**go**	**hálainn**	**tá**	**sé**
EXCL	be.V.COP.PRS	DEM	PRED	beautiful.ADV	be.V.COP.PRS	PRON.3SG

beautiful

ADJ

‘Oh, that’s beautiful, it is beautiful.’ (Adapted from Ní Laoire, 2016, p. 91)

(2) [Irish-English] [Interclausal]

Ná déan sin! *Don’t even think about it!*

Ná	**déan**	**sin**	***Don’t***	***even***	***think***
NEG.IMP	do.V.PRS.2SG	DEM	do.V.NEG.IMP.2SG	EMPH	think.V.PRS.2SG

about	***it***
PREP	3SG.NEUT.PRON

‘Don’t do that. Don’t even think about it!’ (Adapted from Ní Laoire, 2016, p. 91)

Other code-switching categorisations include insertion and alternation as proposed by Muysken (2000). Insertional code-switching concerns the insertion of elements or constituents (e.g., lexical items) from one language into the structure of the other language.

An example of this is provided below in (3), in which an English (***bold italic***) prepositional phrase is inserted into a Spanish structure (**bold**).

(3) [Spanish-English] [Insertion]

Yo anduve *in a state of shock* pa dos días.

'I walked in a state of shock for two days.'
(Muysken, 2000, p. 5, citing Pfaff, 1979, p. 296)

Additionally, alternational code-switching (Muysken, 2000) refers to a complete switch from one language to another. Thus, there is an alternation between structures of languages, with each language occurring only within its own structure. This is showcased in (4) below, in which there is a complete change from French **(bold**) to Russian (***bold italic***) involving both grammar and lexicon.

(4) [French-Russian] [Alternation]

Les femmes et le vin, *ne ponimayu*.

'Women and wine, I don't understand.'
(Muysken, 2000, p. 5, citing Timm, 1978, p. 126)

The above categorisation of insertion by Muysken (2000) can be compared to Myers-Scotton's (1993, 2002) Matrix Language Frame model (MLF). This framework distinguishes between a matrix language, which provides the morphosyntactic structure (i.e., the system morphemes or functional elements) of a sentence, and an embedded language, which supplies inserted lexical elements or content morphemes. To identify the matrix language in a code-switched clause, Myers-Scotton (2002) introduced two principles: the Morpheme Order Principle and the System Morpheme Principle. The Morpheme Order Principle states that constituent order in a bilingual clause follows the matrix language. The second principle asserts that the matrix language supplies the functional elements in such a clause, referred to as system morphemes in the MLF framework.

This community-specific[3] practice often occurs in minority and migrant communities, where individuals typically have bilingual language profiles shaped by migration, education and social environments. For instance, in "communities where the home language is different

[3] Important to note, that while it can be community-specific, code-switching also takes place in other settings in the absence of a community, such as between single bilingual family members, such as between parents-children or siblings, or friends.

from the majority societal language, different generations may codeswitch in different ways and for different reasons" (Beauty-Martinez et al., 2025, p. 3). Community members may regularly use multiple languages in their daily lives, and it is this dual-language usage that creates a natural environment for blending languages within conversations as individuals navigate and cater to their interlocutor within changing linguistic and cultural contexts. This practice is governed by many factors, including the geographical, historical and social settings within each community and the profile of its bilingual speakers (Parafita Couto & Balam, in press). Despite the widespread prevalence of multilingual communities worldwide (Beatty-Martinez et al., 2025), most of the research on code-switching comes from Spanish-English communities in the USA (Parafita Couto et al., 2023). This is largely due to the availability of university researchers and bilingual speakers, a bias which will be addressed both in the Results and Discussion sections of this scoping review.

Researchers have extensively studied the grammatical structures involved in and created during code-switching for decades (Myers-Scotton, 2008; Pfaff, 1979; Woolford, 1983). Compared to the limited research on the phonetics of code-switching, researchers have developed a more advanced understanding of its syntactic and morphological patterns. A wealth of descriptive and theoretical literature exists on morpho-syntactic aspects of code-switching (Parafita Couto et al., 2023), whilst aspects of speech sounds often remain underexplored (Olson, 2024). The adaptation of loan words has received much attention from phonologists (Jacobs & Gussenhoven, 2000; Kang, 2011; van Coetsem, 1988, see Broselow, 2009 specifically for prosody), creating an entire subdiscipline of *loanword phonology.* This subdiscipline plays a key role in understanding how borrowed elements are integrated into the recipient language. Yet, researchers have debated for more than half a century about how to identify borrowings and code-switches (Stammers & Deuchar, 2011). This debate is demonstrated in the current study by the large proportion of results relating to borrowings instead of code-switches from the advanced search of databases in this scoping review.

The integration or convergence between sound systems in code-switching has received less attention. For example, Spanish-English code-switching studies on VOT, the language combination and segmental feature which have been the focus of the majority of phonetic studies on code-switching, have produced mixed results. VOT is defined as the temporal difference, measured in milliseconds, between the release of a stop consonant and the onset of voicing of the following segment (Lisker & Abramson, 1964). López (2012) had Spanish-English bilinguals act as their own controls in a reading aloud task of monolingual and code-switched sentences. The author found no significant differences between the VOT of L2 dental stop /t/ produced in monolingual sentences and in Spanish-English code-switched sentences. Meanwhile, Balukas and Koops (2014) also measured VOT of voiceless stops produced by Spanish-English bilinguals and found differences in only one language. The authors analysed a spontaneous speech sample and found that the VOT of their bilingual speakers' L2 English was shorter when produced closer to a code-switch, but there was no effect for L1 Spanish. Furthermore, Bullock et al. (2006) found effects of code-switching on the VOTs of both languages. Using sentence reading tasks in monolingual and code-switched conditions, the researchers found that the L2 English VOT of Spanish speakers was shorter in the code-switching context, but VOT of their L1 was not affected. On the other hand, their L1

English speakers showed a shortening of both English and Spanish VOT in code-switching contexts. Olson (2013) also found effects on both languages during code-switching. In his cued picture naming task, the VOT of the speakers' dominant language (English or Spanish) shifted towards the non-dominant language under code-switching, while the non-dominant language was not affected. Olson (2013) concluded that the differences observed in both languages were caused by language dominance. Bullock et al. (2006), on the other hand, concluded that language dominance was not a contributing factor to the observed differences. These varied results and interpretations - based on just one language pair and segmental feature - characterise this emerging interdisciplinary field.

Olson (2024) has called for future code-switching research to include more diverse language pairings, as previous research on code-switching has focused largely on Indo-European language pairings, more specifically, the combination of Spanish and English. Furthermore, Olson (2024) emphasises the need for phonetic research to examine a wider array of (supra)segmental features, in order to counterbalance the current overrepresentation of VOT studies. These recommendations by Olson (2024) are supported by the findings of this scoping review (see Results), and a further discussion of the implications of this bias will follow in the Discussion section.

Future research, particularly concerning reviews of such literature, must also address a terminological inconsistency within the field of code-switching (Bullock, 2009). Terms such as code-switching, language switching, language mixing, code-mixing and even translanguaging are often used inconsistently across studies. Some researchers use them interchangeably (Romaine, 1995), while others, such as Olson (2013), assign specific meanings based on structural and functional criteria. This lack of terminological consensus complicates cross-study comparisons, blurs theoretical boundaries and presents significant challenges for synthesising findings, developing clear typologies and advancing cumulative knowledge. Researchers may, for instance, describe the same phenomena using different terms, or different phenomena using the same terms. To mitigate this issue and ensure comprehensive coverage of phonetic studies involving the use of more than one language in an utterance or conversation, key terms within the search strategy (see Methods) have been curated independently by all the team members. These team members are the first author (Deasy), the checker (Dancheva) and three supervisors (Parafita Couto, Chen and Muntendam). The chosen terms reflect both prior research experience and insights from the literature, aiming to capture as much relevant literature on the same phenomenon as possible.

The aforementioned challenges in code-switching and phonetic research on bilinguals underscore the relevance and timeliness of a scoping review, which is the focus of the present study. By reviewing the phonetics, phonology and prosody of code-switching across diverse bilingual contexts, this review aims to systematically map the existing body of research, identify prevailing methodological approaches, and highlight gaps in knowledge. Unlike systematic reviews, which are designed to answer narrowly defined research questions and often include quality appraisal of studies, scoping reviews are exploratory in nature. They aim to clarify what is known about a topic and are particularly useful in emerging or under-

researched fields (Munn et al., 2018). As such, the scoping review may serve as a precursor to a more targeted systematic review (Tricco et al., 2018).

The decision to adopt a scoping review methodology was guided by the limited volume of research specifically addressing the intersection of phonetics and code-switching, as well as the broad range of methodologies employed in the field – from spontaneous speech data to experimental paradigms. This methodological diversity, along with the inclusion of both published and unpublished sources, aligns with the inclusive and flexible nature of scoping reviews (Peters et al., 2020). Finally, given the community-specific nature of code-switching (cf. Beatty-Martinez et al., 2025), a scoping review provided a valuable framework for mapping existing evidence across different temporal and geographic locations.

In the following sections, we will first outline the six research objectives of this scoping review addressed in the form of thirteen research questions. In the Methods section, the criteria for study inclusion, information sources and a flowchart describing the data collection and selection procedure will be presented. The findings of the data extraction process will be presented in the Results section alongside figures and graphs. Finally, the Discussion section will consider the bias in the scope of included studies and populations, the implications of the findings for future research, and the limitations of the current review.

1.2 Objectives

This scoping review will examine and map the research available to date on the phonetics of code-switching across bilingual contexts to answer the objectives and research questions as presented in Table 1:

Table 1. Objectives and research questions.

Objectives		**Research questions**
(i)	identify language combinations in which the phonetics of code-switching have (not) been investigated	1. For which language combination(s), in which geographic locations, have the phonetics/phonology/prosody of code-switching been investigated?
(ii)	describe the demographic and bilingualism-related characteristics of participants investigated	2. What were the demographic characteristics of participants in which the phonetics/phonology/prosody of code-switching has been investigated (geographic location, age range, sex and gender distribution, socioeconomic status, bilingual profile)? 3. How many participants were involved in studies investigating the phonetics/phonology/prosody of code-switching?

(iii)	identify approaches and methods used to explore the phonetics of code-switching in these populations	4. Was code-switching the main focus of the investigation, or was it addressed sporadically? 5. How was code-switching defined? 6. Which approach was used to explore code-switching in participants: spontaneous speech, semi-experimental approach, experimental approach, a combination? 7. Which method was used to elicit phonetic/phonological/prosodic data: production, perception, production-perception? 8. Which type of subject design was used: within-subject, between-subject, within and between-subject? 9. Which method was used to analyse the code-switching data: quantitative, qualitative, mixed method?
(vi)	identify (supra)segmental features investigated in these populations	10. Which segmental features have been explored in the code-switching of participants,: (such as)[4] vowel height, lenition, VOT? 11. Which suprasegmental features have been explored in the code-switching of participants: (such as) intonation, stress, rhythm, lexical tone?
(vii)	identify which types of code-switching have been explored	12. Which types of code-switching have been explored in phonetic research: within-word, between-words, within-utterance and between-utterances?
(viii)	outline findings on the influence of the matrix and embedded language on each other at the phonetic level.	13. Are there indications of phonetic/phonological/prosodic influence between the matrix and embedded language: unidirectional, bidirectional?

[4] Listed features were subject to modification following data collection, as at the time of pre-registration, it was not possible to predict which (supra)segmental features would appear in the literature.

2. Methods

This section documents the pre-registration of the protocol for this review, the data collection process, as well as the data extraction process. These processes were undertaken by the first author and the checker. Further information concerning the breakdown of tasks among all five project members can be found in the pre-registered protocol on the project OSF page.

2.1 Protocol and pre-registration

A preliminary protocol was prepared according to the JBI methodology for scoping reviews. Foundational guidance was drawn from Levac et al. (2010) and Munn et al. (2018, 2022) to gain a comprehensive understanding of scoping review methodology prior to initiating the protocol. The design, formatting and decision-making processes were further informed by Peters et al. (2015, 2020, 2024) and Tricco et al. (2018). Additional insights were drawn from Kašćelan and Parafita Couto (2024). The protocol was pre-registered on the Open Science Framework (OSF) on 13 January 2025. Throughout this review, we use footnotes to specify any changes to the pre-registered protocol and provide a justified rationale for those decisions. At the time of pre-registration, no prior or ongoing reviews on the topic were known. A subsequent search conducted on 24 March 2025, using the Web of Science database, Google Scholar and OSF, yielded no additional scoping reviews or pre-registrations on the topic.

2.2 Eligibility criteria

We adhered to the eligibility criteria as reported in the pre-registered protocol (Deasy et al., 2025). The table in this section is a close adaptation of that found in the protocol. Table 2 reports on the eligibility criteria for inclusion with a summary of the criteria relating to population, concepts and context of interest.

Table 2. Scoping review criteria for Population, Concepts and Context (PCC).

PCC element	Criteria
Population	N/A
Concept	Code-switching is the concept under investigation in this scoping review. All types of code-switching were included, therefore, any use of more than one language in an utterance or conversation was eligible, regardless of how it was labelled in each included study. This scoping review also concerns the concepts of phonetics, phonology and prosody. Therefore, studies that investigated speech sounds were included. The search

	strategy section below outlines the terms used when searching the literature.
Context	The context relates to any bilingual community from any geographic location, with any language combination(s) and with any type of bilingualism (e.g., simultaneous, sequential, early, late, etc.). Bilingual individuals (of any age, sex, gender, language combination(s) and socioeconomic status) were included in this scoping review. See the search strategy below for further specifications of bilingualism-related terms.

2.3 Information sources

As scoping reviews lend themselves to the inclusion of all types of literature sources (Peters et al., 2020), there were no methodological restrictions and quantitative, qualitative and mixed-method studies were all included. Furthermore, any approach used to investigate code-switching was included: spontaneous speech, semi-experimental, experimental, or a combination of these.

