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A Quantitative Analysis of Inner Speech Between Monolingual and Bilingual Speakers

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Abstract

Inner speech is an individual's silent, inner monologue; a growing amount of evidence indicates that inner speech is very common among both monolingual and multilingual speakers. Studies have shown that important cognitive functions are involved in inner speech pertaining to psychological development, however connections between inner speech and language acquisition/usage across speakers have been less of a focus. This study investigates the frequency and degree to which inner speech is used between monolingual English speakers and early-onset bilingual English/Spanish speakers by using a survey called the Revised-Varieties of Inner Speech Questionnaire (VISQ-R) by Alderson-Day et al. (2018). The aim of the study is to report general inner speech use, compare relative frequencies of inner speech, and determine whether and how the features examined within the VISQ-R differ between Spanish-speaking bilinguals and English-speaking monolinguals.

Keywords: inner speech, bilingualism, language dominance, age

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A Quantitative Analysis of Inner Speech Between Monolingual and Bilingual Speakers

by

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A QUANTITATIVE ANALYSIS OF INNER SPEECH BETWEEN MONOLINGUAL AND BILINGUAL SPEAKERS

A THESIS

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by

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1. Introduction

Inner speech, also known as verbal thinking or intrapersonal communication, is defined as the subjective experience of language in the absence of overt and audible articulation (Alderson-Day & Fernyhough, 2015). In other words, inner speech is the silent, inner monologue that many people experience every day. Additionally, multiple forms and degrees of inner speech have been described—from experiencing intermittent words/phrases that are prompted in specific circumstances (like counting or rehearsing) to streams of full dialogues in complete sentences (Alderson-Day et al., 2018). Believed to develop as the natural progression of the internalization of private speech (i.e., thinking to oneself aloud), inner speech is subvocalized and often truncated (De Guerrero, 2018). To elucidate the differences between private and inner speech, an example of private speech might be softly telling oneself, "I'm going to make it," during a challenging time or audibly counting when performing mental math. However, it is considered inner speech for an individual to do the same as the above example without verbalizing anything. This audible component is a key difference between private and inner speech (De Guerrero, 2018).

Inner speech is often studied as part of childhood development and age, due to its theoretical link stemming from private speech and social speech (De Guerrero, 2018; Hitch et al., 1991; Vygotsky, 1987). According to Vygotsky, there are three stages of language development. First, social speech develops—which is communication between children and others that usually starts at age two. Next, private speech develops and redirects speech to oneself, usually after age three. Finally, private speech becomes internalized into inner speech. There is often an increase in private and presumably inner speech with increasing mental demand (Frauenglass & Diaz, 1985; Mcleod, 2022; Montero & de Dios, 2006). Studies have also indicated that there are

differences in degrees of inner speech between children and adults (Frauenglass & Diaz, 1985; Morin, 2012) and that changes in memory and cognition with age may also affect inner speech (Geva & Fernyhough, 2019; Hitch et al., 1991; Levy, 1999). As age-related changes are already factors in other forms of cognition, it is conceivable that changes in age might also be associated significant and noticeable changes in inner speech. However, it is also possible that inner speech remains stable as we age, as there are relatively few studies specifically examining the role of age in adults over the age of 18.

Due to inner speech being a natural manifestation of cognitive development, research on inner speech has been of great interest in the field of psychology. Insight on how inner speech develops can provide clues on both normal brain functioning and potential dysfunction. This is because certain variations or impairments of inner speech have been found to correlate with poorer executive function and psychopathologies such as schizophrenia (Alderson-Day & Fernyhough, 2015). However, this is not always the case, as some people experience no inner speech at all and have no mental illness or problems with cognition, suggesting both inner speech and a lack of inner speech may be part of natural, normal development (Vinney, 2022). In this respect, it is clear more nuanced research on inner speech and its involvement in other forms of cognition would be of benefit to the public and scientific community. Such interest is especially relevant within the sphere of inner speech and language.

Given that it has been argued that inner speech plays a role in numerous cognitive tasks such as reading, self-evaluation, and problem-solving (Perrone-Bertolotti et al. 2014), it is of interest to investigate inner speech within the scope of linguistics, particularly with respect to bilingualism, multilingualism, and language acquisition. However, research on this intersection, specifically within the domain of multilingualism and bilingualism, is limited (Dewaele, 2015).

Of interest within multilingual studies is a focus on how linguistic factors such as proficiency, language dominance, age of acquisition, and the number of known languages plays a role on inner speech frequency and preference(s). Language dominance can be defined as the relative strength of a language that influences a speaker's inclination to use and shift to it (e.g., Flores et al., 2022). In bilingual and multilingual speakers, there is usually one language that a speaker prefers and relies on more often, whether due to comparative proficiencies of each known language or an earlier age of acquisition (Flores et al., 2022). Many people's native or first language (L1) is often stronger than their second (L2), third (L3), or subsequent language (LX) (DeKeyser, 2000; Kroll et al., 2008; Resnik, 2021.). Age of acquisition (AoA) refers to the age at which a person acquires or learns a language and is dependent on both the timing of acquisition and amount of input a person receives (Schulz & Grimm, 2019). AoA is one of the strongest indicators of eventual native-like proficiency, and there has been much research which suggests that the earlier a person acquires a language, the more native or native-like the person will be in terms of linguistic features such as language processing speed, accent, and fluency (Schulz & Grimm, 2019). Due to the effects AoA and proficiency have on language dominance, one goal of the current study is to ascertain whether and how these factors influence inner speech.

