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Language Attrition among Bilingual Speakers: Causes, Patterns, and Sociolinguistic Implications

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ABSTRACT: This study examines language attrition among bilingual speakers as a longitudinal, usage-sensitive, and socially embedded process rather than as uniform linguistic loss. It investigates how bilingual experience, migration history, language dominance, education, social integration, and heritage-language maintenance shape change in vocabulary, grammar, pronunciation, fluency, reading comprehension, and listening comprehension. The study used a mixed-methods longitudinal design, with 144 adult bilingual speakers assigned to three language-use profiles and assessed at three time points. Researchers collected data through standardized proficiency assessments, timed vocabulary retrieval, narrative and conversational speech samples, reading and listening comprehension tasks, a language-background questionnaire, and semi-structured interviews. Quantitative analysis combined descriptive statistics, group comparisons, regression models, and mixed-effects modeling, while qualitative analysis examined how speakers interpreted language change in relation to identity, family communication, belonging, and cultural continuity. The results indicate that attrition was most visible in lexical retrieval and oral fluency, more gradual in grammatical accuracy, and least severe in comprehension when receptive exposure remained available. Stronger heritage-language use, community support, family communication routines, and literacy practice were associated with lower attrition risk, whereas dominance shift, restricted productive use, and limited social networks increased vulnerability. The study contributes a multidomain sociolinguistic model of bilingual attrition that connects linguistic performance, bilingual life history, and sociocultural participation. It argues that language attrition results from dynamic interactions among cognitive access, language exposure, social identity, and institutional support, with implications for bilingual education, migration policy, heritage-language programs, and family language planning.

Keywords: language attrition; bilingualism; heritage language; language dominance; sociolinguistic identity.

I. INTRODUCTION

Language attrition has become a central concern in contemporary sociolinguistics and applied linguistics because bilingual speakers increasingly live in conditions where one language is socially dominant while another is tied to family, community, education, migration history, or heritage identity. In international migration contexts, a Spanish-English bilingual in the United States, a Turkish-German bilingual in Germany, an Arabic-French bilingual in Europe, or a Korean-English bilingual in Australia may continue to identify with a heritage language while using the societal language for schooling, employment, public services, and digital communication. These situations make attrition a practical and theoretical issue: speakers may retain comprehension while losing lexical accessibility, preserve formulaic expressions while weakening grammatical productivity, or maintain emotional attachment to a language while avoiding its public use. Language attrition is therefore a psycholinguistic issue of reduced activation and a sociolinguistic issue of access, identity, legitimacy, and language ecology [1].

First language attrition research has demonstrated that bilingual development cannot be fully understood by comparing bilinguals to monolingual norms. Bilingual speakers distribute their languages across different interlocutors, domains, and purposes; therefore, change in one language often reflects the reorganization of the whole bilingual repertoire. Recent scholarship has emphasized that attrition and dominance are related but not identical. Dominance describes the relative availability and use of languages at a given point in time, whereas attrition refers to measurable weakening or restructuring in a language that had previously been acquired to a higher level [2]. This distinction matters because a bilingual speaker may be dominant in the societal language without showing severe attrition, and another may show lexical or phonological attrition in specific tasks despite strong cultural attachment to the heritage language.

Attrition research also contributes to broader theories of bilingualism. Attrition challenges the assumption that once a language is fully acquired, it remains stable unless affected by pathology. Instead, language knowledge is dynamic and sensitive to changing experience. Reviews of the field show that attrition depends on the onset age of bilingualism, prior attainment, frequency of use, literacy, emotional attitudes, language dominance, re-exposure, and social networks [3]. Attrition may affect different linguistic domains unequally. Lexical access and retrieval speed are often vulnerable because they depend heavily on recent activation. Fluency may decline when speakers have fewer opportunities for spontaneous production. Grammar may be more resilient when deeply entrenched, but complex structures and low-frequency forms can weaken. Phonology may shift gradually through contact with the dominant language. Comprehension may be less vulnerable than production because receptive exposure can maintain partial activation even when active use decreases.

Recent work has moved beyond defining attriters as deficient speakers. Attrition should be distinguished from incomplete acquisition, general bilingual difference, language mixing, and ordinary variation. Speakers who experience attrition often reorganize access to linguistic resources under new social and cognitive pressures [4]. This view is important for heritage-language communities, where speakers may be judged against monolingual norms or expected to perform an idealized version of ancestral-language competence. In family and community contexts, a speaker may feel insecure when unable to retrieve words in conversation with grandparents, avoid public heritage-language use because of accent insecurity, or shift to the dominant language in education and employment while still valuing bilingual identity.

Researchers have also underexamined second-language attrition, particularly when classroom learning ends or when immersion experience is followed by a return to a different language environment. Studies of instructed and immersion-based learners show that attrition cannot be predicted simply by time since instruction; language use, re-exposure, proficiency level, and social motivation also matter [5]. This insight applies equally to first and heritage-language attrition. Reduced use creates vulnerability, but it does not automatically produce uniform decline. A language may remain stable when speakers continue to use it in emotionally meaningful, literate, community-based and institutionally supported domains. Conversely, attrition may accelerate when a language becomes restricted to passive listening or ceremonial identity without regular production.

This study addresses this theoretical and methodological problem through a mixed-methods, longitudinal sociolinguistic investigation of bilingual speakers with different migration histories, dominance profiles, language-use routines, and heritage-language practices. The design examines lexical, grammatical, phonological, fluency, and comprehension outcomes over time and connects quantitative change with speakers' accounts of identity, family communication, education, social integration, and language maintenance. Its originality lies in combining longitudinal measurement, multidomain attrition assessment, and sociolinguistic interpretation in one framework. Rather than asking whether bilingual speakers lose language ability in general, the study identifies which domains are most vulnerable, which experiences protect against attrition, and how speakers interpret linguistic change in relation to belonging and cultural continuity.