This scoping review includes published journal articles, book chapters, conference proceedings and unpublished literature such as posters, dissertations and theses. In cases of evidence synthesis, we did not include such literature directly in our scoping review. Instead, we followed up on the original papers reviewed in each synthesis. The references of all included abstracts[5] were also screened, and relevant literature was then included for full text review. A breakdown of the abstract and full text screening process can be found on the project OSF page. This page contains a complete dataset component of entries from search engines along with specified reasons for exclusion.

The following electronic databases were searched: EBSCOhost, ProQuest, Taylor & Francis, Web of Science, Google Scholar, Leiden University Library Catalogue and Cambridge University Library Browser. All databases were searched between 27 January and 2 February 2025. There was no restriction on the starting date for filtering on these databases.

In addition to the systematic database search, several strategies were employed to identify relevant literature. An announcement about the scoping review was made in the form of an email and poster (see Appendix A) on mailing lists and social media platforms. The email was distributed via mailing lists including The LINGUIST List, the Codeswitching Reading Group and the Bilingual, Mind, and Brain Lab at the University of California Irvine

[5] This deviated from the pre-registered protocol, as we opted to screen the references of included abstracts rather than waiting until the full text screening stage. This decision was based on two factors: (1) we could identify more relevant articles from 53 included abstracts than from 28 included full texts; and (2) due to personal circumstances, the checker was occasionally delayed, giving the first author time between stages to independently screen the reference lists of included abstracts.

mailing list, in January 2025. Three project members posted or reposted the poster on X, LinkedIn and Bluesky during the same period. Personal communication with researchers who responded to the announcement revealed that the poster had also been circulated on Instagram and various WhatsApp groups. This outreach enabled the collection of both published and unpublished work that was not likely to be published before the completion of this scoping review. Additionally, project members identified further relevant studies through their own research and familiarity with the phonetics and code-switching literature. As mentioned previously, the reference lists of sources whose abstracts were included were also screened for further materials.

There were no language restrictions during the search stage. The collaborators understand Bulgarian, Dutch, English, French, Galician, German, Irish, Italian, Portuguese, Sinitic varieties (including Cantonese, Taiwanese and Mandarin) and Spanish. Based on the search results, it was not necessary to exclude any sources based on language.

2.4 Search strategy

The original key term list can be found in the pre-registered protocol (Deasy et al., 2025), and the updated key term lists[6] can be found in Appendix B of this review. For all databases except Google Scholar, there were three sets of key terms: Key Term 1 was code-switching related (e.g., code-switch, codemixing, borrowing, intra-sentential, etc.), Key Term 2 was phonetics related (e.g., segmental, suprasegmental, formant, VOT, etc.) and Key Term 3 was context-related (e.g., bilingual, "heritage speaker", "second language", L2, etc.). Each term within a category as outlined in the PCC criteria was connected via a Boolean operator *OR*. These categories were then connected with a Boolean operator *AND*, as follows: (*Key Term 1*) *AND* (*Key Term 2*) *AND* (*Key Term 3*). These lists underwent several rounds of revisions between the first author and checker and were further modified based on the advanced search functions of each database. For example, Web of Science and EBSCOhost required Key Term + ING as a separate item in each necessary case. Taylor and Francis and ProQuest produced results without the need to input such versions of each term. All key term lists were agreed upon between the first author and the checker.

Each database, except Google Scholar, was filtered via titles and abstracts. Titles and abstracts were deemed the most relevant information sources, as filtering via full texts produced many results outside the current scope in initial trials.

While the university databases also had three sets of key terms, the lists had to be shortened considerably for these databases, as there was a 30-word limit in advanced searches for the Cambridge University Library Browser specifically. See Appendix B for this shortened list. Meanwhile, the Leiden University Library Catalogue had to be searched based on titles and descriptions instead of titles and abstracts. Descriptions in the Leiden database

[6] The original key term list underwent significant changes after an initial advanced search of databases, as it became evident that the list was overly broad, yielding many irrelevant results. For instance, the original list was entered into ProQuest, and generated 9,110 abstract results and 216 title results. Considering that only two project members were analysing all seven databases amid time constraints, such results were impractical. Moreover, it was apparent that many of these results were outside the scope of the current review, with generic key terms like "code", "speech" and "simultaneous" leading to results from fields often unrelated to linguistics.

refer to either abstracts or excerpts of abstracts written by the author of a text or descriptions of a text produced by a library staff member.

Google Scholar was searched based on either two or three sets of key terms. Therefore, it was searched with either Key Term 1 and Key Term 2 items or Key Term 1, Key Term 2 and Key Term 3 items. All included search strings can be found in Appendix B. It was also the only database that was filtered based on titles, as the option to filter via abstracts was not available. The list of key terms used for Google Scholar was more limited than for the other databases, as broader searches yielded an unmanageable number of results that the team did not have time to review. However, by the end of the data collection process in March 2025, Google Scholar was independently searched by the first author, and no additional publications were identified as missing or newly available.

There was no start date restriction for any of the databases and the full database was used in all cases except for EBSCOhost. The following databases were selected in EBSCOhost to ensure generated results were as accurate as possible: Alumni Edition, Academic Search Premier, Africa-Wide Information, Bibliography of Asian Studies, Communication & Mass Media Complete, eBook Academic Collection (EBSCOhost), eBook Open Access (OA) Collection (EBSCOhost), MLA Directory of Periodicals and MLA International Bibliography.

2.5 Selection process

The data collection and selection process are represented in the flowchart in Figure 1. We collected 689 entries from systematic advanced searches of seven databases. The first author collected these entries independently from Web of Science, EBSCOhost, Taylor and Francis, Google Scholar and Leiden University Library Catalogue. The checker collected entries from ProQuest and the Cambridge University Library Browser. These entries can be found in the *systematic database inclusion-exclusion* sheet in the data file component on the project OSF page. 243 duplicates were identified by the first author and were removed. A further 56 entries were removed as they constituted medical papers resulting from the inclusion of “L1”, “L2” and “L3” which overlap with the name of the lumbar vertebrae of the spine. These entries were not within the scope of the current review and were removed before abstract screening to save time. The remaining 390 abstracts were independently screened by both the first author and checker and the following exclusion criteria were applied: (1) not about code-switching, (2) not about phonetics/phonology/prosody, (3) not about bi/tri/multilingualism, (4) not in a language the checkers speak/understand, (5) not available, (6) other (to be specified in each case). 329 abstracts were initially excluded at this stage.

The screening process also left us with 13 initial disagreements (only 3.33% of cases). We discussed these disagreements until a consensus was reached. This consensus consisted of 7 exclusions and 6 inclusions. These 7 exclusions accompanied the excluded 329 abstracts, totalling 336 excluded abstracts at this stage. 1 further abstract was removed as it was agreed upon for inclusion; however, the full text was inaccessible. This resulted in 53 full texts (47 direct inclusions and 6 inclusions following the initial disagreement) for independent screening by the first author and checker.

Furthermore, the first author independently searched the reference lists of the 53 texts before full text screening. This process resulted in 34 further entries. 1 entry was a duplicate and was therefore removed, and 2 full texts could not be found by any project member. Therefore, the abstracts of 31 papers from reference lists were screened independently by

both researchers. There were 3 initial disagreements for which no consensus was reached, so these full texts were sent alongside 22 agreed-upon included texts for full text screening. The list of papers identified in references can be found in the *identified in references* sheet in the data file component on the project OSF page.

Full texts were screened following the same six exclusion criteria applied to abstracts with the addition of: (7) not a study, a review. From the 53 full texts stemming from abstract inclusion, the checkers disagreed on 9 (i.e., 16.9% of cases)[7] and further discussed until a consensus was reached. This left us with 28 full texts from the systematic review of databases for inclusion in this scoping review.

Furthermore, the aforementioned 25 full texts, which were collected from the reference lists of sources whose abstracts were included, were also screened in the same way. 15 of these texts were included in the scoping review.

In parallel with the systematic database searches, we also screened papers received through other channels. These included responses to emails circulated via mailing lists, a poster shared on various social media platforms and papers identified by project members based on their own expertise and familiarity with the topic. This process yielded 45 papers. Of these, 13 were duplicates of records already identified through the systematic review and were therefore excluded. The remaining 32 abstracts were independently screened. One initial disagreement between the researchers was resolved through discussion. This discussion led to the inclusion of the paper for further screening. As a result, 13 papers obtained via personal communication were selected for full-text screening. Of these, 9 were ultimately included in the scoping review. These papers can be identified in the *personal communication* sheet of the data file, and the full texts can be found in a component also located on the project OSF page.

To ensure that no relevant literature was overlooked, the social media poster was reposted in March. As this did not yield any additional papers, formal data collection concluded on 1 April 2025. However, during the revision phase on 1 May 2025, two project members identified two further theses (Drop, 2023; Verzijden, 2023). Since these theses were completed under the supervision of the project members, they were not subjected to the formal data screening process but were incorporated into the scoping review during the final revisions.

54 papers were therefore included for data extraction and analysis. From the 54 papers, there were 29 journal articles, 7 conference proceedings, 6 dissertations, 4 book chapters, 6 theses and 2 posters. The full texts of all of these sources can be found in a component on the project OSF page.

[7] These cases concerned the inclusion or exclusion of papers addressing Intonation Units and (un)filled pauses. Intonation Units were excluded because they are discourse-level constructs rather than lower-level phonetic or phonological features grounded in acoustic or articulatory properties. (Un)filled pauses were excluded as they were considered paralinguistic or disfluency phenomena, not core elements of phonology or prosody.

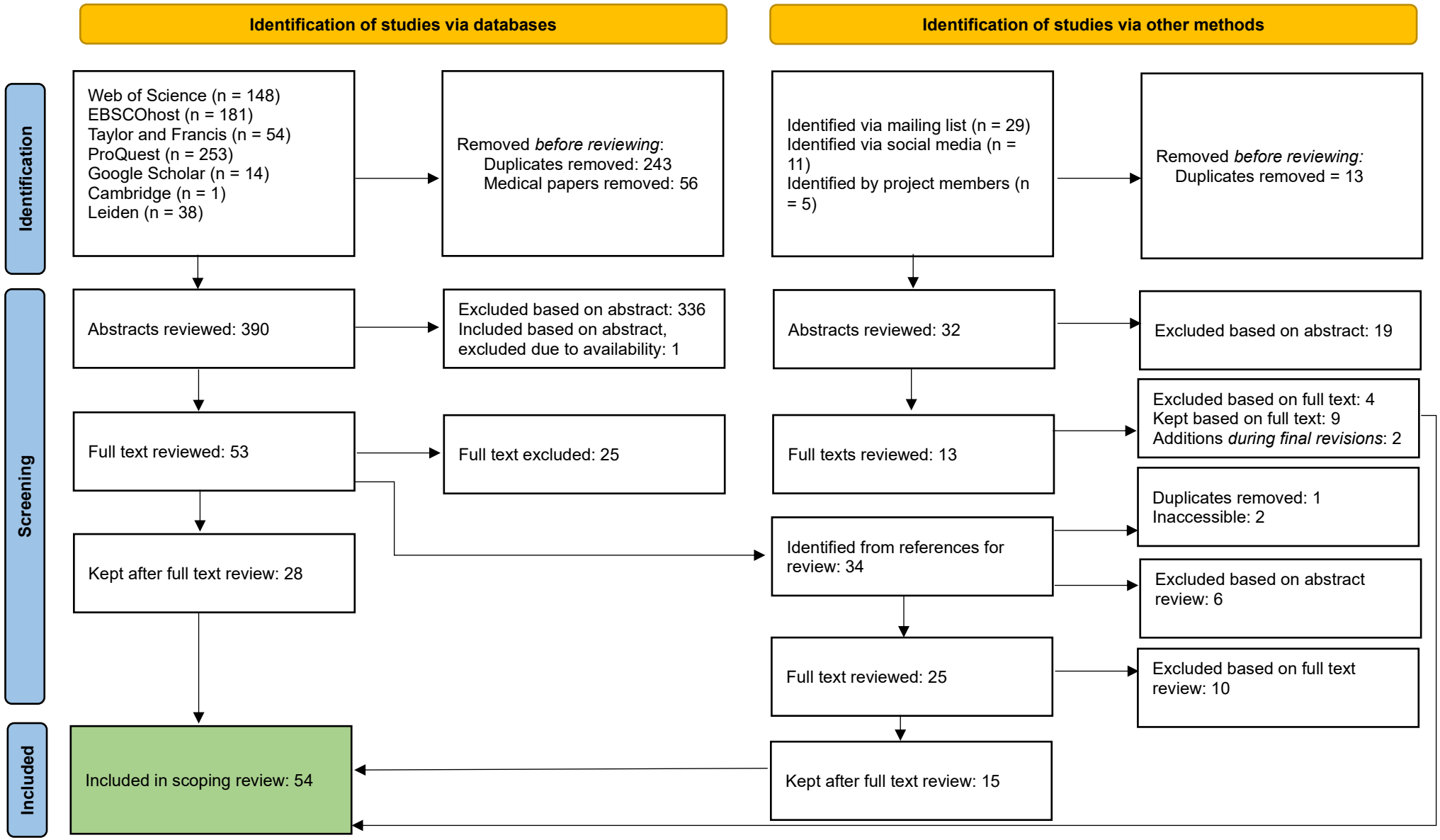

Figure 1. The Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) flowchart of the scoping review process.

2.6 Data collection process

A data extraction sheet was developed by the first author and is included in the data file submitted alongside the pre-registered protocol on the project page of OSF (see *data extraction* sheet, uploaded on 13 January 2025). To ensure consistency, 3 of the 54 included full texts were randomly selected (Antoniou et al., 2011; Balukas & Koops, 2014; Kelly et al., 2020) and the data was independently extracted by the first author and checker using the existing data chart. Following this, the first author reviewed both data charts and ensured that there were no inadequacies in the first author's charts compared to the checker. There was no need for a discussion following this analysis and the first author continued to extract data from the remaining papers. During this process, the first author consulted with the project team regarding the column labelled "matrix language influence", as little extractable information was available in the reviewed papers. The column was retained to support later reporting on VOT studies, where a noticeable bias related to this segmental feature and code-switching was observed. These results will be provided in the Discussion section along with a discussion on the bias in the findings. Some column title names were modified and the order in which columns appeared was changed for ease of readability, however, no further adjustments were made to the data extraction sheet. Furthermore, a folder containing the full texts of all included sources is available on the project´s OSF page.