A relatively recent, large computational analysis by Hartshorne et al. (2018) examined the effects of age on second language acquisition and ultimate language attainment (the outcome/endpoint of acquisition) from a dataset of 669,498 native and non-native English speakers and found that not only does language-learning ability decrease with age, but it confirmed previous studies (Johnson & Newport, 1989) regarding the importance of early AoA in reaching an ultimate attainment near that of a native speaker. Alongside those with high verbal analytical abilities (DeKeyser, 2000), AoA has been found to be one of the strongest indicators

of eventual native-like proficiency (Hartshorne et al., 2018), and there has been much research suggesting that the earlier a person acquires a language, the more native or native-like the person will be in terms of linguistic features such as language processing speed, accent, and fluency (DeKeyser, 2000; Hartshorne et al., 2018; Johnson & Newport, 1989; Schulz & Grimm, 2019).

The overall goal of this study is to build on previous research by Alderson-Day et al. (2018), which categorized and quantified inner speech via a questionnaire focused on the relevance of inner speech with respect to psychopathology. However, the focal point of this thesis centers on inner speech differences between bilingual and monolingual speakers as opposed to only examining monolingual data, and the study does not attempt to relate results to psychopathology. The organization of the paper is as follows: the literature review begins with a more detailed definition of inner speech and touches upon inner speech with regards to linguistic contexts. Then, it will summarize key findings from previous studies on the topic. The current study section will list the participant parameters and procedures for data collection as well as state the research questions. Results and data analysis will be shown. Finally, a discussion on the implications of the results in context with bilingualism will be given as well as a concluding summary. In contrast with the aim of the above article, the central interest of this study is on inner speech and how it relates to bilingualism and monolingualism, specifically between Spanish/English bilinguals versus solely English monolinguals.

2. Literature Review

The act of inner self-talk has been found to carry a multitude of important cognitive functions, from playing a role in self-regulation (e.g., problem-solving, planning, memorization) to reading and writing, task-switching, to rehearsals and self-awareness (Morin, 2012). It has a clear distinction from another mental phenomenon called private speech in which a person

(typically, children, e.g., Morin, 2012) speaks aloud to themself for similar regulatory and problem-solving purposes. Private speech is thought to be a precursor to the development of inner speech, where children's verbal self-regulation eventually becomes internalized into inner speech (Morin, 2009). This internalization and activation can even be seen in brain scans. According to Hurlburt et al. (2016), inner speech is actually comprised of two phenomena—inner speaking and inner hearing—described to be as disparate as speaking to a tape recorder and hearing your voice played back. Inner speech and inner hearing have been found to have different neural correlates via MRI, with inner speech activating the left inferior frontal gyrus and inner hearing activating a separate region of the brain, the temporal lobes associated with auditory imagery (Hurlburt et al., 2016). There are also large individual differences in terms of how many people experience inner speech. It is thought that between ⅓ to ½ of the adult population regularly engage in inner speech (Soloducha, 2020), with some researchers arguing that a vast majority of individuals engage in some form of inner speech (e.g., Hurlburt et al., 2013). Such a range in frequency indicates the degrees and forms of inner speech may be variable throughout the population.

Variation in inner speech use or development may also be affected by age-related brain development, as many studies on the topic have indicated—specifically pertaining from early childhood to puberty (De Guerrero, 2018; Frauenglass & Diaz, 1985; Hitch et al., 1991; Mcleod, 2022; Montero & de Dios, 2006; Vygotsky, 1987). Inner speech activation has been studied with regard to age in the form of EMG subvocal muscle laryngeal recordings (Morin, 2009a; Winsler et al., 2009) and via MRI scans (Hurlburt et al., 2016; Simons et al., 2010) which can help determine age related changes in inner speech over time. In terms of functional differences, it has been found that children tend to use inner speech to engage in self-regulation (Morin, 2009a),

memory engagement (Vissers et al., 2020), and executive functioning (Winsler et al., 2009). However, studies indicate adults similarly engage in inner speech with regards these and other cognitive demands and emotional regulation (Alderson-Day et al., 2018; Resnik, 2021; Winsler et al., 2009)

Inner speech's potential ubiquity and function in cognition can tie well into its research in the field of linguistics, specifically among researchers examining language acquisition and bi-/multilingualism. In a 2015 study by Dewaele, a web-based questionnaire examining the inner speech use of 1454 adult multilinguals was administered to determine inner speech use with respect to sequential languages. Results of the study showed that participants stated they engaged in inner speech more often in their native tongue and less often in each subsequently acquired language (Dewaele, 2015). Additionally, self-perceived proficiency, general use, and socialization were strongly linked to greater L1 inner speech use. According to Dewaele (2009, 2015), sequential bilingual speakers prefer using their L1 for inner speech, especially in the context of calculations, more cognitively demanding tasks, and emotional inner speech. Even for simultaneous bilinguals, those grown up having learned two languages at the same time and thus acquiring two L1s, there is often a preference for one language or the other depending on the context. For instance, Cook (2012) showed that some bilinguals prefer to think in Spanish when performing mental math while preferring to think in English for other activities. If studies are indicating some language preferences are dictated by contexts, then perhaps various forms of inner speech may also be elicited by context.