This topic has considerable international relevance. Heritage-language schools, bilingual education programs, migrant-support systems, universities, and family-language initiatives often assume that bilingual maintenance depends mainly on motivation or family effort. Yet speakers' opportunities to maintain a language depend on social networks, literacy resources, community infrastructure, institutional recognition, peer interaction, and the public status of the heritage language. A robust account of attrition must therefore combine psycholinguistic measurement with sociolinguistic interpretation. This study

contributes to that goal by linking standardized tests, retrieval tasks, narratives, comprehension measures, questionnaires, and interviews in a unified longitudinal protocol.

II. RESEARCH PROBLEM

The first problem is linguistic. Language attrition affects domains unevenly, and single-score proficiency approaches are inadequate because they can hide domain-specific vulnerability. A speaker may show stable listening comprehension but slower lexical retrieval, or strong everyday fluency but weaker control of formal grammatical structures. Treating attrition as a single score therefore risks overlooking the linguistic domains most susceptible to reduced use.

The second problem is sociolinguistic. Attrition is often explained through migration or non-use, but education, social integration, family language policy, community density, literacy practices, language ideology, and identity also shape speakers' language trajectories. A bilingual speaker who migrates but maintains regular heritage-language networks may experience less attrition than a speaker who remains near the community but shifts entirely to the dominant language in education and work.

The third problem is methodological. Attrition research requires longitudinal evidence, multiple linguistic measures, and participants' own interpretations. Cross-sectional comparisons can identify group differences, but they cannot show whether change occurs within the same speakers over time. Similarly, quantitative tests can show decline, but interviews are needed to explain why speakers use, avoid, value, or emotionally distance themselves from a language.

III. RESEARCH OBJECTIVES

This study investigated the causes, patterns, and sociolinguistic implications of language attrition among bilingual speakers through a longitudinal mixed-methods design. The objectives are :

- To measure longitudinal change in lexical retrieval, grammatical accuracy, phonological stability, oral fluency, reading comprehension, and listening comprehension across three time points.
- To compare bilingual speakers with different language-dominance, migration, exposure, and heritage-language-use profiles in order to identify the domains most susceptible to attrition.
- To examine the predictive role of language exposure, frequency of use, migration length, education, social integration, community support, and language dominance through regression and mixed-effects modeling.
- To interpret speakers' accounts of attrition in relation to identity, family communication, heritage-language maintenance, and cultural continuity while developing a sociolinguistically informed attrition model.

1. RESEARCH QUESTIONS

- RQ1. Which linguistic domains are most susceptible to attrition among bilingual speakers across lexical, grammatical, phonological, fluency, and comprehension measures?
- RQ2. How do language exposure, frequency of use, migration experience, education, language dominance, and community support predict attrition over time?
- RQ3. How do bilingual groups with different language-use and heritage-language-maintenance profiles differ in patterns of attrition, stabilization, and maintenance?
- RQ4. How do bilingual speakers interpret language attrition in relation to identity, family communication, social integration, cultural continuity, and practical implications for bilingual education and heritage-language policy?

IV. LITERATURE REVIEW

1. LANGUAGE ATTRITION AND BILINGUAL DEVELOPMENT

The contemporary field of language attrition has moved from deficit-oriented descriptions toward dynamic bilingual models. Attrition is relevant to bilingual development because it shows that linguistic knowledge remains experience-sensitive across the lifespan and that bilingual speakers cannot be understood simply as two monolinguals in one person. Their languages interact, compete, reinforce, and reorganize in response to changing environments [1]. However, the literature also shows a continuing

tension between studies that treat attrition mainly as reduced performance and studies that interpret attrition as restructuring of the bilingual repertoire. This distinction matters because dominance can shift without measurable loss, while attrition can appear in specific domains even when a speaker remains strongly identified with the affected language [2].

Recent reviews clarify that attrition is not a pathological disappearance of language but a set of changes in accessibility, processing, and use [3]. At the same time, empirical findings are not uniform: lexical access often weakens quickly, while grammatical or phonological patterns may remain stable or change only under sustained contact pressure. These differences show why attrition should be measured with tasks that distinguish active retrieval, production fluency, grammatical control, phonological stability, and comprehension rather than with one global proficiency score.

2. LEXICAL ACCESS, AGE, USE AND REACTIVATION

Lexical access is often one of the most vulnerable domains in attrition. Attriters may know a word receptively but fail to retrieve it quickly in speech, replace it with a dominant-language equivalent, or rely on paraphrase. Studies of Turkish-English and Turkish-Dutch speakers show that age at onset of bilingualism, language use, attitudes, and contact patterns interact in shaping lexical and structural outcomes [6], [7]. Yet this line of work also shows contradiction: age of onset may matter in some groups, while recent use and frequency explain more variance in others. Lexical diversity, naming latency, and category fluency tasks therefore provide a sensitive but not exhaustive window into attrition [8].

Reactivation studies complicate the idea of permanent loss. Returnee heritage speakers may recover aspects of a childhood language when exposure increases, but reactivation depends on earlier acquisition, duration of reduced use, age, literacy, and social integration [9]. Adult bilingual attrition research therefore needs longitudinal evidence because a single testing moment cannot distinguish permanent decline, temporary access difficulty, or recovery through renewed exposure.

3. HERITAGE-LANGUAGE ACQUISITION, INPUT AND MAINTENANCE

Heritage-language research is directly relevant to attrition because heritage speakers often acquire a minority language early and then experience reduced exposure as the societal language becomes dominant. Research on heritage-language development shows that reduced input, limited literacy, and weaker institutional support can lead to profiles that differ from monolingual norms without necessarily indicating incomplete or defective competence [10]- [14]. Input quality, output opportunities, and family practices matter because they shape how often the heritage language is used in meaningful interaction [15], [16].