2.7 Data items

In line with the pre-registered protocol and our objectives, the following data items were extracted from each included study by the first author:

- Resource description - document number, author(s), year of publication, DOI, title, document type
- Objective (i) – language combination(s) under investigation, geographic location in which the study took place
- Objective (ii) - number of participants, age of participants, sex and gender distribution of participants, socioeconomic status of participants, bilingual profile of participants
- Objective (iii) - whether code-switching was the main focus of investigation, how code-switching was defined, the experimental approach in eliciting code-switch data, the method to produce phonetic data, the subject design type and the method used to analyse data
- Objective (iv) - segmental feature analysed, suprasegmental feature analysed
- Objective (v) - type of code-switching
- Objective (vi) - phonetic/phonological/prosodic influence between matrix and embedded language

If a data item was not available from a study, it was marked as "n/a" referring to not available/no answer. Such instances can be seen in the *data extraction* sheet of the data file on the project OSF page. These instances are also recorded below in the Results section of this scoping review. Further details of each data item and how it was extracted will also be described in the Results section.

2.8 Synthesis methods

In line with the objectives of scoping reviews, the objectives of this scoping review did not include explicit critical appraisal of the studies included in the review. As a result, a critical appraisal was not explicitly conducted. However, in the Results and Discussion sections of this review, the analysis of extracted data will include a quality assessment of gathered evidence. In particular, we will address the contributions and limitations of existing research as well as its generalisability and thus implications for future research.

3. Results

In this section, we use a combination of tables, figures and narrative to present the extracted data and address the six objectives and thirteen research questions of this scoping review.

3.1 Participants and demographics

A total of 1,233 bilinguals were recruited across the 54 included papers. The number of participants in each study ranged from 1 to 90. 5 studies had less than 4 participants (range: 1-3), 32 studies had between 4 and 20 participants and 17 studies had more than 20 participants (range: 21-90).

There were 57 geographic locations[8] identified in the included papers. 49 papers directly stated the location in which the study took place and thus from which participants were recruited. The remaining 5 papers (Bullock et al., 2006; Bullock & Toribio, 2009a; Muldner et al., 2017; Toribio et al., 2005; Zeng, 2024) did not state the location in which the studies took place. In these cases, the first author used the affiliated university along with the languages of the participants to determine the location. Therefore, these locations were Canada, the USA, the USA, the USA and Taiwan respectively. Hazan and Boulakia (1993) recruited participants from 2 countries (France and the UK), and Li et al. (2023) used corpora from 5 countries (Canada, Malaysia, Singapore, Australia and China). The remaining 52 papers recruited participants from 1 country only. Just over half of the papers (n = 30, 52.63%) recruited participants who resided in the USA. From the studies that specified the region or city more precisely, the participants resided in: the Midwest region, San Diego, Boston, central-northern New Mexico, the Southwest region, Austin (Texas), California, Miami, Wyoming, the Chicago area, Florida, New Mexico and El Paso. Australia (Sydney, Cairns, Canberra and Victoria) appeared as the geographic location of 4 studies. Meanwhile, China (two instances of Hong Kong and one unspecified) and the UK (one instance of London and two unspecified instances) each appeared 3 times in the included studies. There were two studies from Canada (one instance of Toronto), India (one instance of Hyderabad), Spain (Barcelona and Bilbao and Lekeitio in the Basque Country), Taiwan and the Netherlands. Finally, Singapore, Malaysia, France (Paris), Poland (Poznán), Lebanon (Beirut), Argentina (Sarmiento/Comodoro Rivadavia), Brazil (Nova Petrópolis and Sao Paulo das Missoes) and Czechia all appeared as the geographic location of 1 study. A visual representation, in the form of a heatmap based on numeric frequency, of the countries included in the studies can be seen in Figure 2.

[8] Some studies included more than one location.

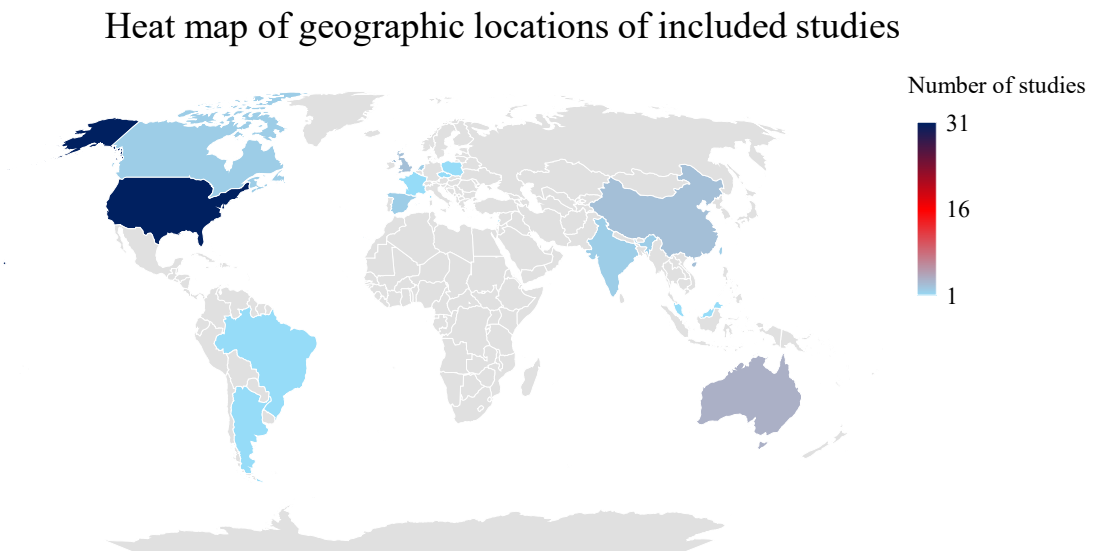

Figure 2. Number of studies on the phonetics of code-switching per country.

Considering the language combinations of bilingual participants, as anticipated in the Introduction, just over half (n = 29, 53.70%) included Spanish-English bilinguals. Meanwhile, 3 studies dealt with French-English bilinguals and 2 studies each dealt with Bulgarian-English, Cantonese-English, Mandarin-English and Greek-English. 7 of the remaining 13 studies concerned bilinguals who spoke English and one of the following languages: Taiwan-Mandarin, Bengali, Czech, Hindi, Korean, Lebanese Arabic and Polish. Only 6 studies focus on a language combination that did not include English. These studies were Birkner (2004) with German-Portuguese, Aly (2017b) with Spanish-Basque, Henriksen et al. (2021) with Spanish-Afrikaans, Penning (2021) with Papiamento-Dutch, Drop (2023) with Mandarin-Dutch and Verzijden (2023) with Taiwanese-Mandarin. The consequences of these findings will be discussed further in the Discussion section of this review. Finally, 1 study (Olson & Seo, 2024) reported on both Spanish-English bilinguals as well as Korean-English bilinguals and Li et al. (2023) dealt with Mandarin-English, Cantonese-English and Vietnamese-English bilinguals. A visual representation of language combinations, in the form of a clustered bar chart of combination frequencies, can be found in Figure 3 below. The findings show that 88.88% of the studies (n = 48) concerned English and another language. English standard varieties included American, Australian, British, Canadian, Indian, Singaporean and Malaysian. Spanish dialects included Mexican, Ecuadorian, Peruvian, Colombian, Peninsular, Paraguayan, Chilean, Costa Rican, New Mexican, Caribbean, Honduran and Bolivian. French standard varieties included Canadian and Metropolitan. Table 3 provides a visual representation of language combinations correlated with the geographic locations of included studies.

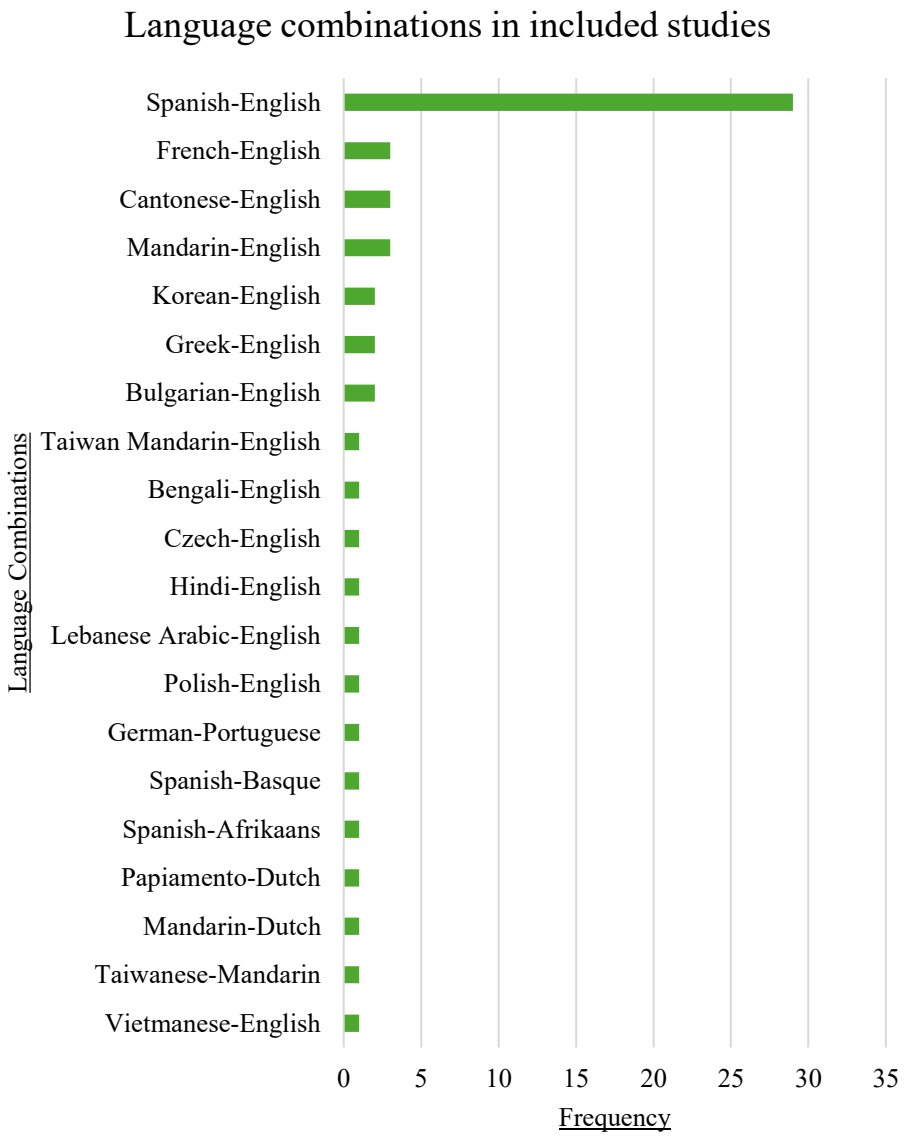

Figure 3. The number of studies in which each language combination occurred.

Table 3. A table of countries and language combination frequencies.

Country	Language combination(s)	Frequency
Argentina	Spanish-Afrikaans	1
Australia	Greek-English	2
	Mandarin-English	1
	Vietnamese-English	1
Brazil	German-Portuguese	1
Canada	French-English	1
	Cantonese-English	1
China	Cantonese-English	3
Czechia	Czech-English	1
France	French-English	1
India	Hindi-English	1
	Bengali-English	1
Lebanon	Lebanese Arabic-English	1
Malaysia	Mandarin-English	1
Poland	Polish-English	1
Singapore	Mandarin-English	1
Spain	Spanish-Basque	1
	Spanish-English	1
Taiwan	Taiwanese-Mandarin	1
	Taiwan Mandarin-English	1
The Netherlands	Mandarin-Dutch	1
	Papiamento-Dutch	1
UK	Bulgarian-English	2
	French-English	1
USA	Spanish-English	28
	Korean-English	2
	Mandarin-English	1
	French-English	1

The studies included in this scoping review span over three decades, consequently encompassing a wide range of reporting practices, most pertinently so for participant ages (this resulted in the creation of Table 4 below). Some studies provide complete descriptive statistics (mean age, standard deviation and age range). In contrast, others offer partial information, some offer approximates and 9 studies did not include any information regarding participants' age. 33 studies (61.11%) included participant age range and 1 study (Alvanoudi, 2023) included an approximate age range. From the 33 studies that included a precise age range, participants ranged from 2-85 years old. 22 studies provided the mean age of participants. The first author could calculate the mean age of participants in a further 5 studies based on raw data that was provided. From these 27 studies, 11 studies also identified the SD of participants' ages. The provided mean ages span from 18.5 years (Elias et al., 2017) to 75.1 years (Henriksen et al., 2021). 2 studies included only those who were children (classified here as any participant under 18 years old), while the remaining studies that recorded age appear to have dealt with a mix of children and adults, however, mainly solely adult bilinguals. Some studies were much less specific, referencing participants simply as "adults" (Grosjean & Miller, 1994), "at least 18" (Drop, 2023) and "university age" (Muldner et al., 2017). 3 studies included in this scoping review included only 1[9] participant (Piccinini & Garellek, 2014; Rao et al., 2018; Shen et al., 2020). In these cases, the mean age (as can be found in Table 4) is equal to the sole age recorded, and the standard deviation is not applicable.

[9] Piccinini and Garellek (2014) and Shen et al. (2020) included more participants, however, those participants took part in perception experiments which were outside the scope of this review. Therefore, only the speaker who provided the data for those perception experiments, along with the phonetic analysis of that speaker data was included in this review.