However, since multilingual and bilingual speakers' language use often differs from person-to-person, in different contexts, and over time, there are often varying degrees of language LX activation and usage (Cook, 2016). Variation in language use, proficiency, and

levels of ultimate attainment can all impact language choice in terms of inner speech (Dewaele, 2004). Dewaele argues that there is a link between language dominance and inner speech, with speakers having a L1 preference regardless of frequent subsequent LX activation. Other researchers have reported similar findings. For example, Resnik (2021) collected reports on inner speech use from 167 German-speaking multilinguals via a web survey and 24 in-depth interviews. Results suggested that participants used their L1 in inner speech much more frequently overall than their L2/LX. However, Resnik also found that high frequency of L2 use, naturalistic exposure, and high self-reported proficiency were associated with an increased likelihood of L2 inner speech use, indicating that other external factors may be involved.

Two prominent surveys, the Bilingualism and Emotions Web Questionnaire (BEQ) (Dewaele & Pavlenko, 2001-2003) and the Varieties of Inner Speech Questionnaire (VISQ) (McCarthy-Jones & Fernyhough, 2011), are web-based questionnaires used in inner speech research. According to Wilson & Dewaele (2010), the BEQ was a dedicated webpage advertised through the Linguistlist listserv as well as to multilingual students and institutions globally. The questionnaire was broken into a demographic section to gather data on age, education, gender, etc. as well as linguistic data on language dominance, AoA, and number of languages known. The questionnaire also contained Likert-type questions on language choice on factors such as emotions, calculations, inner speech, etc., with a final portion that contained open-ended questions on language choice and emotions. In the span of the two years when it was active, the BEQ allowed researchers to gather data from roughly 1800 multilingual participants from various language backgrounds for the scientific community.

The second survey, the VISQ, did not focus on any multilingual components; instead, it tailored questions that addressed four separate categories of inner speech: *dialogic*, *condensed*,

evaluative/critical, and *other people*. McCarthy-Jones and Fernyhough (2011) defined *dialogic* inner speech as thinking in terms of a back-and-forth conversation such as mentally asking oneself a question and hearing the response. *Condensed* inner speech was categorized as thinking in shorted words/phrases, whereas *evaluative/critical* inner speech are thoughts that revolve around self-assessments or scenarios. Finally, the '*other people*' category was defined as hearing thoughts in other people's voices. The VISQ demonstrated good test reliability and has since then been used to assess inner speech with regards to hallucination-proneness (Alderson-Day et al., 2014), psychosis (de Sousa et al., 2016), reading imagery (Alderson-Day et al., 2017), as well as being adapted for use with Spanish (Perona-Garcelán et al., 2017), Colombian (Tamayo-Agudelo et al., 2016), and Chinese populations (Ren et al., 2016). An updated version of the VISQ, the Varieties of Inner Speech Questionnaire-Revised (VISQ-R), is utilized in the current study.

The VISQ-R is a modified version of McCarthy-Jones and Fernyhough's (2011) questionnaire (Alderson-Day et al., 2018). It examines inner speech through the same four psychological categories as the VISQ, and adds an additional category called *positive/regulatory* which adds questions reflecting inner speech instances with more positive and self-supporting roles, for instance when thinking of oneself in an encouraging way or using phrases like, "you can do this" (Alderson-Day et al., 2018). The new questions contained aspects of literal/metaphorical language, speaker position, and mood regulation, and added 17 questions to the original VISQ's 18. Alderson-Day et al. (2018) was the first study to employ the VISQ-R, using a factor analysis of two samples—one comprised of 1412 predominantly English-speaking, 18-81 year-old adults and another sample comprised of 377 predominantly female university students—that looked at inner speech with regards to reading, hallucination-proneness, anxiety,

depression, self-esteem, and dissociation. The results showed that the most common function of inner speech fell within the dialogic and evaluative/critical categories, indicating that that these two functions may act a "core" feature and function in inner speech production (Alderson-Day et al., 2018). The above analysis was primarily aimed at developing a psychological diagnostic tool via the inner speech questionnaire, and their study did not explicitly examine the role of bilingualism or whether differences would emerge in the five categories for bilingual respondents. Thus, the current study investigates the relevance of the VISQ-R for this population, with the goal of extending the framework of utility of the VISQ-R to other domains.

3. Current Study

The VISQ-R questionnaire improved upon by Alderson-Day et al. (2018) has been useful in quantifying inner speech as markers for potential psychopathological tendencies, however this study extends the VISQ-R beyond the scope of its original intention. The current study utilizes it for the purposes of quantifying inner speech as well, but additionally investigates responses as they relate to potential language differences between bilingual English/Spanish speakers and monolingual English speakers. Because the focus is on inner speech with respect to variation between monolingual and bilingual speakers and not on traits indicating psychopathology, our approach is to explore patterns in responses for each of the VISQ-R categories: *Condensed (C), Other people (O), Dialogic (D), Evaluative/Critical (E), Positive/Regulatory (P)*. This study will also examine qualitative feedback provided in the form of open-ended responses regarding the respective use of inner speech outside of the constraints of the VISQ-R survey. It is the hope that this study will act as a pilot study regarding the use of VISQ-R in this manner and be considered another tool in assessing inner speech with respect to language in a similar way that the

Bilingualism and Emotions Web Questionnaire (BEQ) (Dewaele & Pavlenko, 2001-2003) has been.