Research on bilingual children and immigrant families shows that both internal and external factors shape language outcomes. The amount of input matters, but so do interaction, literacy, schooling, family attitudes, and community practices [17]-[20]. For adult bilingual attrition, these findings suggest that language maintenance is more likely when speakers continue to use the language across several domains: family, literacy, work, religion, cultural participation and digital communication.

4. MEASURING BILINGUALISM, DOMINANCE AND LANGUAGE EXPERIENCE

A major methodological challenge in attrition research is measuring bilingual experience. Language dominance should not be inferred from a single variable such as age of acquisition, self-rated proficiency or country of residence. Studies have shown that dominance is multidimensional and affects performance and processing outcomes [21]. Experiential measures can proxy dominance when they include current exposure, cumulative exposure, use across contexts, and proficiency in both languages [22].

Recent methodological work recommends careful reporting of bilingual profiles, including age of acquisition, home language, education, literacy, self-ratings, objective proficiency and language-use contexts [23]-[26]. These recommendations are essential for attrition studies because unreported variation in bilingual experience can create misleading group comparisons.

5. MIXED-METHODS AND LONGITUDINAL APPROACHES

Longitudinal designs are especially valuable in attrition research because they let researchers distinguish stable bilingual differences from within-speaker change. Mixed-effects models are suitable because repeated

observations are nested within speakers, tasks, items, and time points; they also test whether attrition trajectories differ by language-use profile while accounting for individual variation [27]-[29]. Longitudinal research is not simply a stronger version of cross-sectional comparison; it changes how we interpret attrition by showing whether change accumulates, stabilizes, or reverses.

Qualitative analysis is equally important because attrition is experienced socially and emotionally. Thematic analysis can capture how speakers describe forgetting, avoidance, shame, pride, identity negotiation and family communication [30], [31]. Mixed-methods integration through joint displays helps connect quantitative score changes with qualitative explanations, making the analysis more transparent and theoretically useful [32].

Table 1. Literature-review synthesis and study positioning.

Research strand	References	Main contribution	Use in this study
Attrition theory	[1]-[5]	Defines attrition as dynamic change in accessibility, processing, and use, while distinguishing attrition from dominance shift.	Supports a non-deficit model of bilingual change and clarifies the theoretical boundary between reduced access and loss.
Lexical and structural attrition	[6]-[9]	Shows effects of age, use, attitude, lexical access, reactivation, and domain-specific vulnerability.	Guides selection of retrieval, narrative, fluency, and comprehension tasks while avoiding one-score interpretation.
Heritage-language maintenance	[10]-[20]	Connects input, output, family practice, literacy, and institutional support to heritage-language outcomes.	Explains why sociolinguistic ecology can protect or weaken maintenance.
Dominance and measurement	[21]-[26]	Shows that bilingual profiles require multidimensional reporting.	Justifies language-background and dominance instruments.
Longitudinal and mixed methods	[27]-[32]	Supports repeated-measures inference, mixed-effects modeling, thematic analysis, and mixed-methods integration.	Strengthens transparency, replicability, and theory-linked interpretation.

Additional evidence supports a multi-domain approach to attrition but also shows that results vary by population and method. Lexical-retrieval research with sequential bilingual heritage children shows that language experience can predict attrition more strongly than age of acquisition when input and residence length reshape access to the heritage language [33]. Grammatical attrition research indicates that structural vulnerability depends on the interaction between reduced use, representational stability, and processing pressure [34]. Phonetic and perceptual studies show that attrition may appear in speech perception and phonological categories, extending beyond vocabulary and morphosyntax [35]. Broader bilingualism scholarship reinforces the need to understand bilingual speakers through their lived repertoires, domains of use, and interactional histories rather than through monolingual comparison alone [36].

V. RESEARCH GAP AND STUDY CONTRIBUTION

The first gap concerns multidomain measurement. Many studies examine lexical access, grammar, phonology, fluency, or proficiency separately, but fewer studies compare lexical retrieval, grammatical accuracy, phonological stability, oral fluency, reading comprehension, listening comprehension, identity, and community support within the same longitudinal design. This makes it difficult to determine whether attrition is primarily lexical, grammatical, phonological, fluency-related, comprehension-based, or socially mediated in a given population.

The second gap concerns sociolinguistic explanation. Attrition is often linked to reduced use, but researchers pay less attention to how language ideology, community support, family practices, literacy, education, and social integration shape attrition trajectories. The present study therefore treats speakers' language use as socially enabled or restricted, not merely as an individual choice.

The third gap concerns methodological integration. Quantitative measures can identify change, but interviews explain why speakers use one language more than another and how they evaluate language change. This study contributes a multidomain sociolinguistic model of bilingual attrition that links linguistic performance, bilingual experience, and sociocultural meaning. The novelty lies in integrating lexical, grammatical, phonological, fluency, comprehension, identity, family communication, and community variables in one longitudinal mixed-methods framework.

VI. CONCEPTUAL AND THEORETICAL FRAMEWORK

The conceptual framework integrates language attrition theory, bilingualism, psycholinguistics, sociolinguistics, heritage-language studies, and usage-based linguistics. Attrition theory explains why reduced activation can weaken accessibility. Bilingualism research explains language dominance and cross-language interaction. Psycholinguistics explains retrieval, inhibition, and competition in processing. Sociolinguistics explains why language use is distributed across social networks, institutions, and identities. Heritage-language studies explain the relationship between family transmission, literacy, and minority-language maintenance. Usage-based linguistics explains why frequency, recency, and meaningful use influence stability.

The framework treats attrition as a socially structured accessibility process. Reduced use does not automatically erase linguistic knowledge, but it changes how quickly and confidently speakers retrieve and deploy forms in communicative contexts. Language exposure, frequency of use, migration, and dominance shift affect linguistic access; social integration, education, and community support affect opportunities for continued use; and identity, family interaction, and cultural continuity shape whether speakers invest in maintenance.