Table 4. A chronological list of studies alongside a description of participant age data.

Study	Hazan and Boulakia (1993)	Grosjean and Miller (1994)	Zheng (1997)	Birkner (2004)	Toribio et al. (2005)	Bullock et al. (2006)	Bullock and Toribio (2009a)	Antoniou et al. (2011)	López (2012)	Olson (2012)	Olson (2013)
n (participants)	21	5	30	3	10	Exp.1: 15 Exp.2: 10	33	16 (two groups of 8)	16	6	20
Mean age (in years)	19	-	-	-	-	Exp.1: 30.5 Exp.2: 27	-	English mode: 31.2 Greek mode: 26.1	21	26.8	-
SD (in years)	-	-	-	-	-	-	-	-	-	-	-
Age range	15-43	-	6-10	-	20-40	-	26-31	-	19-23	19-37	-
Other	-	"Adults"	-	One female participant was 42	-	-	-	-	-	-	-
Notes				No further information was provided		Exp. (experiment)					

Study	Balukas (2014)	Balukas and Koops (2014)	Goldrick et al. (2014)	Piccinini and Garellek (2014)	Simental (2014)	Olson (2015)	Piccinini and Arvaniti (2015)	Schwartz et al. (2015)	Šimáčková and Podlipský (2015)	Yavaş and Byers (2015)	Fricke et al. (2016)
n (participants)	20	20	10	1	8	13	14	12	20	20	85
Mean age (in years)	-	-	22	22	-	-	20.2	-	-	-	-
SD (in years)	-	-	3.62	—	-	-	-	-	-	-	-
Age range	50-92	-	19-30	22-22	22-62	-	18-24	-	19-27	18-30	9-78
Other	-	-	-	-	-	-	-	-	-	-	Median – 29.5
Notes			Calculated from raw data								

Study	Olson (2016)	Piccinini (2016)	Aly (2017a)	Aly (2017b)	Elias et al. (2017)	Ojeda et al. (2017)	Muldner et al. (2017)	Rao et al. (2018)	Tsui et al. (2018)	Olson (2019)	Kelly et al. (2020)
n (participants)	13	Exp.1: 10 Exp.4: 24	9 (divided into 2 subgroups)	7	11	15	12	1	60 (divided into 3 groups of 20)	49	9
Mean age (in years)	24.85	Exp.1: 19.8 Exp.4: 19.9	CB: 52 MB: 30	24	18.5	-	-	-	Cantonese dominant: 21.15 English dominant: 22.90 Balanced bilinguals: 22.20	-	-
SD (in years)	5.21	-	-	-	-	-	-	-	Cantonese dominant: 0.49 English dominant: 3.18 Balanced bilinguals: 4.14	-	-
Age range	18-35	Exp.1: 18-24 Exp.4: 18-26	CB: 39-68 MB: 24-36	21-31	18-20	18-23	-	-	-	-	18-45
Other	-	-	-	-	-	-	"University age"	-	-	-	-
Notes	Calculated from raw data		CB – Cuban born MB – Miami born								

Study	Shen et al. (2020)	Uribe (2020)	Henriksen et al. (2021)	Johns and Steuck (2021)	Penning (2021)	Gavino and Goldrick (2022)	Yusko (2022)	Alvanoudi (2023)	Dancheva (2023)	Drop (2023)	Gutiérrez Topete (2023)
n (participants)	1	16	10	34	25	18	5	3	15	5	60
Mean age (in years)	21	-	73.1	-	27	21.56	40.8	-	23	-	22.05
SD (in years)	—	-	-	-	8.57	3.09	15.25	-	-	-	5.45
Age range	21-21	18-42	59-85	-	18-61	18-27	22-60	~69-80	-	-	18-50
Other	-	-	-	-	-	-	-	-	-	“At least 18”	-
Notes						Calculated from raw data	Calculated from raw data	Approximate age range			

Study	Lee et al. (2023)	Li et al. (2023)	Mitra and Dutta (2023)	Rosario Rivera (2023)	Verzijden (2023)	Dancheva et al. (2024)	Exton (2024)	Olson and Seo (2024)	Seo and Olson (2024)	Zeng (2024)
n (participants)	8	90	10	60 (divided into 2 groups of 30)	67	33	10	86	37	12
Mean age (in years)	-	-	-	Spanish heritage group: 20.48 L2 Spanish learner group: 20.6	29.16	25	36	-	23.9	22
SD (in years)	-	-	-	Spanish heritage group: 0.56 L2 Spanish learner group: 0.16	11.37	-	-	-	3.8	1.83
Age range	2;0-3;0		19-28		14-58	-	24-69	-	-	20-26
Other	-	-	-	-	-	-	-	-	-	-
Notes	Longitudinal study				Calculated from raw data					

None of the 54 studies explicitly distinguished between the sex or gender of participants. Therefore, for the purpose of this review, all of the binary sex/gender data is presented as male and female. 22 of the 54 studies did not provide a sex/gender breakdown, this amounted to 620 of the total participants' sex/gender not being accounted for (50.28%). In the 32 studies that collected and presented sex/gender data, there were 197 males (15.98%) and 416 females (33.74%). A visual representation of the breakdown between males, females and no data can be found in Figure 4.

Figure 4. Proportion of male, female and unspecified bilinguals in included studies.

Concerning socioeconomic status (SES), the included studies generally did not provide many details of the participants' status. There were no instances of a study including a mean/median value of the SES of participants and there was also no such labelling of a low, medium, high or mixed status. No information about the SES of participants was provided in 21 of the 54 studies. SES was explicitly mentioned in three studies, two of which had participants who were children. Zheng (1997) stated that participants were primary school students from schools that "were chosen from the different socio-economic areas in Victoria" (p. 53), and Lee et al. (2023) mentioned that "all children had a similar socio-economic background with at least one parent who was a high school or university teacher" (p. 7). Birkner (2004), on the other hand, indicated SES based on place of residence insofar as one participant came from a place with "an urban character" (p. 130) and the other two participants came from "a place that is socio-economically marked by a peasant population" (p. 130).

The remaining studies presented limited, and indirect, evidence of SES in the form of education (n = 21), occupation (n = 8) or through the method of participant recruitment (n = 7)[10]. This last indicator, the method of participant recruitment, refers to studies that indicated

[10] These numbers do not amount to 54 as some studies had more than one indirect indicator of SES.

that participants were recruited from a university campus. Based on two studies, which elaborated more on this (Bullock & Toribio, 2009a; Schwartz et al., 2015), both students and university staff/faculty may be recruited from a university campus. However, there may be a wide range of SES employees working on a university campus, such as those with no university degree to those who hold the highest level of education. Furthermore, there is also no information to negate that such a recruitment method may also include members of the public who happen to be on a university campus for a wide variety of reasons.

There were often very few details available on participants' education when it was indirectly offered as an SES indicator. For instance, Muldner et al. (2017) mention that participants attended an English-speaking university, with no further indications as to their education level. Similarly, Hazan and Boulakia (1993), López (2012) and Drop (2023) describe the participants as "college students" or simply "students", again with no further clarification.

Occupations were generally listed, for instance by Balukas (2014) and Aly (2017a), with some examples including "retired", "secretary" and "planning technician". A more in-depth breakdown of the instances of education and occupation which appear as SES indicators can be found in the relevant column of the *data extraction* sheet in the data file.

Given this limited information, the first author decided that it would not be appropriate to further classify the SES of bilingual participants into scales that had been produced for the protocol (see *scales* sheet in the data file submitted alongside the protocol on OSF). This breakdown consisted of low, medium, high or mixed SES. It may be possible to categorise participants who have a university degree of any kind within the high category. However, such a decision may likely misrepresent and stereotype the SES of participants. There is no longer such a clear and distinct link between university education and a high SES, nor does a university degree guarantee a high annual income. This may be dependent, particularly, on the specialisation, type and location from which the degree was obtained. None of these details are presented in the included studies, so categorisations exceeding what has already been described above will not be included in this scoping review.

Finally, the bilingual profile of participants in the included studies was also analysed. This was done by collecting and analysing participants' information concerning language background and current language practices when included in each study. To summarise the most common data points that were presented concerning participants' bilingual profiles, based on a qualitative analysis of the data, the following characteristics appeared in the 54 studies: 5 studies included L1 Spanish speakers, 4 included L1 English speakers, 6 studies included L2 Spanish speakers and 18 studies included L2 English speakers[11]. 6 studies dealt with heritage speakers, while 11 studies dealt with early bilinguals and 6 studies dealt with late bilinguals.

Similarly to participant age, the amount of information on language dominance and use varied considerably between studies. For instance, Birkner (2004) and Yusko (2022) provided very limited information, with the former mentioning that "all three speakers had markedly different degrees of bilingualism" (p. 129) and the latter that they were working with "Spanish-English bilinguals" (p. 13). These authors provided no further breakdowns

[11] There is some overlap between these categories as some studies included both L1 Spanish and L1 English speakers for example.

concerning participants' L1/L2, age of exposure, age of acquisition or language dominance. Similarly, limited information was also provided by authors who were working with corpora that were not their own, such as Johns and Steuck (2021) and Li et al. (2023).

28 studies classified bilinguals based on an explicit L1/L2 distinction or by using the term 'native'. Examples of such studies include Zeng (2024) who refers to "native speakers of Taiwan Mandarin" (p. 122), Henriksen et al. (2021) who refers to participants who "spoke Afrikaans since birth (L1) and learned Spanish (L2)" (p. 211), Verzijden (2023) who references "the speakers have not been selected to be native speakers of Taiwanese" (p. 44) and Bullock and Toribio (2009a) who analysed "15 L1 Spanish and 10 L1 English" (p. 197) bilingual participants. These distinctions were often accompanied by terms such as early and late bilinguals. Early bilinguals were characterised as those who learned/acquired or were exposed to both languages before the age of either 5, 6 or 7 (Li et al., 2023; Muldner et al., 2017; Olson, 2012; Ojeda et al., 2017; Piccinini, 2016; Piccinini & Arvaniti, 2015; Piccinini & Garrellek, 2014; Tsui et al., 2018; Yavaş & Byers, 2015). Meanwhile, late (sequential) bilinguals were often classified as students or learners of an L2 (Bullock et al., 2006; López, 2012; Rosario Riveria, 2023; Toribio et al., 2005). Such bilinguals were often majoring or minoring in an L2 at university, and at the very least, enrolled in some language courses. There was a consensus that for such bilinguals the age of L2 acquisition was after 12, such as in the case of Rosario Rivera (2023), who had a subgroup of L2 learners of Spanish with a mean age of acquisition of 13.97 years (SD = 0.39). For more details on an exact breakdown of the L1/L2 distinction of participants in included studies, see the relevant column (*Bilingual profile*) in the *data extraction* sheet in the data file. Some papers did not use a specific term (such as early, late, sequential or simultaneous) but instead, the authors presented the age of language acquisition, in combination with a measure of standard deviation. This measure was used as a point of reference when presenting participants' bilingual profiles in the following studies: Antoniou et al. (2011), Elias et al. (2017), Gavino and Goldrick (2022), Mitra and Dutta (2023), Olson and Seo (2024) and Seo and Olson (2024).

One way to measure bilingual age of acquisition and current language dominance is by providing participants with a questionnaire before or after they complete an experimental study to learn more about their language background. This was indeed the case for 33 (61.11%) of the included studies. The Bilingual Language Profile (BLP) (Birdsong et al., 2012) was used by 9 studies as an instrument to assess language dominance through self-reports on language history, language proficiency and language attitudes in each language (Drop, 2023; Gutiérrez Topete, 2023; Henriksen et al., 2021; Mitra & Dutta, 2023; Olson, 2019; Olson & Seo, 2024; Rosario Rivera, 2023; Seo & Olson, 2024; Shen et al., 2020). Scores can range from -218 to 218 with each extreme indicating dominance in one language and 0 indicating a balanced bilingual. 7 further studies (Mitra & Dutta, 2023; Olson, 2013, 2015, 2016; Piccinini, 2016; Piccinini & Arvaniti, 2015; Tsui et al., 2018) used the Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian et al., 2007) to collect self-reported proficiency and experience data from bilingual participants. 2 studies (Gavino & Goldrick, 2022; Piccinini, 2016) used the Multilingual Naming Test (MINT) (Gollan et al., 2011) to assess language proficiency and similarly 1 further study (Aly, 2017b) used a Semantic Verbal Fluency task to assess language dominance. The remaining studies used modifications of these questionnaires to measure relative language proficiency, such as in the form of a 7-point scale (Bullock & Toribio, 2009a) and a 5-point scale (Balukas, 2014).

Alternatively, other modified versions of language background questionnaires were also used (Balukas & Koops, 2014; Elias et al., 2017; Muldner et al., 2017).

A final measure that contributed to clarifying participants' language profiles was based on bilinguals' residential movements, length of stay in a particular language environment or generational status. This was a method used in at least 13 studies. For instance, Penning (2021) highlighted that despite most of the early Papiamento-Dutch bilinguals in the study being born in Aruba and Curaçao, they had lived in the Netherlands from 4 months to 32 years. Similarly, Seo and Olson (2024) highlighted where L1 Korean participants were born and raised, the mean age at which they moved to the USA and the mean length of residence in the USA. Bullock et al. (2006), Yavaş and Byers (2015) and Olson (2016) also included the average years of residence in each specific language environment. Alvanoudi (2023) identified participants' generational status with the description of first-generation Greek participants. Furthermore, Balukas (2014), Piccinini and Arvaniti (2015), Johns and Steuck (2021) and Li et al. (2023) also referenced the generational status of participants. First- and third-generation bilinguals were the most frequently recorded in the included studies.