3.1 Research Questions

This study aims to investigate inner speech in both monolingual and bilingual speaker populations. The overarching research question concerns whether there are quantitative differences in the rates of inner speech between monolinguals and bilinguals. Furthermore, this study aims to extend the Alderson-Day et al. (2018) VISQ-R by examining whether differences emerge with respect to the five categories of inner speech across both groups. Although our initial investigation aimed to explore the role of age of acquisition and proficiency, as we outline below, our sampling technique did not provide a wide enough range of responses to be able to explore these variables of bilingualism. In an exploratory analysis, we instead investigate the role of current age and gender, factors which are to date, underexplored in inner speech research on adult populations.

3.2 Methods

Data were gathered via a 10-minute Qualtrics online survey. The survey was divided into three subsections: a demographic questionnaire, the VISQ-R questions, which were comprised of 35 questions from Alderson-Day et al. (2018), and one open-ended concluding question where participants could provide text input. The demographic questionnaire asked the participant's age, gender, level of education, language dominance, age of acquisition, and self-reported proficiency level. Questions from the VISQ-R were implemented using a 4-point Likert scale, with responses ranging from never (1), sometimes (2), most of the time (3), always (4). All participants had access to the same Likert scale questions, except for an additional set of questions provided to participants who self-identified as bilingual. Bilingual-specific questions were included in the

demographic portion, as well as one additional multiple-choice question which asked participants to identify which language they were thinking about when they answered the previous questions about inner speech. Finally, subjects were also presented with one additional open-ended question:

> For monolinguals: *Is there anything else you would like to share about how you think? This can be for instance content dependent (inner speech changes based on topic) or context dependent (inner speech changes based on location/people).*
>
> For bilinguals: *Is there anything else you would like to share about thinking in English vs Spanish? This can be for instance content dependent (inner speech changes based on topic) or context dependent (inner speech changes based on location/people).*

The survey was distributed by convenience and snowball sampling. Surveys were shared via Montclair State University listserv, social media, and word-of-mouth to colleagues and students in New Jersey. The complete survey is provided in full in the Appendix.

3.3 Participants

All respondents were over the age of 18 and under 65. The two groups comprised of bilingual Spanish/English speakers and monolingual English speakers. There was a total of 55 respondents that started the survey, although 21 surveys were incomplete and removed leaving an adjusted new total of 34 respondents. Of the 34 participants, 17 were monolingual and 17 were bilingual. No criteria were used for participation for bilinguals (e.g., proficiency, AoA) and all participants self-identified as monolingual or bilingual.

Monolingual respondents' ages ranged from 21 – 60 years old, with an average age of 32. The majority of respondents were women (10), followed by men (5), and nonbinary individuals

(2). Roughly half of respondents had at least a bachelor's degree (9), followed by some college (4), professional degree (3), and finally associate degree (1).

Bilingual respondents' ages ranged from 20 – 51 years old, with an average age of 31. Respondents identified as women (8), men (8), and nonbinary (1). The education distributions were: bachelor's degree (7), professional degree (6), high school/GED (2), associate degree (1), and doctorate (1). A comparative demographic distribution can be seen in Table 1.

Table 1

Comparative Demographic Distribution

	Age (years)	**Gender**	**Education**
Monolingual (n=17)	Range: (21 – 60) Average: 32	Men: 5 (29.4%) Women: 10 (58.8%) Nonbinary: 2 (11.8%)	Less than high school: 0 (0%) High school/GED: 0 (0%) Some college: 4 (23.5%) Associates: 1 (5.9%) Bachelors: 9 (52.9%) Professional: 3 (17.6%) Doctorate: 0 (0%)
Bilingual (n=17)	Range: (20 – 51) Average: 31	Men: 8 (47.0%) Women: 8 (47.0%) Nonbinary: 1 (5.0%)	Less than high school: 0 (0%) High school/GED: 2 (11.8%) Some college: 0 (0%) Associates: 1 (5.9%) Bachelors: 7 (41.2%) Professional: 6 (35.3%) Doctorate: 1 (5.9%)

Most bilingual respondents (15) reported that English was their dominant language. Most acquired English early, with 10 respondents having acquired it since birth, 5 between ages 5 – 10. One respondent acquired English in their teens between ages 11 – 14, and one acquired English after the age of 18. For Spanish acquisition, 11 respondents acquired Spanish since birth, 4 between ages 5–10, and 2 between ages 11–14. Aside from one participant, everyone acquired

both English and Spanish before adulthood with the vast majority acquiring English and Spanish before age 10.

Bilinguals generally ranked their proficiency in both languages highly. English proficiency was ranked from 8 (very good) to 10 (perfect), with no respondents ranking lower than a 7 (good). Ten respondents ranked themselves as excellent, 6 as perfect, and 1 as very good. Spanish proficiency was more varied; 6 ranked themselves as good, 6 ranked as very good, 2 as excellent, another 2 as perfect, and 1 respondent ranked themself as adequate. A comparative age of acquisition and proficiency chart can be seen in Table 2.