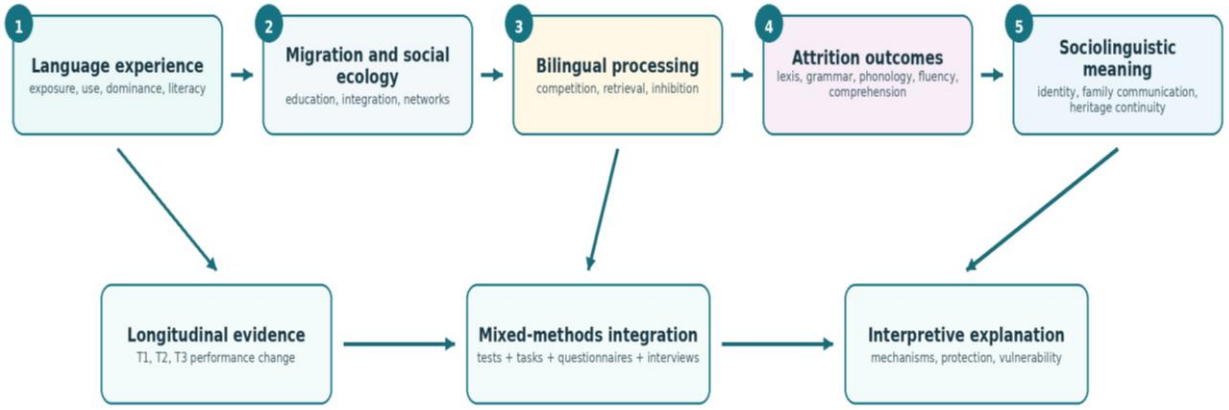


FIGURE 1. Longitudinal sociolinguistic attrition framework.

Figure 1 summarizes the analytical movement from language experience and migration ecology to bilingual processing, measurable attrition outcomes, longitudinal evidence, mixed-methods integration, interpretive explanation, and sociolinguistic meaning.

Table 2. Theory-to-variable alignment for the attrition framework.

Perspective	Theoretical concept	Measured indicator	Operational role
Language attrition theory	Reduced use and accessibility	Change in scores across T1, T2 and T3	Identifies longitudinal weakening or stability.
Bilingualism	Dominance and interaction	Dominance index; exposure balance	Explains why attrition differs by language profile.
Psycholinguistics	Retrieval and processing	Naming latency, fluency, comprehension	Tests vulnerability of access-based domains.
Sociolinguistics	Language use in social contexts	Family, education, community and work use	Explains social distribution of maintenance.
Heritage-language studies	Transmission and identity	Family language policy; literacy; community support	Links attrition to cultural continuity.
Usage-based linguistics	Frequency and entrenchment	Cumulative and recent exposure	Explains protective effect of regular use.

VII. METHODOLOGY

1. RESEARCH DESIGN

The study used a mixed-methods longitudinal sociolinguistic design. The quantitative strand assessed linguistic performance at three time points over twelve months: baseline, six-month follow-up, and twelve-month follow-up. The qualitative strand examined how bilingual speakers interpreted changes in their language ability and how those changes affected identity, family communication, and cultural participation. The empirical protocol was implemented between March 2022 and May 2023 in university, community, and heritage-language networks. The design was explanatory: quantitative results identified attrition patterns, while qualitative interviews explained their social meaning.

2. PARTICIPANTS AND SAMPLING

The final sample included 144 adult bilingual speakers across three language-use profiles: high heritage-language maintenance, balanced bilingual use, and dominant-societal-language use. We recruited participants through heritage-language associations, university bilingual networks, community education programs, and multilingual professional groups. The sample included Arabic-English, Turkish-German, Spanish-English, Korean-English, and French-English bilinguals, allowing comparison across migration, education, and heritage-language-use profiles. Participants ranged in age from 18 to 46; 82 identified as female, 59 as male, and 3 preferred not to report gender. Inclusion criteria were adult age, bilingual experience from childhood or adolescence, regular contact with both languages at some point in life, and completion of the three testing waves. Exclusion criteria were neurological disorders affecting language, incomplete core responses, and inability to complete the testing battery.

Table 3. Participant grouping and sampling logic.

Group	n	Profile criteria	Analytical function
High maintenance	48	Regular family/community use; literacy in heritage language	Lower observed attrition risk; used as maintenance comparison group
Balanced use	48	Frequent use of both languages across domains	Moderate observed risk with domain-specific variation
Dominant societal-language use	48	Reduced heritage-language production; high societal-language exposure	Higher observed lexical and fluency vulnerability
Total	144	Three time points; mixed assessment battery	Completed three time points; supports longitudinal comparison

3. INSTRUMENTS

The language-background questionnaire combined items adapted from the Language History Questionnaire 3.0 and bilingual dominance measures, recording age of acquisition, migration history, years of residence, language use by domain, literacy practices, education, family language policy, and self-rated proficiency. Objective tasks included a standardized proficiency assessment aligned with CEFR descriptors, timed picture naming, category fluency, translation recognition, a picture-based narrative task, an eight-minute conversational sample, reading comprehension passages, and listening comprehension tasks. Semi-structured interviews examined attitudes, identity, family communication, and perceived language change. Instruments were piloted with 18 bilingual speakers and reviewed by two applied-linguistics specialists before main data collection.

Table 4. Instruments and analytical functions.