3.2 Definitions of code-switching

Code-switching was the main focus of investigation in 49 of the 54 studies (90.74%). The remaining 5 studies (Birkner, 2004; Goldrick et al., 2014; Hazan & Boulakia, 1993; Lee et al., 2023; Schwartz et al., 2015) did not focus on code-switching. Instead, instances of code-switching appeared sporadically in the data (Birkner, 2004; Lee et al., 2023) while the main focus was on list intonation and intonation patterns in one language respectively. Meanwhile, Hazan and Boulakia (1993) focused on the voicing contrast between minimal pairs and Goldrick et al. (2014) focused on cognitive processing demands during language switching resulting in (non)nativelike pronunciation in the L2. Finally, Schwartz et al. (2015) focused on the effect of L2 proficiency and phonological factors on L1 phonetic realisations.

These 5 studies, along with 8 others, did not define code-switching. 3 of the 8 (Bullock et al., 2006; Kelly et al., 2020; Šimáčková & Podlipský, 2015) studies were conference proceedings, which often have limited space, thus, the format may have contributed to the omission of an explicit definition. Bullock and Toribio (2009a) and Elias et al. (2017) did not define code-switching, however, both included in-depth discussions on the phenomenon from the literature. Zheng (1997), Gavino and Goldrick (2022) and Mitra and Dutta (2023) were the final 3 papers that did not define code-switching.

From the 41 papers that defined code-switching, 4 defined code-switching by citing Myers-Scotton (1993) as “the alternation between two (or more) languages or language varieties within a single interaction” (Olson, 2016, 2019; Olson & Seo, 2024; Seo & Olson, 2024). A further 12 papers used similar wording whereby referring to alternation or switching of two or more languages in the same utterance, interaction or sentence. 2 papers cited a different part of Myers-Scotton (1993), namely code-switching defined as “the selection by bilinguals or multilinguals of forms of an embedded variety in utterances of a matrix variety during the same conversation” (Olson, 2012, 2019). López (2012) used a similar definition, incorporating terms such as matrix and embedded language, without directly citing Myers-Scotton (1993). 2 papers (Antoniou et al., 2011; Yavaş & Byers, 2015) cited Grosjean (1982,

2008) with a definition of code-switching as a "within utterance shift from the base language of the established conversational context, to produce a within-sentence target word in their other out-of context language". Grosjean and Miller (1994) also make use of a definition which involves a guest or out-of context language.

Poplack (1980, 2001) is cited in 5 papers (Balukas, 2014; Fricke et al., 2016; Henriksen et al., 2021; Simental, 2014; Uribe, 2020)[12]. Poplack (1980) refers to "the use of more than one language in the same turn of speak or discourse" while Poplack (2001) defines code-switching as "the mixing by bilinguals of two or more languages in discourse or one of a number of linguistic manifestations of language contact and mixing". Piccinini and Garellek (2014), Aly (2017b), Rao et al. (2018), Dancheva (2023) and Dancheva et al. (2024) used similar wording to Poplack (1980) by using "the use of" as opposed to Myers-Scotten (1993)'s 'alternation'. Meanwhile, Rosario Rivera (2023) combines the two definitions by citing Clyne (1987) as "the alternative use of two languages either within a sentence or between sentences". 2 papers (Piccinini, 2016; Piccinini & Arvaniti, 2015) placed importance on the point of the switch by simultaneously citing Gumperz (1977) and Bullock and Toribio (2009b). Penning (2021) also emphasised the switch point as "sometimes a switch refers to the point where the language changes" (p. 12). Alvanoudi (2023) and Exton (2024) also emphasised the switch point as occurring between utterances or within the same utterance. Balukas and Koops (2014) cite Backus (2005), whereby code-switching relates to "discourse in which words originating in two different language systems are used side-by-side" by bilingual speakers. A productive quality is given to code-switching by Verzijden (2023) who cites Deuchar (2012) with code-switching as "an activity which may be observed in the speech (or writing) of bilinguals who go back and forth between their two languages in the same conversation". Seliger's (1996) definition, "code-switching is simply another way of speaking, an in-group or community norm, and not mixing languages in certain circumstances would be considered irregular and socioculturally insensitive" is cited by Toribio et al. (2005).

3.3 Methods and approaches to code-switching

The experimental approach taken by each study to elicit code-switching data was categorised into four groups: spontaneous speech, semi-experimental, experimental and a combination of these approaches. From the 54 studies included, the approaches used were as follows: spontaneous speech (n = 17), semi-experimental (n = 1), experimental (n = 31), a combination (n = 5).

The studies which used a naturalistic or spontaneous speech approach included informal conversations reminiscing on life stories and the history of a community between participants and a researcher who became a member of the target community (Alvanoudi, 2023), conversations between bilingual participants using prompts about a target culture (Piccinini & Arvaniti, 2015), semi-structured group interviews (Uribe, 2020; Zheng, 1997) and discourse videos taken from the YouTube channel of a spiritual and motivational speaker (Rao et al., 2018). 3 studies (Balukas, 2014; Balukas & Koops, 2014; Johns & Steuck, 2021)

[12] Note that Henriksen et al. (2021) cites both Poplack (1980) and Myers-Scotton (1993).

used the New Mexico Spanish English Bilingual (NMSEB) corpus (Torres Cacoullos & Travis, 2018), which consists of a total of 31 recordings with 40 speakers totalling 29 hours or 300,000 words of data. This corpus was elicited through conversational sociolinguistic interviews. Furthermore, Fricke et al. (2016) and Yusko (2022) both used the Bangor Miami Corpus (Deuchar et al., 2014). This corpus consists of 56 recordings involving a total of 84 speakers living in Miami, Florida. It consists of 35 hours of conversation and 242,475 words. The 5 studies that analysed these corpora used only a subset of each. The remaining studies that utilised spontaneous speech used other corpora (Lee et al., 2023; Li et al., 2023; Penning, 2021; Verzijden, 2023) and semi-structured interviews (Birkner, 2004; Dancheva, 2023; Simental, 2014).

The only semi-experimental study was conducted by Aly (2017a). The author included two tasks in the study, the first of which was a Discourse Completion Task (DCT) to prompt participants to answer freely while still eliciting a specific discourse category. Secondly, the author conducted structured interviews designed to elicit various sentence types and semi-spontaneous utterances.

The experimental studies included a variety of tasks to elicit relevant data. The most common task was reading aloud (n = 23), specifically of sentences (n= 21). Other reading aloud tasks included passage reading (n = 1) and word reading (n = 1). These studies are listed in Table 5 below. 6 studies used cued picture naming to elicit data (Gavino & Goldrick, 2022; Goldrick et al., 2014; Kelly et al., 2020; Mitra & Dutta, 2023; Olson, 2013; Tsui et al., 2018). Sentence repetition and delayed sentence repetition tasks were used by Dancheva et al. (2024) and Šimáčková and Podlipský (2015), respectively. Elias et al. (2017) used a controlled narration reading task and Exton (2024) used narration in the form of a wordless picture book which adults read to other adults or infants.

5 studies combined these methods. Grosjean and Miller (1994) used a semi-experimental (story retelling) and an experimental approach (reading aloud). Piccinini (2016) used spontaneous speech (conversations) and an experimental approach (reading aloud), while Ojeda et al. (2017) used both spontaneous speech (informal interviews) and a semi-experimental approach (story retelling/answer directed questions after reading a paragraph of text). Finally, two studies used a combination of all three approaches (Aly, 2017b; Gutiérrez Topete, 2023).

As can be inferred from above, all studies used a production method, as opposed to perception[13] or a combination of both, to elicit data. Furthermore, a quantitative method of analysis was used across all studies.

3 studies used a between-subject task design (Antoniou et al., 2011; Birkner, 2004; Kelly et al., 2020), whereby different groups of participants experienced only one condition and group differences were compared. For instance, Birkner (2004) interviewed one participant in monolingual German and Portuguese while the other two participants took part in a bilingual interview. Similarly, Antoniou et al. (2011) had two groups of participants, one

[13] Whether or not to include perception studies was a discussion between the first author and checker. However, it was ultimately deemed that the perception studies that got to full text screening were outside of the scope of this current review. Many of these studies did not focus on a particular (supra)segmental feature and instead used measures such as reaction time to elicit data. The analysis of (supra)segmental phonetic and prosodic features was deemed more relevant for the current review. The exclusion of such studies is marked with an exclusion code of “6 (perception)” in the *Systematic Database Inclusion-Exclusion* sheet.

in Greek mode and one in English mode. Therefore, when participants read sentences aloud in English or Greek a switch took place from that of the carrier phrase, language context and experimental instructions. The remaining 51 studies used a within-subject design in which every participant took part in each condition.

Table 5. A list of reading aloud task types and relevant studies.

Reading aloud task	Study
Sentence reading	Toribio et al. (2005) Bullock et al (2006) Bullock and Toribio (2009a) Antoniou et al. (2011) López (2012) Olson (2012) Piccinini and Garellek (2014) Olson (2015) Schwartz et al. (2015) Yavaş and Byers (2015) Olson (2016) Muldner et al. (2017) Olson (2019) Shen et al. (2020) Henriksen et al. (2021) Drop (2023) Mitra and Dutta (2023) Rosario Rivera (2023) Olson and Seo (2024) Seo and Olson (2024) Zeng (2024)
Passage reading	Muldner et al. (2017)
Word reading	Hazan and Boulakia (1993)

3.4 Segmental and suprasegmental features

Research questions 10 and 11 in the pre-registered protocol, and this scoping review, aim to summarise the segmental and suprasegmental features that were examined alongside code-switching in the included studies. A footnote was included alongside these two questions, as at the time of pre-registration, it was not possible to predict which (supra)segmental features would appear in the literature. Instead of creating set criteria concerning the included features, it was decided that literature that dealt with any (supra)segmental feature, in combination with bilingual code-switching, would be included. Upon inclusion, features were

then categorised by the first author. These overarching categorisations appear here, alongside a summary of each feature examined in each paper.

From the 54 studies included in this scoping review, 30 studies (55.56%) dealt with one or more segmental features, 18 dealt with one or more suprasegmental features and 6 studies (Dancheva, 2023; Elias et al., 2017; Fricke et al., 2016; Muldner et al., 2017; Piccinini, 2016; Piccinini & Arvaniti, 2015) examined both segmental and suprasegmental features.

72.22% (n = 26) of the 36 studies[14] that dealt with segmental features included an analysis of VOT. Therefore, VOT studies made up almost half (48.15%) of the included studies in this review. An in-depth discussion on this bias will follow in the Discussion section. 25 of the 26 studies on VOT dealt either fully or in part with word-initial voiceless stops. Some studies focused on all voiceless stops (/p, t, k/) and others dealt with a subset of the voiceless stops. Furthermore, 5 studies dealt with voiced stops in a word-initial position. 1 study (Antoniou et al., 2011) also dealt with voiced and voiceless stops in a word-medial position. A complete description of the exact stops and positions that each study dealt with can be found in the relevant column (*Segmental feature*) in the *data extraction* sheet of the data file that accompanies this review.

7 studies dealt with shifts in vowel height (F1) and vowel backness (F2) during code-switching. These studies often dealt with a vowel that is present in one language and absent in the other, such as Olson and Seo (2024) and Seo and Olson (2024), who both dealt with the English low, front and unrounded vowel [æ], which is absent from the Korean inventory. The production of this English vowel along with the closest vowel in the Korean vowel space [e~ɛ] was measured by the authors in both studies. Similarly, Mitra and Dutta (2023) chose a vowel that is absent in one language when they compared [æ], common across both Bengali and Indian English, and [ʌ] which is absent in Bengali. Muldner et al. (2017) also selected an absent vowel (French [œ] has no English equivalent) as well as vowels that were similar across the two languages (e.g. [i]). Ojeda et al. (2017) dealt solely with a shared vowel between Spanish and English, namely [u]. Meanwhile, Elias et al. (2017) examined vowel quality, in the form of F1 and F2, in all five Spanish heritage speaker vowels in monolingual vs. code-switched conditions with English. Finally, Piccinini (2016) dealt with formant values F1, F2 and F3 in an analysis of the English discourse marker *like* in Spanish code-switched sentences.

A phonological change in consonants whereby sounds ‘weaken’ or ‘soften’, labelled in included studies as lenition, spirantization or tapping took place in 5 studies. Olson (2019) and Olson and Seo (2024) both dealt with the potential impact of code-switching on the realization of intervocalic word-initial voiced stop spirantization in Spanish and English. Piccinini (2016) and Henriksen et al. (2021) both presented studies on intervocalic voiced stop lenition to fricatives, while Yusko (2022) presented work on intervocalic cases of the /d/ → [ð] spirantization process of Spanish and the /t/ → [ɾ] tapping process of English in Spanish-English code-switching contexts.

The fricative /s/ was the subject of 2 studies by Olson (2019) and Olson and Seo (2024) concerning assimilation and voicing respectively. Lastly, vowel glottalization vs.

[14] The number of studies in this section does not add up to 36 as some studies analysed multiple segmental features.

sandhi linking between Polish and English vowels was presented in 1 study by Schwartz et al. (2015).

From a total of 24 studies[15] that examined suprasegmental features, some variation of pitch made up 54.17% (n = 13) of the studies. Pitch was often labelled as either pitch or fundamental frequency (f0) in the studies. We are aware that pitch is frequently measured using f0, however, the classifications here will be in line with how they were labelled in each paper, to accurately map the literature as is the aim of a scoping review. Table 6 presents a breakdown of the studies that dealt with these variations.

Table 6. A list of variations of pitch and relevant studies.

Feature analysed	Study
Pitch	Rao et al. (2018) Alvanoudi (2023) Drop (2023)
Pitch range	Olson (2012) Olson (2015) Zeng (2024)
Pitch reset	Zeng (2024)
f0 contours	Piccinini and Garellek (2014) Muldner et al. (2017) Shen et al. (2020) Dancheva (2023) Drop (2023)
Peak alignment and pitch accent	Aly (2017a) Aly (2017b)

7 studies considered the duration of either vowels or syllables. Olson (2012, 2015) examined the duration of stressed vowels by measuring the temporal difference, in milliseconds, between the release of a stop consonant and the onset of the closure of the following consonant. Meanwhile, Elias et al. (2017) and Muldner et al. (2017) both dealt with vowel duration, while Piccinini (2016) and Rao et al. (2018) dealt with various syllable durations. Lastly, Alvanoudi (2023) also dealt with duration, however, the type of duration was unclear.