Table 2

Bilingual Age of Acquisition and Self-Rated Proficiency

	Age of Acquisition	Self-rated proficiency (Scale: 1-10)
English	Since birth: 10 Ages 5-10: 5 Ages 11-14: 1 After 18: 1	Mean: 9.30 Range: 9 – 10
Spanish	Since birth: 11 Ages 5-10: 4 Ages 11-14: 2 After 18: 2	Mean: 7.82 Range: 5 – 10

4. Results

4.1 Data Analysis

The data were analyzed as follows. Inner speech frequency was calculated for both groups on a scale of 1 – 4, with values around 1 indicating low inner speech use and higher values approaching 4 indicating high rates of inner speech. As a first step, overall rates of inner speech were calculated as average scores across all items. Next, to replicate the analysis procedures outlined in Alderson-Day et al. (2018), nine items were removed from further

analysis (questions 21, 22, 23, 24, 26, 29, 30, 33, and 34). The remaining questions were categorized according to their respective VISQ-R categories (e.g., *Condensed (C), Other people (O), Dialogic (D), Evaluative/Critical (E), Positive/Regulatory (P)*) as seen in the VISQ-R Question Correspondence in Table 3.

Table 3

VISQ-R Question Correspondences

Questions	VISQ-R Category
1, 7, 8, 14, 15	Condensed
3, 4, 5, 12, 16	Other People
2, 6, 10, 13, 25	Dialogic
9, 11, 17, 18, 20, 28, 31	Evaluative/Critical
19, 27, 32, 35	Positive/Regulatory

After responses were analyzed across all participants, we then categorized the data via two different groupings. Per our main research question, monolingual responses (n=17) were compared to bilingual responses (n=17). Then, in an exploratory analysis focusing on the role of age, data were grouped according to age, with 30 as a cut off. This resulted in a 'younger' group who were under the age of 30 at time of testing (n= 17), which we compared to the 'older' respondent group who were over the age of 30 (n= 17). Due to the small number of respondents (n=34), it is important to note that this study functions as a pilot study, and interpretation of the data was done with caution.

4.2 Results: VISQ-R categories

In an analysis that included all subjects, overall inner speech scores were calculated as 2.30 (SD = 0.97). This score indicated low-to-medium rates of inner speech in our sample, with some variability that suggested individual differences across respondents with respect to inner

speech usage/frequency. To further explore inner speech, we then analyzed group responses to the VISQ-R categories. Table 4 provides the mean responses per category.

Table 4

VISQ-R Category Mean Values

	Condensed	Other People	Dialogic	Evaluative/ Critical	Positive/ Regulatory
Monolinguals (n=17)	2.32 (0.83)	1.75 (0.90)	2.52 (0.95)	2.37 (0.90)	2.31 (0.76)
Bilinguals (n=17)	2.31 (1.05)	1.77 (0.94)	2.67 (0.94)	2.39 (1.07)	2.54 (0.82)
All Subjects (n=34)	2.31 (0.95)	1.76 (0.91)	2.59 (0.95)	2.38 (0.99)	2.48 (0.79)

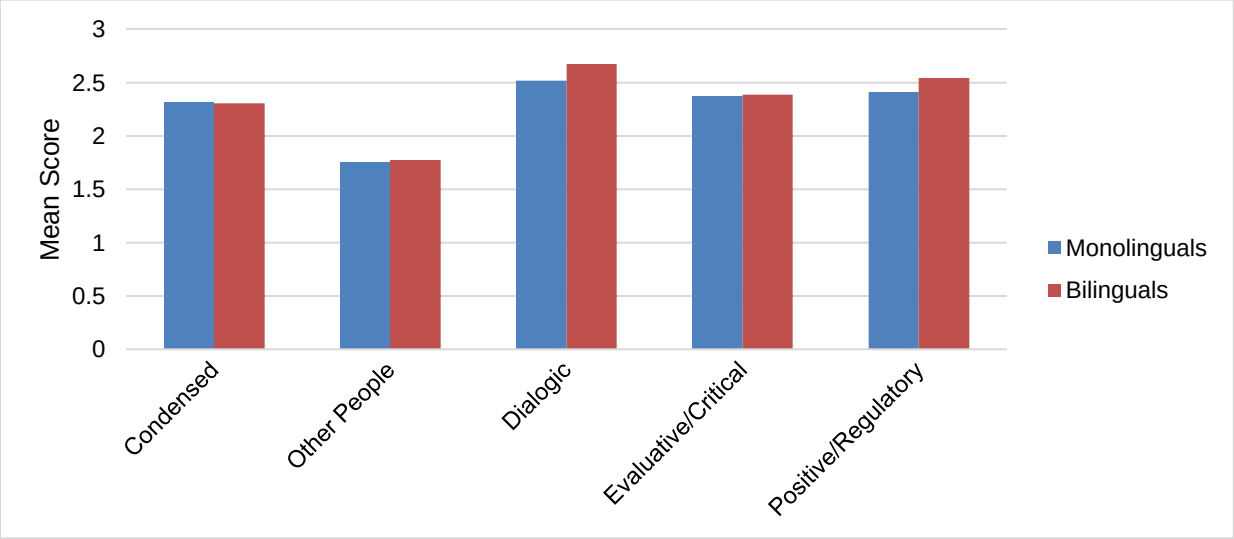
Overall, the pattern of responses was quite similar for monolingual and bilingual participants, with similar scores observed across all categories. There are two categories that stand out in this data. The category with the highest average for all participants is the *dialogic* category, with a mean score of 2.59 for all participants. In contrast, the category with the lowest score was *other people*, which was 1.76 for all participants. By comparison, the results of the Alderson-Day et al. (2018) study found the highest category to be the *evaluative/critical* followed by the *dialogic* category. However, results of their lowest category (*other people*) mirrored that of this study.