Instrument	Data produced	Analytical function
LHQ3-adapted language-background questionnaire	Exposure, use, dominance, migration, literacy, community support	Predictor variables and language-use profile classification
CEFR-aligned standardized proficiency assessment	Global speaking, reading, listening, and grammar scores	Baseline competence and longitudinal change
Timed picture naming, category fluency, and translation recognition	Accuracy, response time, omissions, self-repairs	Lexical access vulnerability
Picture-based narrative and 8-minute conversational sample	Fluency, grammar, phonology, lexical diversity, repairs	Production-based attrition evidence
Reading and listening comprehension battery	Literal and inferential comprehension accuracy	Comparison of receptive and productive change
Semi-structured interviews	Identity, family communication, perceived change, maintenance practices	Sociolinguistic interpretation and triangulation

4. ANALYTICAL PROCEDURE

We analyzed quantitative data in four stages. First, descriptive statistics summarized baseline performance and longitudinal change. Second, group comparisons examined differences among language-use profiles using repeated-measures ANOVA and post-hoc contrasts where appropriate. Third, regression analyses identified predictors of attrition risk. Fourth, mixed-effects models estimated time, group, and predictor effects while accounting for repeated observations by speaker, task, and item. The primary mixed-effects specification was: $AttritionScore_{it} = \beta0 + \beta1Time_t + \beta2Exposure_i + \beta3DominanceShift_i + \beta4MigrationDuration_i + \beta5CommunitySupport_i + \beta6HeritageEducation_i + u0i + u0task + \varepsilon_{it}$. Missing item-level values below 3% were handled using scale-level mean substitution when at least 80% of items were completed; sensitivity analyses compared complete-case and imputed results. We checked model assumptions through residual plots, VIF values, influence diagnostics, convergence checks, and inspection of random-effect variance. We analyzed qualitative interviews using reflexive thematic analysis, including repeated reading, initial coding, category development, evidence matrices, negative-case analysis, and interpretive memoing.

5. RELIABILITY, VALIDITY AND ETHICS

We supported reliability through instrument piloting, internal-consistency checks for questionnaire scales, double coding of 20% of narrative and interview data, and coder-resolution meetings. Internal consistency was acceptable for the exposure and dominance scales (α = .81-.88). Intercoder agreement reached κ = .84 for speech-sample coding and κ = .82 for qualitative theme classification. We strengthened validity through triangulation across proficiency, retrieval, speech, comprehension, questionnaire, and interview evidence. The institution's Social Sciences Research Ethics Committee granted ethical approval

before data collection, and all participants provided informed consent. We anonymized data, stored them securely, and analyzed them using participant codes only.

VIII. FINDINGS

The findings are reported in relation to the four research questions. The longitudinal results identify domain-specific attrition across three measurement points, group differences across language-use profiles, predictors of attrition risk, and qualitative meanings attached to language change. The quantitative and qualitative strands integrate to show how measured change corresponds with speakers' accounts of identity, family communication, and heritage-language maintenance.

1. DOMAIN-SPECIFIC ATTRITION PATTERNS

The results indicate that attrition was most visible in vocabulary retrieval and oral fluency. Lexical retrieval declined more sharply than reading and listening comprehension, suggesting that active access was more vulnerable than receptive knowledge. Grammatical accuracy showed moderate decline, especially in low-frequency morphology and complex sentence production. Phonological stability showed smaller but measurable drift, mainly in pronunciation confidence and contact-influenced features. Comprehension remained comparatively stable, especially among speakers who maintained passive exposure through media, family listening, or community events.

Table 5. Longitudinal domain scores across three time points.

Domain	T1 mean	T2 mean	T3 mean	Change	Interpretation
Vocabulary retrieval	74.2	68.9	63.7	-10.5	Largest observed decline; active lexical access weakened.
Grammatical accuracy	78.4	75.2	72.1	-6.3	Moderate decline in low-frequency and complex structures.
Phonological stability	82.1	80.0	78.3	-3.8	Gradual contact-related phonological drift.
Oral fluency	70.3	65.1	59.4	-10.9	Reduced spontaneous production and longer pauses.
Reading comprehension	83.5	81.6	79.8	-3.7	Comparatively stable receptive skill.
Listening comprehension	84.1	82.8	80.5	-3.6	Maintained by passive exposure and family listening.

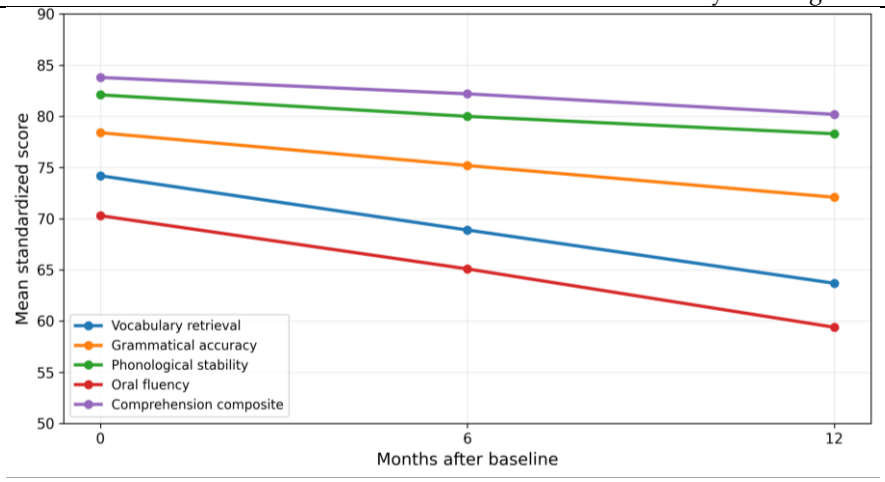


FIGURE 2. Longitudinal change across linguistic domains.

2. GROUP DIFFERENCES BY LANGUAGE-USE PROFILE

Group comparisons showed that speakers in the high-maintenance profile had smaller declines than speakers in the dominant-societal-language profile. The balanced-use group showed intermediate patterns: comprehension and grammar remained relatively stable, but lexical retrieval declined when daily heritage-language production was limited. Repeated-measures comparisons indicated a significant time-by-profile interaction for lexical retrieval and oral fluency, showing that the frequency and functional range of language use mattered more than symbolic identification alone.