[15] The number of studies in this section does not amount to 24 as some studies analysed multiple suprasegmental features.

Speech rate was a topic of investigation for Fricke et al. (2016), who used the average syllable duration of the part of the utterance that led up to a switch point as the measure of speech rate. Speech rate was measured by Johns and Steuck (2021) by dividing the number of syllables in each Intonation Unit (IU), by the duration of the IU in seconds. Penning (2021) followed Johns and Steuck (2021) in a further corpus analysis of speech rate, while Piccinini and Arvaniti (2015), Dancheva (2023) and Dancheva et al. (2024) were the fourth, fifth and sixth studies to measure speech rate.

3 studies were concerned with lexical tone (Li et al., 2023; Penning, 2021; Zheng, 1997) insofar as they focused on the effects and constraints of tone on code-switching between a tonal and a non-tonal language. Verzijden (2023) took this investigation one step further by investigating constraints by lexical tone in two tonal languages. Intonation was the subject of 2 studies, once in the form of list intonation (Birkner, 2004) and once also in an investigation of intonation patterns in the production of Cantonese by Cantonese-English bilingual children (Lee et al., 2023). Intensity/loudness, calculated as energy in decibels (dB), was also the subject of 2 studies (Alvanoudi, 2023; Rao et al., 2018). Finally, 1 study (Penning, 2021) tackled lexical, or word stress defined as the accentuation of syllables within words.

3.5 Type of code-switching

The type of code-switching investigated in the included studies was categorised into four groups: within-word, between-words, within-utterance and between-utterances. An example of each type of code-switching will be provided below using examples from the included studies. The latter category names have changed slightly from those presented in the pre-registered protocol (formerly, within-phrase and across-phrases) to align with the word categorisations. We are aware that code-switching types are subject to numerous terminological issues and variations across studies, and the studies included in this scoping review are no different. 37 of the studies (68.52%) did not name the type of code-switching investigated. Therefore, to find a solution for the terminological issue in studies that presented an explicit code-switching type and to be able to include the studies that did not label the code-switching type, the first author categorised studies based on whether code-switching occurred within or between single words or at a level above the single word, namely multiple words (labelled here as utterances).

For example, Seo and Olson (2024) analyse ‘intersentential’ and ‘intrasentential’ code-switching, which will be labelled here as within-utterance and between-utterances. On the other hand, Gavino and Goldrick (2022) do not provide any label concerning the type of code-switching produced during their study, however, the use of a cued picture naming task to elicit single target words is assumed here to produce code-switching of the between-words type and therefore will be labelled as such. If code-switching was not labelled in a particular study, as can be seen from the latter example, every effort has been made to deduce the type of code-switching based on the experiment type, task type and examples provided of elicited data. From the 54 studies included in this review, no studies dealt with within-word code-switching, 7 dealt with between-word code-switching, 44 dealt with within-utterance code-switching and 12 dealt with between-utterance code-switching. 36 studies dealt with only one

type of code-switching, 13 dealt with two types, while the type of code-switching could not be identified in a total of 4 studies.

7 studies investigated between-word code-switching (Gavino & Goldrick, 2022; Goldrick et al., 2014; Gutiérrez Topete, 2023; Kelly et al., 2020; Mitra & Dutta, 2023; Olson, 2013; Tsui et al., 2018). These studies used a (cued) picture naming task. Since none of these studies explicitly labelled the type of code-switching, the first author classified them as involving between-word switching based on their experimental design. In these tasks, participants were shown an image along with a visual language cue. For example, in Kelly et al. 2020, an image of a cat was paired with a Union Jack flag to elicit the English target word *cat*. The next slide showed a house paired with a Lebanese flag to prompt the Lebanese Arabic word *beit* ('house').

Of the 44 studies involving within-utterance code-switching, 16 explicitly labelled the code-switching type, while the remaining 28 were classified by the first author based on task design or examples provided in the studies. Many of these studies used carrier phrases to elicit within-utterance switching. For example, Antoniou et al. (2011) employed phonetically matched English and Greek carrier phrases (p. 9):

English: **say /.../ again**

Greek: **λέει/.../ άλλο** ('say /.../ again')

Thus, Greek targets were embedded in English carrier phrases and vice versa:

Greek (***bold italic***) embedded into English: **say *πα* again**

English (***bold italic***) embedded into Greek: **λέει *pa* άλλο** ('say *pa* again')

Terminology varied across studies: Antoniou et al. (2011) used 'within-utterance', while Olson (2012), Simental (2014), Elias et al. (2017), Yusko (2022), Rosario Rivera (2023) and Seo and Olson (2024) used the term 'intrasentential'. Uribe (2020) used 'intrasegmental', while Balukas (2014) and Balukas and Koops (2014) both referenced internal code-switching within IUs. Dancheva et al. (2024) referred to 'alternational' and 'insertional' code-switching and Olson (2015) and Muldner et al. (2017) also used 'insertional'. Toribio et al. (2005) referenced 'intra-phrasal'. Of the 28 studies without explicit labels, 19 were classified based on provided examples, while 7 were deduced solely from the task type when no examples were available. Only three studies, Olson (2012), Elias et al. (2017), and Drop (2023), focused exclusively on within-utterance code-switching. For a full breakdown of code-switching types in each study, see the relevant column (*Type of code-switching*) in the *data extraction* sheet.

12 studies dealt with between-utterance code-switching. An example of this type of code-switching is as follows, based on Seo & Olson (2024, p. 6):

Korean utterance followed by an English utterance (***bold italic***):

Pak-sencangnim-uy ekkay-ka mwukewe poipnita. ***Captain roles require big responsibilities.***

('Captain Park's shoulders look heavy. Captain roles require big responsibilities.')

Of these studies, 8 had been labelled by the respective authors as 'intersentential' (Rao et al., 2018; Rosario Rivera, 2023; Seo & Olson, 2024; Simental, 2014; Yusko, 2022), 'intersegmental' (Uribe, 2020), 'insertional' (Olson, 2015) and 'insertional/alternational' (Aly, 2017a). The remaining 4 studies (Alvanoudi, 2023; Olson, 2016; Penning, 2021; Verzijden, 2023) did not explicitly name the type of code-switching that they focused on. This was deduced based on examples of the spontaneous speech samples or target sentences provided in each study. Rao et al. (2018) was the only study to deal exclusively with between-utterance code-switching.

3.6 Influence between matrix and embedded language

The majority of studies did not explicitly inquire or report directly on an influence between the matrix language and the embedded language within the studies. Specifically, 48/54 studies included no data on a matrix or embedded language influence. Worth noting at this point, is that 7 of these 48 studies were (cued) picture naming tasks, whereby a single target word was to be elicited, thus a matrix and embedded language could not necessarily be constructed in these cases. In any case, we will return to address the low frequency of work on this topic, and the focal points of discussion that replaced it in the included studies in the Discussion section. The remaining 6 studies addressed the matrix and embedded language and provided the following results: 2 studies reported no influence, 4 studies reported a unidirectional influence between the matrix language onto the embedded language (although two of these instances were reported with hesitation and one instance occurred predominantly in only one group of speakers, as can be seen in Table 7 below) and 1 study reported a bidirectional influence.

Table 7. A summary of studies that identified matrix/embedded language influence.

Study	Findings	Direction of influence
Grosjean and Miller (1994)	"The results showed that the base language had no impact on the production of code switches. The shift from one language to the other was total and immediate." (p. 201)	No influence

Bullock and Toribio (2009)	"All groups show convergence of English towards Spanish irrespective of whether English is the 'base' or 'guest' language." (p. 200)	Bidirectional[16] influence
López (2012)	"The VOT values of the velar stop produced when switching from Spanish to English … are significantly shorter than those of monolingual /k/. This suggests a possible effect of the matrix language (Spanish) on the embedded or guest language (English) that lasts throughout the whole utterance." (p. 257)	(Possible) Unidirectional influence of matrix language onto the embedded language
Aly (2017b)	"Peak alignment patterns of the Matrix Language (Basque) are surfacing in the Embedded Language (Spanish)." (p. 92)	(Group specific) Unidirectional influence of matrix language onto the embedded language
Muldner et al. (2017)	"The matrix language does not influence the vowel height and backness (as measured by F1 and F2) of the vowels of the embedded words." (p. 48)	No influence
	"The pitch of code-switched vowels approached the pitch of the other language: English words in a French context have higher pitch than they would in an English context, approaching the pitch a French word has in a French context. ... In other words, the embedded words seem to take on the intonational pattern of the matrix language (the language of the carrier phrase)." (p. 47)	Unidirectional influence of matrix language onto the embedded language
Penning (2021)	"The results indicate that the position of Dutch insertions is to some extent constrained by Papiamento tone because they exclusively occur within a phrase with targets with HL tones (i.e. not with target with LH tones)." "The strength of the above claims needs to be considered with care" (p. 69-70)	(Possible) Unidirectional influence of matrix language onto the embedded language

[16] This influence is reported here as bidirectional as we focus on the purely structural properties of utterances. While the phonological findings indicate that the influence is always unidirectional (Spanish onto English), the evidence suggests that whether Spanish is the 'base' or 'guest' language that it will still influence English and vice versa.

4. Discussion

This scoping review aimed to present and summarise published and unpublished academic literature on the phonetics, phonology and prosody of code-switching. This next section will discuss the review's findings and draw implications for future researchers. Focus will be placed on the bias of VOT studies in the literature and demographic (under)representation of participants and language combinations. Furthermore, the generalisability of the findings and limitations of this scoping review will be considered.

4.1 Bias in phonetic focus

We found that almost half of the studies included in this scoping review dealt with VOT as a segmental feature. Furthermore, all but one of these VOT studies dealt specifically with the VOT of word-initial voiceless stops (/p, t, k/). This is certainly not a new finding, as many of the studies in this scoping review, as well as in a recent review on the phonetics of code-switching by Olson (2024), refer to VOT as 'oft-investigated' (Schwartz et al., 2015). The tendency to investigate code-switching via VOT has been motivated by the well-documented nature of this segmental feature, alongside the cross-linguistic differences that it embodies and its provision of a gradient measure (Olson, 2024). VOT results are often recorded based on the influence of Language A and Language B on each other. Thus, unidirectional interference occurs when Language A impacts Language B, but the reverse is not found. Bidirectional interference occurs when Language A impacts Language B and vice versa. Cases have also been reported (most notably by Grosjean & Miller, 1994) of no interference between two languages as a result of code-switching. No interference is classified, in this case, as a "total and immediate" (p. 201) shift of the VOT from one language to the other. Additions to these three possible outcomes are suggested by authors such as Bullock and Toribio (2009a), whereby a convergence/divergence contrast is reported. While convergence relates to the aforementioned uni- or bidirectional interference, divergence occurs when speakers 'exaggerate' contrasts between the two languages.

The results from the 25 VOT studies on word-initial voiceless stops are in line with Olson's (2024) claim that "unidirectional interference has been the most common finding in the literature" (p. 681). 15 of the 25 studies reported a unidirectional interference, with the language with long-lag VOT shifting in the direction of the short-lag language. For instance, English voiceless stops are considered long-lag (VOT: 30-120 ms), while Spanish voiceless stops are short-lag (VOT: 0-30 ms) (Lisker & Abramson, 1964). Thus, in the case of Bullock et al. (2006), Balukas and Koops (2014), Fricke et al. (2016), Olson (2016), Piccinini (2016) and Uribe (2020) all authors found a unidirectional shortening convergence of English VOTs towards Spanish VOTs. In this subset of studies, we observe unidirectional convergence in both spontaneous speech (Balukas & Koops, 2014; Fricke et al., 2016; Uribe, 2020) and experimental sentence reading tasks. Meanwhile, bidirectional interference and no interference were each reported in 4 studies, and divergence was reported in two studies. As also noted by Olson (2024), the cases of no interference and divergence effects were often either small or the experimental conditions had limitations that have since been questioned (see, for instance, Bullock & Toribio, 2009a concerning Grosjean & Miller's (1994) stimuli).

16 of these 26 studies (61.54%) on VOT resulted from the systematic search of 7 databases. Thus, while the advanced database search was relatively successful in locating articles, it also highlights the importance of looking beyond databases when conducting scoping reviews. Personal communication, via mailing lists and social media posts, provided us with 5 additional VOT studies, and similarly, examining the references of included studies yielded 5 studies. 'VOT' was included in all database search strings, yet we emphasise the importance of including and searching for unpublished literature during a scoping review. We are certain that some unpublished literature on the topic was not included in this scoping review, a point that will be addressed further in the limitations section. However, the inclusion of unpublished literature in this review has been crucial for providing an accurate representation of the field to date, which will enable future researchers to extend their work.

Concerning the distinction between segmental and suprasegmental features, this scoping review identified a clear preference for the investigation of segmental features alongside code-switching in the literature. While VOT is a main contributing factor to this, with more VOT studies alone than studies that investigated suprasegmental features, it is still worth noting that this bias towards segmental features exists. An interesting point observed in the included studies in this scoping review is that while a segmental feature (VOT) was first investigated alongside code-switching in 1993 (Hazan & Boulakia), suprasegmental features were largely absent[17] from the literature until 2012 (Olson). This close to 20-year advantage for research on segmental features has led to a clear preference for and advanced knowledge of the influence of code-switching on segmental features. While there is a clear need for studies focusing on segmental features to move away from VOT, the need for increased focus on suprasegmental and prosodic analyses of code-switching is perhaps more pertinent.