To visualize the differences across the VISQ-R categories, Figure 1 illustrates the mean scores for monolingual and bilingual participants. Given the small sample size, as well as the striking similarity across the group responses, a statistical comparison was not conducted on this data. What is the case visually and numerically is that there were no differences across the

VISQ-R categories that seemed to be associated with language group (monolinguals vs. bilinguals).

Figure 1

VISQ-R Monolingual and Bilingual Mean Scores



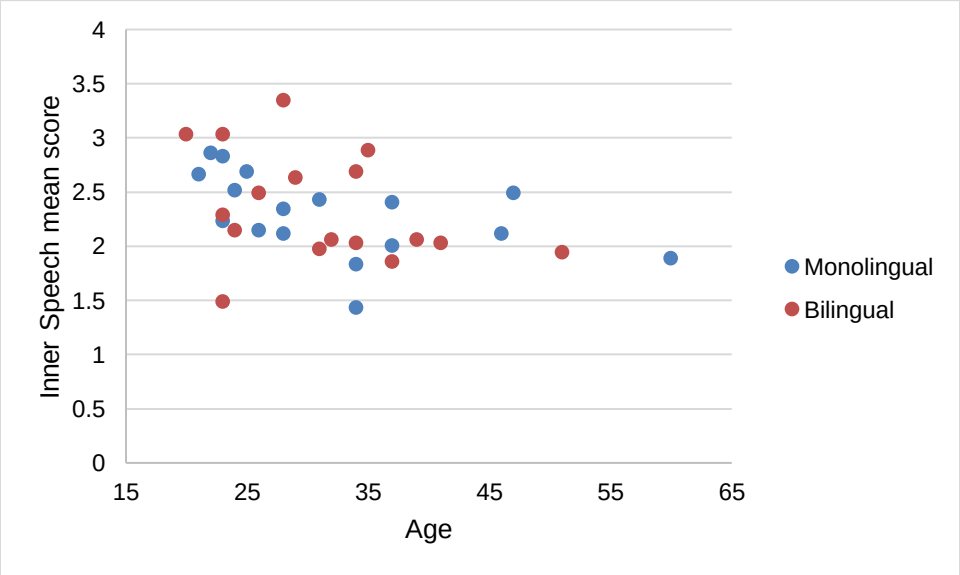
4.3 The Role of Age and Gender: An Exploratory Analysis

An analysis between age and overall inner speech scores was done, with no apparent immediate patterns standing out. However, monolingual and bilingual data were combined and reorganized into two groups: those under 30 and those over 30, creating a new younger and older division to scrutinize any results that may have been missed. Mean values for inner speech in respondents under 30 years old was 3.31 (SD = 1.00), while mean values were 2.11 (SD = 0.89) for those over 30 years. Additionally, there was only one respondent who showed inner speech scores lower than 2 in the under 30 group with a score of 1.49, whereas there were six respondents who had inner speech scores under 2 in the over 30 group. Results may be indicative of a trend towards a negative relationship between age and inner speech, with lower age

associated with greater number of higher self-reported inner speech scores and higher age associated with a greater number of lower inner speech scores. A graph comparing inner speech and age can be seen in Figure 2.

Figure 2

Age versus Inner Speech Means

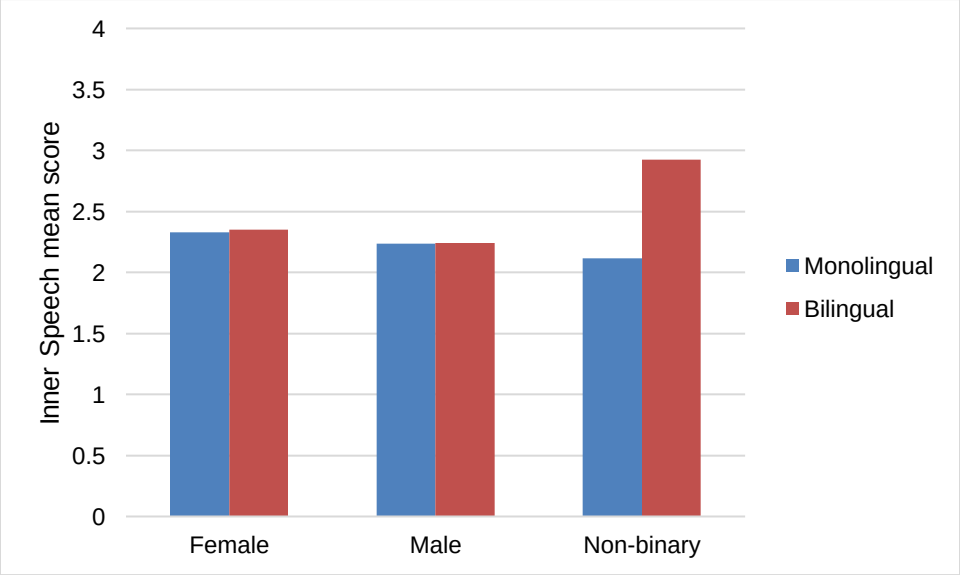


Finally, gender was analyzed in terms of inner speech, both with all participants combined as well as comparing monolingual and bilingual groups. Combined inner speech means for female respondents was 2.35 (SD = 0.96), 2.25 for males (SD = 1.00), and 2.43 for non-binary participants (SD = 1.02). Within the two language groups, mean inner speech scores across gender were similar. For monolingual respondents: female at 2.33 (SD = 0.92), male at 2.24 (SD = 0.92), and nonbinary respondents at 2.12 (SD = 0.81). Bilingual respondents showed means at 2.35 for females (SD = 0.97), 2.24 for males (SD = 1.02), and 2.92 for non-binary respondents (SD = 1.26). Note that while the means for the non-binary participants showed the largest differences across language groups, this comparison was between two respondents in the

monolingual group and one participant in the bilingual group. Figure 3 shows the respective comparative means by gender between monolingual and bilingual speakers.