3. PREDICTORS OF ATTRITION RISK

Regression and mixed-effects analyses showed that recent heritage-language use, cumulative exposure, heritage-language education, and community support predicted lower attrition risk. A shift toward dominance of the societal language and longer migration duration predicted higher attrition risk, especially for vocabulary retrieval and fluency. The model included random intercepts for participant and task and remained stable after sensitivity checks. These patterns support a usage-based interpretation: forms activated regularly across social domains remained more accessible, while forms restricted to passive or ceremonial use weakened in production.

Table 6. Predictors of attrition risk.

Predictor	Standardized beta	SE / 95% CI	p	Interpretation
Recent heritage-language use	-0.36	0.08 / [-0.51, -0.21]	< .001	Protective effect across domains; stable in sensitivity analysis
Cumulative exposure	-0.31	0.07 / [-0.45, -0.17]	< .001	Reduced attrition risk through repeated activation
Dominance shift to societal language	0.29	0.09 / [0.12, 0.46]	.002	Increased lexical/fluency vulnerability
Migration duration	0.18	0.06 / [0.06, 0.30]	.010	Predicted gradual weakening after controls
Community support	-0.22	0.07 / [-0.35, -0.09]	.004	Protected identity-linked and productive use
Heritage-language education	-0.20	0.06 / [-0.32, -0.08]	.006	Protected literacy and formal registers

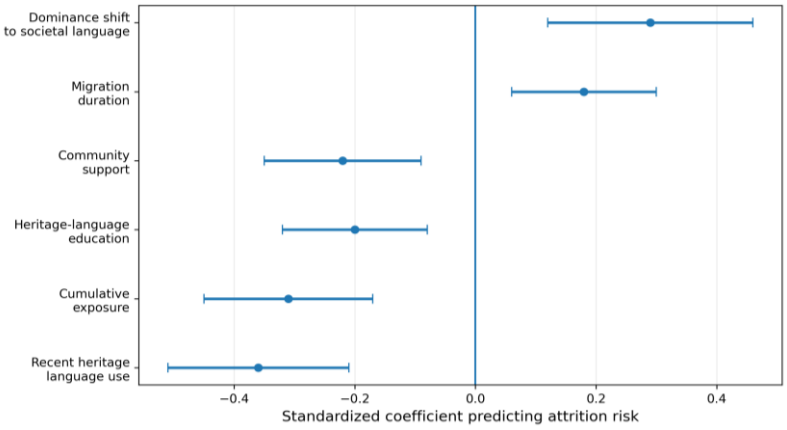


FIGURE 3. Predictors of attrition risk.

4. QUALITATIVE THEMES

The qualitative analysis identified four recurring themes. First, speakers described lexical forgetting as socially visible because it interrupted conversation and relatives could interpret it as distance from the

heritage community. Second, speakers reported that comprehension remained emotionally meaningful even when active production declined. Third, family communication was a critical site of maintenance because speakers continued to use the heritage language with parents and grandparents even when they used the societal language elsewhere. Fourth, identity did not disappear as language weakened; instead, speakers negotiated new forms of belonging through partial use, code-switching, literacy, music, digital media, and community events.

Table 7. Qualitative themes and sociolinguistic meanings.

Theme	Interview evidence	Sociolinguistic interpretation
Lexical retrieval and embarrassment	P18: "I know the word when I hear it, but I cannot bring it quickly when my aunt asks me."	Attrition affects interactional confidence.
Receptive maintenance	P41: "I still understand family conversations, even when I answer in the other language."	Comprehension can remain stronger than production.
Family communication	P07: "I try to speak it with my grandparents because that is our connection."	Heritage use is tied to family continuity.
Identity negotiation	P96: "Losing words does not mean I do not belong, but it makes me feel I have to explain myself."	Attrition is experienced as social positioning.

IX. DISCUSSION

The findings support the central argument that language attrition among bilingual speakers is multidimensional and socially embedded. The longitudinal pattern shows that lexical retrieval and oral fluency are most vulnerable, whereas reading and listening comprehension are more stable. This confirms research identifying lexical access as sensitive to recent activation [8], but it extends that work by showing how fluency, literacy, and community use interact with retrieval decline. The results therefore caution against interpreting attrition as total language loss; attrition is more accurately understood as uneven reorganization across domains of use.

The results also support usage-based accounts of language stability. Recent use and cumulative exposure predicted lower attrition risk because frequent activation strengthens access to forms, routines, and discourse patterns. Heritage-language education and literacy practice also appeared protective because they extend the language beyond informal family talk into formal registers, narrative structure, and metalinguistic awareness. This finding is consistent with heritage-language input research [15]-[20], but it challenges studies that treat amount of exposure as sufficient by showing that productive diversity, not passive exposure alone, is especially important.

Migration duration predicted attrition risk, but it did not operate alone. Speakers with long residence in a dominant-language environment did not necessarily show high attrition when they maintained community networks and family communication routines. This finding challenges a simplistic migration-equals-loss model. Migration creates conditions for a shift in dominance, but social practices determine whether the heritage language continues to function as a living resource. Education, community participation, and intergenerational communication can buffer attrition by keeping the language a tool for interaction, not just a marker of identity.

The qualitative themes deepen the interpretation of the quantitative patterns. Lexical forgetting was experienced as emotionally and socially salient because it often occurred in family or community settings where speakers wanted to display belonging. Comprehension stability offered continuity, but participants reported that receptive knowledge did not always enable a fluent response. This distinction has practical implications: heritage-language programs should not focus only on comprehension or cultural appreciation; they should create opportunities for active production, literacy, narrative practice, and interaction across age groups.