While much of the emphasis in the included studies was placed on VOT, there was a notable underrepresentation of explicit analysis regarding the influence of the matrix and embedded languages on each other as conceptualised in theoretical models of code-switching (e.g., Myers-Scotton, 1993). Instead, discussions of phonetic outcomes were frequently framed through the lens of L1/L2 interference. For instance, Antoniou et al. (2011) and Šimáčková and Podlipský (2015) both reported findings that align with unidirectional L1-to-L2 influence, but these were primarily interpreted in terms of language dominance and age of acquisition rather than in relation to the structural properties of matrix and embedded languages during the switch. Antoniou et al. (2011) found evidence of L1 influence on L2 phonetic production among early L2-dominant bilinguals, whereas Šimáčková and Podlipský reported L1-to-L2 phonetic interference among late bilinguals when switching from the L1 into the L2. In both cases, the interactional context and the linguistic architecture of the switch were not explicitly theorised through matrix language models. This highlights a critical gap in the integration of code-switching theory with phonetic analysis, suggesting that future research should more carefully incorporate frameworks like the Matrix Language Frame Model[18] to capture how language dominance, structural roles, and phonetic patterns intersect during code-switching.

[17] Only two cases of suprasegmental features are reported before 2012 (Birkner, 2004; Zheng, 1997), the publication by Olson (2012) acted largely as a starting point for studies which followed.
[18] See Aly (2017b) for the most in-depth discussions on matrix and embedded language influence.

4.2 Bias in demographic focus

The demographic bias reported in these results mirrors a broader bias in code-switching and linguistic scholarship. Participants are primarily recruited from the USA and, if not, from Western Europe, with language combinations rarely exceeding Indo-European languages. As previously reported, 30 out of the 54 studies recruited participants residing in the USA, while 29 studies focused on Spanish-English as a language combination. Furthermore, only 6 studies (11.11%) addressed language combinations that did not include English. This bias towards English was evident for both L1 and L2 speakers, with 18 of the studies involving participants who had L2 English, the largest proportion of any bilingual profile analysed. Of the 6 studies that focused on languages other than English, only 2 examined non-Indo-European languages: Aly (2017a) studied Basque, a language isolate and Verzijden (2023) studied Taiwanese and Mandarin, both part of the Sino-Tibetan family. Thus, only one study included in this scoping review dealt with a language combination that was completely non-Indo-European. We do not necessarily view this finding as biased in relation to the available literature, as while it is possible that our search strategy may not have located every relevant study, we did not exclude any papers based on our language proficiency. We chose English as the language for our search strategy and purposely did not translate it into other languages. We were confident that if the full text of a paper were not in a language we understood, a translated version of the abstract would be available from databases. This was indeed the case, and in the few instances where a translation did not accompany an abstract, we were able to utilise translation tools. As a result, none of the 54 studies included in this review were published in a language other than English, although some abstracts had corresponding translations available on relevant databases.

The finding that most included studies involved participants from North America and Western Europe, along with the general exclusion of non-Indo-European language families, is particularly concerning. As previously mentioned in the Introduction, a major reason for this overrepresentation of participants from North America, speaking Spanish and English, is due to the large number of speakers and availability of university researchers (Parafita Couto et al., 2023). This correlation between the USA and Spanish-English studies can be seen particularly in Table 3. Based on the 2020 Decennial Census from the USA, 13.7% of the population speaks Spanish (United States Census Bureau, 2020). This equates to just over 43 million speakers, placing the USA among the top five largest Spanish-speaking countries (Statista, 2025). Moreover, 7 of the top 10 universities globally are located in the USA (*World University Rankings 2025*, 2025). This combination of a high population density and leading academic researchers has resulted in a strong bias in the literature for investigations into Spanish-English bilinguals.

A total of 3 studies recruited participants from South America (2) and Africa (1), yet none of these 3 studies included a non-Indo-European language. Thus, there is a clear and concerning gap in the phonetic literature on code-switching concerning some of the world's most intensely diverse linguistic populations (Aboh, 2020; Amuzu & Singler, 2014). For example, the number of languages spoken in Nigeria is still not even fully clear, with the most recent speculations put at between 450 and 500 languages (Adegbite, 2010; Omodiaogbe, 1992). Moreover, about a quarter of the world's linguistic genetic diversity comes from the 108 language families found in South America (Campbell, 2012). In such densely multilingual areas, code-switching happens to be the norm of communication

(Kašćelan & Parafita Couto, 2024). It is therefore pertinent to explore and research the general linguistic and code-switching habits of these communities to draw both greater generalisability from findings and to gain access to a wealth of naturally occurring multilingual data.

We followed Kašćelan and Parafita Couto (2024) in classifying participant data using the binary labels *male* and *female*, as this was the only available categorisation in the included studies. This approach was necessary given that 40.74% (n = 22) of the studies did not provide any information on participants' sex or gender. Furthermore, no study explicitly distinguished whether the reported data referred to sex (a biological classification) or gender (a social identity). Combined with the findings of Kašćelan and Parafita Couto (2024), these results highlight a broader issue concerning a lack of clarity and consistency in reporting participant identity characteristics. More pertinently for the topic of this current review is the complete absence of non-binary populations in research on bilingual phonetics and code-switching. Existing evidence suggests that VOT in monolingual non-binary speakers may diverge from cisgender norms (Rechsteiner & Sneller, 2023), yet this variability remains almost entirely unexplored in bilingual contexts. Furthermore, to our knowledge, no studies have examined the phonetics of code-switching in non-binary bilingual individuals. As a result, while the included studies in this scoping review may have normalised phonetic data based on gender-specific speech settings, these settings only include binary genders (see Olson, 2019, for example). Improving the representation and recognition of gender-diverse participants is essential for enhancing the accuracy, inclusivity, and ethical integrity of research in this field.

As presented in the Results section, little information was available regarding the SES of participants in the included studies. Where SES indicators were mentioned, they were often indirect and inconsistently reported in the form of education, occupation and through the method of participant recruitment. Given this, the first author decided not to categorise participants by SES, as doing so would have required speculative assumptions that risked stereotyping. For instance, while one might assume that holding a university degree signals high SES, such a conclusion overlooks key intersecting factors such as migration status, multilingualism and place of residence. Kašćelan and Parafita Couto (2024) highlight how, in multilingual and migrant contexts, the link between educational attainment and SES can be particularly tenuous. Drawing on data from Fernández-Reino and Brindle (2024) on migrants' labour market integration in the UK, they caution that "research on multilingualism should avoid relying solely on education as an SES estimate" (p. 21). More relevant to our current study would be the integration of migrations into labour markets in the USA, and particularly Hispanic populations, based on the language combinations and ethnicities described in the included studies. Antman et al. (2023) report that among the 62.1 million Hispanics in the USA, foreign-born Hispanic men earn 39% less on average than US-born non-Hispanic White men. This earning gap persists for both foreign-born Hispanic women as well as US-born Hispanics. Education is one contributing factor, as highlighted by Antman et al. (2023), in this deficit.

These findings from both Antman et al. (2023) and Fernández-Reino and Brindle (2024) further support the decision to avoid a SES classification in this review. Of the included studies, 21 used education and 7 used university recruitment as indirect SES indicators. The latter is particularly problematic, as recruiting participants on a university

campus does not guarantee they are students or degree-holding staff; it may include a range of individuals present for unrelated reasons, including visitors or staff in non-academic roles. Without detailed and consistent reporting, categorising SES, particularly relating to this indicator, would risk misrepresentation. We therefore recommend that SES indicators be explicitly and consistently reported in future phonetic research on code-switching. Moreover, we concur with Kašćelan and Parafita Couto's (2024) position that SES should not be estimated based on a single variable. Instead, a multidimensional approach to SES, which takes into account factors such as income, occupation, education and migration background, should be prioritised to ensure a more accurate and representative understanding of participant populations.

4.3 Definitions of code-switching

As discussed in the Introduction and Methods sections, there is a long-standing and well-documented inconsistency in how terms such as code-switching, language switching, code-mixing and translanguaging are used in the literature (Bullock, 2009; Gullberg et al., 2009). Building on this awareness and inspired by Kašćelan and Parafita Couto's (2024) recent scoping review on code-switching in neurodivergent populations, we chose to go a step further by comparing how code-switching is defined across the studies included in this review.

To ensure comprehensiveness, we included studies using a wide range of related terms, even when their underlying assumptions differed. For instance, some studies, such as Goldrick et al. (2014), focused on language switching in controlled tasks, conceptualising switching as a cognitive mechanism (Gullberg et al., 2009), while others, like Penning (2021), examined spontaneous code-switching in sociolinguistic contexts governed by structural constraints. Still others (e.g., Gavino & Goldrick, 2022) used multiple terms interchangeably, without clarifying their operational distinctions. Including all of these studies was necessary to accurately map the field's terminological variation and conceptual boundaries.

Notably, 13 of the 54 studies (24.07%) did not provide any definition of code-switching. While some were short-form conference proceedings or focused only tangentially on switching, the omission is problematic. We emphasise the importance of defining the phenomenon under investigation to improve transparency, comparability, and reproducibility across studies.

Among the remaining 41 studies that did offer a definition, there was no single agreed-upon formulation. However, a pattern did emerge: all definitions shared three or four key components:

1. A reference to switching or varied language use,
2. The involvement of two or more languages,
3. The occurrence of switching within a single utterance, phrase, or conversation,
4. (Optionally) a specification of where the switch occurs—within or between the features of (3).

This shared structure suggests a broad, functional consensus, even if theoretical and terminological differences persist. Nevertheless, the ongoing lack of definitional clarity and, in some cases, the conflation of structurally distinct phenomena present a major obstacle to cumulative knowledge-building in the field. Taking two of the included definitions, for example, Myers-Scotton (1993) defines code-switching as "the alternation between two (or more) languages or language varieties within a single interaction," while Poplack (1980) describes it as "the use of more than one language in the same turn of speech or discourse." These two definitions may appear relatively similar at first glance; however, the former places emphasis on socio-pragmatic interpretations and markedness of language alternation within conversational contexts, whereas the latter focuses on the structural properties and syntactic constraints of switching within utterances. These definitional distinctions underscore the diversity of approaches in the field and complicate the comparability of studies where code-switching is operationalised differently.

Future research would benefit from clear and explicit operational definitions of code-switching. This is especially critical when phonetic variables are under investigation, as different switching types may place varying cognitive, articulatory, and sociolinguistic demands on speakers. Evidence suggests that bilinguals engaging in different types of code-switching exhibit varying levels of cognitive inhibition, due to the need to monitor cross-linguistic competition in 'denser' forms of switching (Hofweber et al., 2020). In this context, insertional code-switching is considered 'denser' than alternational switching, where languages are kept more structurally separate. Furthermore, the social meanings associated with different types of switches, such as whether a switch is regarded as habitual or marked, may influence a speaker's phonetic choices. This can potentially result in variation in features such as pitch, duration, or segmental realisation. Without such definitional precision, comparing findings across studies becomes challenging and may obscure important variation tied to the nature of the switching event itself.

4.4 Generalisability of findings

In assessing the generalisability of the findings in this scoping review, particular attention must be paid to the frequently small sample sizes across the included studies. Of the 54 studies reviewed, 32 had participant samples ranging from 4 to 20, while 17 studies (31.48%) included more than 20 participants. Gavino and Goldrick (2022) justified their sample size of 18 using a Monte Carlo power analysis, which accounted for the number of target items and participants needed to achieve a statistical power exceeding 0.8. However, the majority of the studies did not provide any rationale for their sample sizes. In many cases, small sample sizes were explicitly noted as a limitation (see Alvanoudi, 2023; Toribio et al., 2005; Uribe, 2020). This raises questions about the broader applicability of their findings, particularly in these studies, which used quantitative methods.

One potential solution to the limitations posed by small samples is the implementation of large-scale inter-lab collaborations. This has been proposed by Prévost and Tuller (2023) in research on the speech of bilingual children with Autism Spectrum Disorder (ASD), and a similar model could be fruitfully applied to studies of phonetics and code-switching in neurotypical populations. This suggestion focuses essentially on pooling resources through collaboration. Experimental studies on speech sounds could pool resources ranging from

high-quality portable audio and video recording equipment to software tools and participant pools. These collaborations could further facilitate the exchange and transmission of knowledge across institutions.

If small sample sizes are to be mitigated through large-scale inter-lab collaborations, it is equally important that the collected data is shared and made accessible to researchers both within and outside of the collaboration. As highlighted by Parafita Couto et al. (2023) and Parafita Couto & Balam (in press), limited access to speech corpora continues to hinder progress in code-switching research. We focus here on speech corpora of spontaneous speech, as it offers the most accurate description of community practices, and yet it was the chosen method of only 17 studies (31.48%). This review includes both open-access corpora (e.g., the Bangor Miami Corpus (Deuchar et al., 2014), used by Fricke et al., 2016 and Yusko, 2022) and closed-access corpora (e.g., the NMSEB Corpus (Torres Cacoullos & Travis, 2018), used by Balukas, 2014, Balukas & Koops, 2014 and Johns & Steuck, 2021). Interestingly, a notable distinction emerged from studies which used these corpora: studies using open corpora tended to report more detailed demographic information (such as participant age), whereas those using restricted-access corpora often lacked basic demographic reporting, including age and sex/gender data.

Despite Li et al. (2023) having the largest participant sample (n = 90) from the included studies, thanks to the use of 3 corpora, no age demographics and rather limited information on participant bilingual profiles were reported by the authors. If large-scale, community-specific datasets are collected, they must be used meaningfully and reported responsibly and transparently, particularly if they are to support cross-community comparisons (Parafita Couto et al., 2023). Reporting of participant characteristics, by both corpus creators and users, is a necessary foundation for meaningful and generalisable claims.

Efforts toward data accessibility and transparency align closely with the principles of Open Science. Since the launch of IRIS in 2011 (Mackey & Marsden, 2015), initiatives such as OASIS (Marsden et al., 2018) and repositories like OSF have promoted data sharing and reuse in linguistic research. These platforms complement the goals of large-scale collaborations by making data more accessible to researchers and enabling comprehensive reviews such as this one. Open Access publication of primary studies further supports generalisability by allowing future reviewers and researchers to access and synthesise findings fully and transparently. We, therefore, strongly agree with those such as Parafita Couto et al. (2023) to make corpora of spontaneous code-switching speech fully available.