Figure 3

Gender versus Inner Speech Mean Scores



4.4 Open-Ended Responses

In order to gather qualitative data beyond the limitations of the VISQ-R, an analysis of open-ended responses was done comparing bilingual and monolingual responses with regards to their feelings and thoughts on inner speech. An even split of 5 monolingual and 5 bilingual responses were acquired. Based on the open-ended responses given, some patterns emerge. Within monolinguals, it seems a common pattern of self-correction to positive thought appeared in 2 of the 5 respondents which would likely fall under the positive/regulatory category of VISQ-R. Bilingual respondents focused more on when and whether inner speech was English or Spanish. The most common themes shared were code switching between languages and inner

speech context dependency. All Spanish respondents mentioned inner speech shifting based on changing thoughts or contexts. For example, two participants said they code-switch and think in Spanish when in Spanish-speaking contexts or thinking about Spanish-speaking instances in the past, another said they always think in Spanish when thinking in a religious context/praying. Context dependence was also shared between monolinguals and bilinguals. For instance, one respondent stated inner speech use was more frequent when thinking about musical lyrics while another in terms of movie scenes and quotes. Previous research also supports inner speech varying based on contextual factors (Cook, 2012; Dewaele, 2015, Resnik, 2021). Participant responses are provided below for each group.

4.4.1 Monolingual Responses

> "*I am also fluent in ASL and have used it since I was young and until college."*
>
> *"I experience more inner speech when I mentally prepare to say something specific, like for a speech or specific pre-planned question. Musical lyrics are when inner speech occurs most often. However, other than music or active use, inner speech use is very infrequent."*
>
> *"I will correct my inner speech. For example, if I see someone and my inner speech automatically judges them, I will cut in front of my thought process and think "that's not right", "say something nice about them now", or some other thought that extinguishes the negative one."*
>
> *"Much of the inner speech I experience replicates the person's voice, including accents, and gives an almost exact reproduction in my head. This also is true for TV/Movie characters, Scenes, and Music."*
>
> *"I study meditation which has helped me learn to have the inner voices speak kind words instead of words of anger."*

4.4.2 Bilingual Responses

> *"Even though Spanish is my L1, I usually think in English. If I revisit old conversations (that occurred in Spanish) I'll think of them in Spanish but have thoughts regarding the conversation in English. However, I will only think in Spanish when it concerns religion (e.g., praying, thinking a deity/God)."*

> *"I utilize code switching."*

> *"Context dependent."*

> *"Definitely shift to Spanish when I am with Spanish-speaking people, or when I am thinking about topics about which I communicate more often with Spanish-speakers than with English-speakers."*

> *"I speak English more fluently, but my so Spanish comes up when I'm emotional."*

5. Discussion

5.1 Frequency

This study compared the relationship between monolingual and bilingual speakers with regards to inner speech and examined whether patterns are shared or differ among and within the two groups with respect to the VISQ-R. Since all participants engaged in inner speech one way or another, the variations in inner speech use related more to degrees and forms of inner speech rather than absolute frequency. Inner speech being commonplace within this study is also in line with the growing scientific consensus on this topic as it pertains to the general population (Heavey & Hurlburt, 2008; Hurlburt et al., 2013; Morin et al., 2011; Vinney, 2022). Regarding inner speech rates between monolingual and bilingual participants, no robust differences were found. Perhaps this indicates that there may be little to no difference in inner speech rates between monolinguals and bilinguals in general. Another possibility is that the sample size of

this study was too small with too little variation, and perhaps a larger, more robust study would be able to identify notable differences. Regardless, the data does indicate that inner speech use is frequent across all participants to varying degrees.

No significant differences were found in terms of inner speech within the bilingual group as well. This may have been because many participants acquired their 2nd language at early ages and had a high degree of language proficiency. There was only 1 bilingual participant that indicating learning English after age 18, however she also rated her English proficiency as excellent. It is possible greater variation in inner speech might have been seen if there were more varied language proficiencies in the bilingual participant pool. For instance, an analysis of the results of the BEQ by Dewaele (2015) indicated a range of effects that specifically proficiency had on participants' inner thoughts and feelings regarding their language use. Participants from the BEQ study reported thinking differently when code switching to a certain language, often changing pitch, verbal, and nonverbal behavior, with many reporting that they feel "like another person" (Dewaele, 2015). However, it is difficult for any significant quantifiable data to appear with a bilingual sample size of 17 participants. There were some patterns that arose from the open-ended portion of the survey. For instance, the emphasis on only using one language in certain contexts and the other in different contexts, and the pattern of mentally code switching even when solely thinking about being in those contexts without needing to physically be in them. Inner speech shifts being context-dependent also appeared in some of the monolingual participant responses, for instance when referring to music or in the context of mentally replaying TV shows. Context-dependence is also regularly reported in multiple studies and reviews (Dewaele, 2004, 2009, 2015; Resnik, 2021; Vicente & Martinez Manrique, 2011), so it may be a feature related to both language cognition and inner speech.