The discussion also highlights the importance of avoiding deficit language. Attrition can be painful and consequential, but attriting speakers are not failed monolinguals. They are bilingual speakers whose language repertoires are reorganized by social conditions. The strongest interpretation, therefore, is not that bilingualism causes loss, but that unequal opportunities for use shape access, confidence, and domain-specific performance. This view is consistent with sociolinguistic approaches that treat language competence as socially distributed and with psycholinguistic approaches that treat access as frequency-sensitive.

Some decline in timed vocabulary retrieval may reflect test anxiety, processing speed, literacy background, or task familiarity rather than attrition alone. Some grammatical differences may reflect incomplete acquisition or dialect variation rather than loss. Phonological differences may reflect contact-induced change rather than decline. For this reason, the mixed-methods design is important: longitudinal data help distinguish change from stable difference, and interviews help interpret whether speakers experience the change as loss, adaptation, or domain-specific shift.

Overall, the findings suggest that language attrition is best understood as a dynamic relation between exposure, dominance, social participation and identity. The study contributes to applied linguistics by showing which language domains require support in heritage-language maintenance. It contributes to sociolinguistics by showing that attrition links to social networks, family roles, and community infrastructure. It contributes to bilingualism research by demonstrating that language dominance and attrition should be measured separately, and to psycholinguistics by showing that retrieval-based tasks are particularly sensitive to reduced activation.

X. THEORETICAL CONTRIBUTIONS

The first theoretical contribution is the multidomain sociolinguistic model of bilingual attrition. The model connects linguistic performance with bilingual life history, language dominance, social networks, and identity. It advances beyond single-domain attrition models by integrating lexical retrieval, grammatical accuracy, phonological stability, oral fluency, reading comprehension, listening comprehension, family communication, and community support in one explanatory framework.

The second contribution is a multidomain understanding of attrition. By distinguishing lexical retrieval, grammar, phonology, fluency, and comprehension, the study shows why a single proficiency score is insufficient. The third contribution is sociolinguistic: attrition is interpreted as a socially meaningful process that affects family communication, cultural participation, and heritage-language identity. The study therefore extends heritage-language research by connecting measurable change with speakers' lived experiences of belonging, insecurity, maintenance, and reactivation.

XI. PRACTICAL AND POLICY IMPLICATIONS

For language education, the study recommends that programs should combine vocabulary retrieval training, narrative production, literacy routines, intergenerational storytelling, and community interaction activities. Vocabulary retrieval training can target rapid lexical access through naming, semantic clustering, and topic-based fluency tasks. Intergenerational storytelling can support family transmission while strengthening narrative structure and cultural continuity. Literacy routines can extend heritage-language use beyond informal conversation into reading, writing, and formal registers.

XII. LIMITATIONS AND FUTURE RESEARCH

The study has several limitations. First, the sample was stratified and purposive, which supports analytical comparison but limits population-level generalization. Second, attrition may be confounded by incomplete acquisition, dialect variation, and contact-induced change; the longitudinal design reduces this risk but does not eliminate it. Third, self-reported language use may be imprecise, although the study combined it with objective tasks and interview evidence. Fourth, the twelve-month window may be too short to capture slow grammatical or phonological change. Fifth, the multilingual sample improves international relevance but may also introduce language-pair-specific effects that require larger follow-up studies.

Future research should use longer longitudinal windows, larger samples, multilingual comparisons, naturalistic speech corpora, family-language diaries and community ethnography. Experimental work

should test whether heritage-language classes, literacy practice, digital conversation groups or intergenerational storytelling reduce attrition risk. Future studies should also examine how speakers' emotional relationship to language influences maintenance and reactivation.

XIII. CONCLUSION

This study developed and tested a longitudinal mixed-methods framework for examining language attrition among bilingual speakers. It shows that attrition is not a simple or uniform decrease in linguistic competence. Rather, it is a patterned reorganization of access, confidence, and performance across lexical, grammatical, phonological, fluency, and comprehension domains. The strongest vulnerability appeared in active retrieval and spontaneous production, while receptive comprehension remained comparatively stable when passive exposure continued.

The study also shows that attrition is deeply sociolinguistic. Language weakening is shaped by migration, education, dominance shift, family communication, community support, literacy practices and identity. Speakers do not experience attrition only as a test score; they experience it in conversations with relatives, in feelings of belonging or distance, in decisions about which language to use with children, and in the symbolic meaning of maintaining a heritage language across generations.

The multidomain sociolinguistic model of bilingual attrition links language exposure and bilingual processing to measurable outcomes and connects those outcomes to identity, family communication, and cultural continuity. The central conclusion is that language attrition is both a linguistic and social phenomenon. Regular use, literacy, community support, and institutional recognition can reduce vulnerability, but future intervention research is needed to test which forms of support are most effective across different bilingual populations.

Author Contributions

The author conducted the conceptualization, methodology, data analysis, investigation, writing, review, editing, and final approval of the manuscript.

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Data Availability

The dataset will be available from the author upon reasonable request.

Conflicts of Interest

The author declares no conflict of interest.

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Appendix A. Instrument and Data-Collection Summary

Table A1. Appendix instrument summary.

Component	Included content
A1. Language-background questionnaire	LHQ3-adapted items on age of acquisition, years of residence, daily use, family language, literacy, education, dominance, community support, and self-rated proficiency.
A2. Vocabulary retrieval task	Timed picture naming, category fluency, and translation-recognition items in both languages; scored for accuracy, latency, omissions, and self-repairs.
A3. Narrative sample	Picture-based narrative and personal experience narrative; coded for lexical diversity, grammar, fluency, and discourse organization.
A4. Conversation sample	Eight-minute semi-structured conversation; coded for speech rate, pauses, repairs, phonological transfer, and code-switching.
A5. Interview guide	Interview prompts on identity, family communication, heritage-language use, language confidence, perceived change, and reactivation practices.