4.5 Implications and recommendations for future research

This scoping review has successfully identified language combination(s) in which the phonetics of code-switching has been investigated, described the demographic and bilingualism-related characteristics of the populations studied, identified approaches and methods used in experimental set-ups, identified (supra)segmental features and the types of code-switching examined and presented findings on the influence of matrix and embedded languages at the phonetic level. The outcomes of these 6 objectives have been detailed in the preceding sections.

In alignment with the review's objectives, it is anticipated that this scoping review may serve as a precursor to carry out more targeted systematic reviews which focus on narrowly defined research questions and further appraise the quality of studies on the topic. More broadly, it is hoped that future researchers will use this review to deepen their understanding of the field and identify productive avenues for investigation based on the gaps identified.

Future research should not only advance the results and findings of previous studies, but it should also aim to find answers to questions which have received less empirical attention. To both extend present knowledge and address gaps in the literature, we provide suggestions for future research as implied by the findings of this scoping review. We recommend that future research on the phonetics, phonology and prosody of code-switching broaden its focus in terms of language combinations, particularly to move beyond investigations of Spanish-English bilinguals. Specifically, we encourage studies involving bilingual language combinations that have at least one, if not two, languages which do not belong to the Indo-European family. Future work should also strive for greater regional diversity, outside of North America and Western Europe, and improved sex and gender cataloguing. Such investigations may include underrepresented or marginalised bilingual communities, such as Indigenous speakers, populations in Africa and South America, or those who identify as part of non-binary communities. Code-switching practices in these populations may reflect distinct linguistic ecologies and sociolinguistic dynamics. To further promote greater diversity in participant samples and experimental approaches, we have addressed the need for increased access to existing corpora of spontaneous speech. Open availability to these corpora of informal speech, which are the most natural source of code-switching data (Parafita Couto et al., 2023), could further provide researchers with access to more socioculturally diverse communities and opportunities for future research.

Thus, we suggest that spontaneous data be utilised to a similar extent as experimental approaches have been in the past, to improve population diversity, code-switching type and frequency and methodological variation. Using such data may facilitate the investigation of naturally occurring intra-word code-switching, as opposed to a more arduous task of creating appropriate experimental target stimuli, as this type of code-switching has not appeared in this scoping review. Spontaneous data may also yield higher code-switching frequencies, especially when sourced from those populations where code-switching is the norm. Although many included studies using spontaneous data cited a lack of code-switching occurrences as a limitation, targeting appropriate populations could help mitigate this issue.

Additionally, in line with Olson (2024), we further emphasise the need for research into suprasegmental features generally, and underexplored segmental features of code-switch beyond VOT. We also recommend consistent use of questionnaires, such as the BLP by Birdsong et al. (2012), to collect comprehensive participant profiles, including language background and inclusive information gender, sex and SES. Finally, we stress the importance of establishing, and ideally reaching consensus on, a working definition of code-switching among scholars. This is a foundational step that remains unresolved and is essential for advancing research in any area of code-switching research with greater coherence and comparability.

4.6 Limitations of the current study

While this research was conducted with the utmost precision and every effort was made to ensure that this scoping review is representative of the interdisciplinary field of the phonetics of code-switching, we must also acknowledge certain limitations. These limitations are presented alongside suggested improvements in the hope of inspiring and supporting future reviews and research that may build on this work.

A primary limitation concerns the advanced search options of the various databases and subsequent formulation of the search strings. Although we aimed to create as varied a search string as possible, it had to be refined multiple times due to overly broad results. Striking a balance between topic-specific results and unrelated content – sometimes outside of the field of linguistics altogether – proved challenging. We encourage future researchers to pilot test their search strings across multiple databases earlier in the research process to identify how different platforms interpret and return results. It may be helpful to document how each database handles Boolean operators, truncation, and discipline-specific indexing, as this can significantly affect the relevance of retrieved studies.

Moreover, while Google Scholar would have been especially beneficial due to its broad coverage and accessibility, it was not fully utilised as we did not have enough time to learn how to accurately use it. We therefore recommend that future researchers take full advantage of Google Scholar and its accessibility.

Additionally, we are aware of a small number of relevant studies, primarily unpublished materials in the form of poster presentations and theses that were not included in this review due to inaccessibility. The first author estimates this number to be between three and five studies. These inaccessible papers were noted in the *inclusion-exclusion systematic database* sheet, which may serve as a useful resource for future researchers. Supplementary materials submitted to OSF alongside this review are intended to combat inaccessibility and further support future research. We suggest that researchers use these data files to identify inaccessible articles and, where possible, leverage their resources to obtain them. Given the short, 9-week data collection period, we were often unable to contact the authors of these papers – a further step future researchers may wish to consider if they face similar limitations.

5. Conclusions

This scoping review has outlined the available findings on the phonetics, phonology and prosody of code-switching across bilingual populations. While we generally feel as though this topic is relatively underexplored in the literature, we have also identified several topics of bias in the relevant literature. These biases in focus concern the overrepresentation of particular language combinations (e.g., focus on Indo-European language combinations, most specifically with a focus on Spanish-English pairings), as also identified in code-switching research more generally. Furthermore, we found an overrepresentation of bilinguals from the USA, and the overrepresentation of VOT as a segmental feature in this research. This is accompanied by an underrepresentation of spontaneous speech samples, when compared to experimental methods of data elicitation and suprasegmental features generally. We also analysed and observed a lack of terminological consensus on code-switching, which further mirrors previous findings on the non-comparability of studies in this field. Thus, we have made suggestions to diversify and further progress future research on the topic. With some of these issues in mind, we discuss the generalisability of existing findings and offer suggestions on increasing the accessibility and availability of data.

We have acknowledged certain limitations of this research, particularly concerning the key search terms and databases that we used. Nevertheless, we call for future research to ensure more focus is placed on code-switching practices from intensely diverse linguistic communities, where code-switching is the norm for communication. The benefits of these studies would be twofold: they would contribute to increased linguistic diversity and complement existing research by focusing more on naturalistic data. While experimental elicitation remains crucial in investigating and controlling for certain phonetic features, it often does not faithfully reproduce the social and communicative variables accompanying code-switching. Spontaneous data, on the other hand, can offer insights that are essential for a comprehensive understanding of how phonetic features unfold in natural code-switching contexts. Finally, we would like to see improved reporting of participant demographic data in future studies via detailed language profile questionnaires. This improved reporting could be implemented alongside increased inclusivity of those who identify with non-binary sex and gender categorisations.

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7. References

Note: asterisk (*) indicates inclusion in the scoping review

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8. Appendices

Appendix A

Email sent via mailing lists

Dear colleagues,

In collaboration with researchers from Leiden University, Cambridge University and Florida State University, I am currently conducting a **scoping review of the literature on phonetics, phonology or prosody of code-switching in bilinguals**. This scoping review will first be submitted as a Research Master thesis at Leiden University, with the aim of subsequent publication in a journal. While I am doing a systematic search through several databases, I would also like to ask if you have any work regarding this topic, with currently unpublished work being of particular interest. Therefore, if you have work that concerns this topic, and would like for it to be included in the review, please email me at g.m.deasy.2@umail.leidenuniv.nl by April 1st, 2025.

I am interested in research with bilinguals speaking any language combination(s), of any age range with any sex and gender distribution. Regarding phonetics, phonology and prosody, I am interested in any work that concerns the study of speech sounds in combination with code-switching. I am also inclusive of language mixing research in the broadest sense and the type of bilingualism.

For any further questions, you may contact me at **g.m.deasy.2@umail.leidenuniv.nl**

Best wishes,

Gráinne M. Deasy (Leiden University),

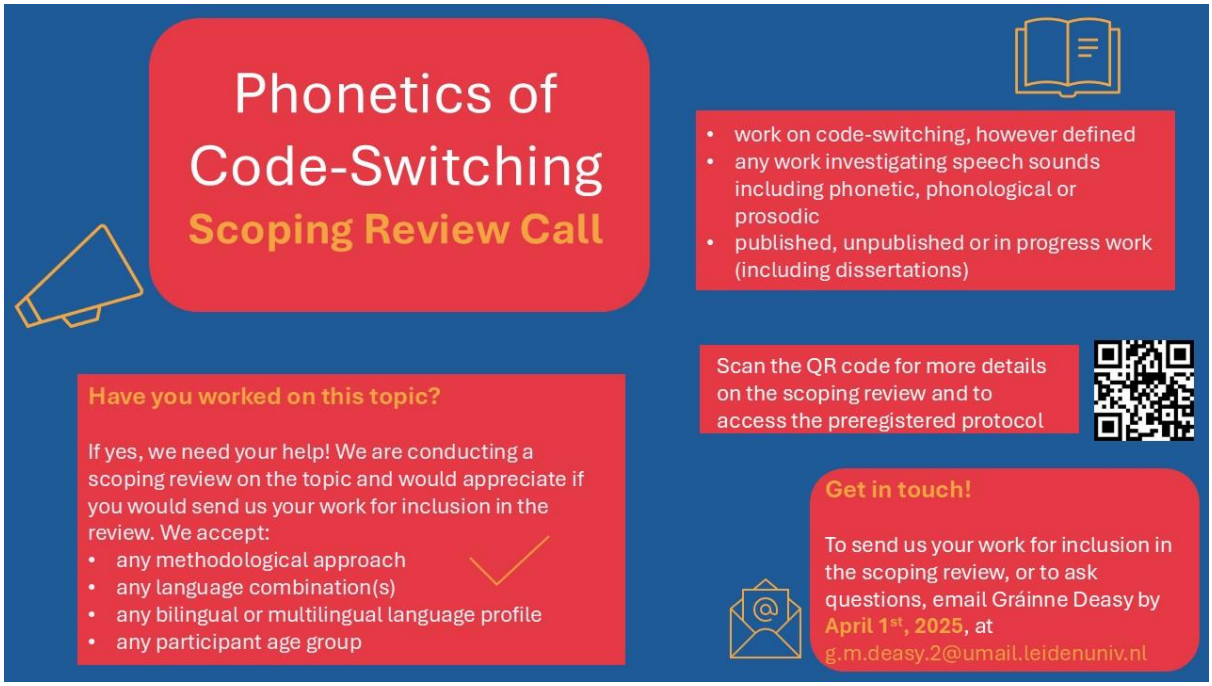
Yoana Dancheva (Cambridge University)

Dr. Maria del Carmen Parafita Couto (Leiden University)

Prof. dr. Yiya Chen (Leiden University)

Dr. Antje Muntendam (Florida State University)

Poster for social media



Appendix B

Search String for Web of Science and EBSCOhost

code-switch OR “code switch” OR codeswitch OR code-switching OR codeswitching OR code-mixing OR codemixing OR "code mixing" OR code-mix OR “code mix” OR codemix OR “language mix” OR "language mixing" OR "language switching" OR “language switch” OR translanguage OR translanguaging OR "code blending" OR code-blending OR “code blend” OR code-blend OR codeblend OR codeblending OR alternation OR insertion OR “congruent lexicalization” OR backflagging OR intra-sentential OR intrasentential OR intra-clausal OR intraclausal OR inter-sentential OR intersentential OR inter-clausal OR interclausal OR borrowing OR loanword AND autosegmental OR segmental OR suprasegmental OR formant OR F0 OR plosive OR “articulation rate” OR “speech rate” OR VOT OR “voiced plosive” OR “voiceless plosive” OR pitch OR “prosodic features” OR prosody OR phonetics OR “phonetic features” OR phonology OR “phonological features” AND bilingual OR trilingual OR multilingual OR “heritage language” OR “heritage bilingual” OR “heritage speaker” OR “preferred language” OR “dominant language” OR “non-dominant language” OR “first language” OR “native language” OR “minority language” OR “majority language” OR “bilingual first language acquisition” OR BFLA OR “second language” OR “foreign language” OR L1 OR L2 OR L3

Search String for Taylor and Francis and ProQuest

code-switch OR “code switch” OR codeswitch OR code-mix OR “code mix” OR codemix OR “language mix” OR “language switch” OR translanguage OR “code blend” OR code-blend OR codeblend OR alternation OR insertion OR “congruent lexicalization” OR backflagging OR intra-sentential OR intrasentential OR intra-clausal OR intraclausal OR inter-sentential OR intersentential OR inter-clausal OR interclausal OR borrowing OR loanword AND autosegmental OR segmental OR suprasegmental OR formant OR F0 OR plosive OR “articulation rate” OR “speech rate” OR VOT OR “voiced plosive” OR “voiceless plosive” OR pitch OR “prosodic features” OR prosody OR phonetics OR “phonetic features” OR phonology OR “phonological features” AND bilingual OR trilingual OR multilingual OR “heritage language” OR “heritage bilingual” OR “heritage speaker” OR “preferred language” OR “dominant language” OR “non-dominant language” OR “first language” OR “native language” OR “minority language” OR “majority language” OR “bilingual first language acquisition” OR BFLA OR “second language” OR “foreign language” OR L1 OR L2 OR L3

Search String for Leiden Universities Library Catalogue and Cambridge University Library Browser

codeswitch OR code-switch OR "code switch" OR “language switch” AND segmental OR suprasegmental OR F0 OR VOT OR “speech rate” OR prosody OR phonetics OR phonology AND bilingual OR trilingual OR multilingual OR “heritage bilingual” OR “dominant language” OR “second language” OR “foreign language”

Search String for Google Scholar

allintitle: codeswitching, phonetics
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allintitle: code switching, phonetics
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allintitle: code switch, phonetics
allintitle: codemixing, phonetics
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allintitle: code-mixing, phonology
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allintitle: codemix, phonology
allintitle: code-mix, phonology
allintitle: code mix, phonology
allintitle: codeswitching, phonetics, bilingual
allintitle: code-switching, phonetics, bilingual
allintitle: code switching, phonetics, bilingual
allintitle: codeswitching, phonetics, multilingual
allintitle: code-switching, phonetics, multilingual
allintitle: code switching, phonetics, multilingual
allintitle: code switching, prosody, bilingual