Appendix B. Example Semi-Structured Interview Prompts

- Can you describe situations in which you feel most confident using your heritage language?
- Are there words, expressions or grammatical forms that you feel have become harder to use?
- How has migration, education or work changed your language use?
- How does language use affect communication with parents, grandparents, children or community members?
- What forms of support would help you maintain or reactivate the language?

Appendix C. Longitudinal Assessment Battery and Scoring Procedures

The longitudinal assessment battery measured attrition across production, comprehension, processing fluency, and sociolinguistic experience rather than inferring attrition from a single global proficiency score.

Table C1. Assessment domains, scoring procedures, and reliability checks.

Domain	Task	Score / indicator	Scoring rule	Reliability procedure
Lexical retrieval	Timed picture naming; category fluency; translation recognition	Accuracy, latency, omissions, self-repairs	Responses scored as correct, semantically related, language-mixed or missing; latency measured from stimulus onset	10% double scoring; latency outliers inspected before exclusion
Grammar	Sentence completion; grammaticality judgement; narrative morphosyntax	Accuracy, error type, agreement marking, word order	Errors coded by type and severity; ambiguous productions reviewed in context	Coder agreement calculated for error categories
Phonology and fluency	Narrative retelling and conversational sample	Speech rate, mean length of run, filled pauses, repairs, phonological transfer	Two-minute comparable speech segments selected from each recording	Acoustic and transcript checks conducted independently

Comprehension	Reading and listening comprehension tasks	Correct responses, response time, inferential accuracy	Literal and inferential items separated; incomplete responses treated as missing	Internal consistency checked by subscale
Sociolinguistic profile	Language-background questionnaire and interview	Exposure, use, dominance, identity, network strength	Composite indices created for recent use, cumulative exposure and heritage maintenance	Scale reliability and profile consistency checked across time

Appendix D. Language-Background Questionnaire: Core Variables

The questionnaire records language experience as a multidimensional construct. The purpose is to avoid treating bilingualism as a simple yes/no category and to document the conditions under which attrition is more or less likely to appear.

Table D1. Questionnaire variables and their analytical functions.

Variable block	Example items	Response format	Analytical use
Migration and education	Age at migration; length of residence; language of schooling; years of literacy instruction in each language	Numeric years; categorical schooling type	Tests whether migration timing and schooling predict language-domain outcomes
Current language exposure	Hours per week using each language at home, work, university, online and community settings	0-7 scale plus estimated hours	Forms the recent exposure and active-use indices
Language dominance	Self-rated speaking, reading, writing and listening in each language; preferred language for emotion, work and family talk	Likert scales and forced-choice items	Used to classify dominance profile and test dominance shift
Family and community networks	Frequency of contact with family/community speakers; participation in cultural or religious events; media use	Weekly/monthly frequency categories	Tests whether social networks buffer attrition
Identity and attitudes	Importance of heritage language for identity, belonging, family responsibility and cultural continuity	Likert scales and short explanation fields	Connects proficiency patterns to sociolinguistic interpretation
Reactivation and support	Formal classes, community programs, reading habits, language apps and planned maintenance practices	Checklist and frequency rating	Identifies modifiable factors for language-maintenance recommendations

Appendix E. Mixed-Effects Model Specification and Reproducibility Log

The quantitative analysis was documented through a transparent modeling log. Each model entry documented the dependent variable, fixed effects, random effects, and diagnostic checks used in the analysis.

Table E1. Mixed-effects model specification and reproducibility log.

Model	Dependent variable	Fixed effects	Random effects	Reported diagnostics
M1: lexical retrieval	Accuracy or latency across naming and fluency tasks	Time, exposure, dominance, migration duration, education, profile, time × profile	Participant; item; task where appropriate	Residuals, influential cases, convergence, latency transformation, random-effect variance
M2: grammar	Grammatical accuracy and error probability	Time, literacy, dominance, age at migration, profile, task type	Participant; item/scenario	Binomial model fit, overdispersion, random-effect variance, sensitivity check
M3: fluency	Speech rate, repairs, pauses, lexical diversity	Time, exposure, conversation network, profile, task context	Participant; speech task	Normality, heteroscedasticity, segment comparability, influence diagnostics
M4: comprehension	Reading/listening comprehension accuracy	Time, literacy, current use, education, profile, modality	Participant; item	Item difficulty, modality effect, missingness, internal consistency
M5: integrated attrition risk	Composite attrition-risk score	Exposure, dominance shift, migration duration, education, community support, identity orientation	Participant	Multicollinearity, VIF, residual pattern, complete-case comparison

Appendix F. Interview Coding Matrix and Trustworthiness Procedures

Interview analysis followed a documented thematic procedure. Initial coding identified participant meanings; focused coding grouped them into themes; integration coding connected themes to quantitative outcomes. Memoing, evidence matrices, second-reader review, negative-case analysis, and direct linkage between themes and extracts strengthened trustworthiness.

Table F1. Thematic coding matrix for interview interpretation.

Theme	Operational definition	Evidence type	Connection to quantitative findings
Lexical insecurity	Reports of forgetting words, code-switching unintentionally, or avoiding heritage-language conversation	Participant describes pausing, circumlocution or embarrassment during family talk	Linked to naming latency, omissions and lower active-use scores
Dominance shift	Perception that the societal language has become easier, faster or more automatic	Participant reports thinking, studying or working mainly in the societal language	Linked to dominance profile and reduced heritage-language fluency

Family communication pressure	Concern that reduced heritage language affects communication with older relatives or children	Participant describes family correction, teasing, silence or responsibility to transmit language	Linked to identity and community-support variables
Maintenance through routine	Regular use through reading, messaging, religious/community participation or formal learning	Participant reports scheduled conversations, literacy practice or community involvement	Linked to smaller longitudinal decline and higher comprehension stability
Reactivation possibility	Belief that the language can improve again through renewed use or instruction	Participant describes return visits, classes, or media exposure restoring confidence	Linked to improvement or stabilization between later waves