5.2 Demographics and Inner Speech

Although the initial goal of the study was not to investigate demographic factors such as age and gender, because of the scope of bilingual participants included (i.e., small rage of AoA and proficiency), we conducted an exploratory analysis using these two variables from the background questionnaire. Results indicated that age in particular may play a role in inner speech production. When dividing the pool of data in half, using the age of 30 as a median value, those under 30 generally had greater average scores of inner speech while those over 30 had lower averages. In fact, there was only one inner speech score below 2 in the under-30 group, while there were six participants with scores under 2 in the over-30 group. It is possible that inner speech diminishes as we age, and this effect has been observed even in this study. If inner speech rates decrease as we age, it could be a potential indicator of other brain changes. For example, according to a recent MRI study (Stephane et al., 2021), specific brain regions related to auditory processing are activated when reading silently to oneself. It is plausible that inner speech activates similar pathways is connected to mental age-related changes. Further research into brain changes using inner speech as an indicator might lead to improved diagnostic techniques. The differences in inner speech by age also raises potential questions as to whether shifts in inner speech from different age demographics can be influenced by differences in social interaction during early development.

Results on the exploratory analysis of gender showed that there was no relationship between gender and inner speech. These results echo findings by Ren et al. (2016), who found no statistical differences in gender vs inner speech in a study of 367 undergraduate native-Chinese students. This indicates that thus far there is no observable difference between men and women in terms of inner speech rates. However, studies have not yet looked at inner speech regarding

gender nonbinary individuals. Although we were able to collect data from nonbinary respondents, the low number of participants prevented a deeper analysis of inner speech differences across gender categories. It is possible that gender may have no impact on inner speech variation, although future work is needed to confirm this finding.

5.3 VISQ-R Categories

There were differences in inner speech with regards to the VISQ-R categories overall. For instance, both monolingual and bilingual participants consistently rated the other people (O) category low on the Likert scale. Given that the VISQ-R was originally created to measure potential psychopathologies and other mental illness (e.g., anxiety and depression), this makes sense as the other people prompts are the main questions researchers used as markers for schizophrenia/auditory hallucinations (McCarthy-Jones & Fernyhough, 2011). This means that this indicator was not frequently elicited in this sample. However, while the other people category was rated low, there was one VISQ-R category that was unanimously rated highly—the dialogic (D) category. This category deals with inner speech in terms of a back-and-forth dialogue, and its higher occurrence is also echoed in previous studies (Alderson-Day et al., 2018; Ren et al., 2016; Tamayo-Agudelo et al., 2016). Higher values in the dialogic category indicate that this pool of respondents may be utilizing inner speech for similar purposes, and it supports the notion of inner speech as a predominantly dialogic, self-regulating phenomenon (Alderson-Day et al., 2018; Ren et al., 2016). Results within each group also mirrored the results between groups, meaning just as no difference was found among monolinguals and bilinguals when looking at the VISQ-R categories overall, any change between each category was the same or similar. For example, both monolinguals and bilinguals rated (O) as low, but they also similarly

rated (D) as high. This further supports the notion that there is no difference in inner speech between highly proficient bilinguals and monolinguals.

5.4 Limitations

A few limitations of this study should be noted. The greatest limitation concerns the sample size of survey respondents. Given that even the original size of the respondent pool (55) was already small, the fact that it had to be further reduced to 34 significantly impacted the amount of data and number of factors that could be analyzed. This could have been ameliorated at least in part if the screening for the bilingual participants had included all types of bilinguals and not been restricted to only Spanish/English bilinguals. However, doing so would have increased the bilingual group. Another potential improvement would be to do the same for the monolingual screening—include anyone who is monolingual rather than English-only, although this raises concerns for the VISQ-R survey, which would have had to have been translated; this could be a useful way to increase monolingual participants in a future study. Another limitation of this study, again likely tied to sample size, was the lack of diverse bilingual factors such as AoA, language proficiency, and dominance. Due to the vast majority of respondents having acquired their second language early, ranking proficiency high in both languages, and almost all participants indicating English as their dominant language, there was very little data to tease apart with regards to checking these factors' potential effects on inner speech.

6. Conclusions

The present study explored the relationship between inner speech frequency and variation within and among monolingual English speakers and bilingual Spanish/English speakers using the VISQ-R (Alderson-Day et al., 2018). No statistical difference between the aforementioned groups was found, indicating inner speech rates may be similar in frequency across language

boundaries. No differences were found regarding inner speech and gender as well. However, inner speech differences were found with regards to age, with younger participants engaging in greater instances of inner speech. This may be due to the effects of aging, social and/or societal differences, although with limited data it is difficult to extrapolate. Shared differences were found regarding each of the VISQ-R categories, with high occurrences of dialogic (D) inner speech use and low occurrences of other people (O) inner speech use, indicating both monolingual and bilingual inner speech use may function similarly or be elicited in contextually similar conditions. This study had limited respondents and as a result, limited data regarding language variation, AoA, and proficiency in terms of inner speech. This shortcoming affected its ability to provide sufficient evidence to firmly make a claim regarding inner speech and language. As a result, the motivation of this study is that it acts as a pilot and precursor for future studies to further test or modify the VISQ-R with respect to bilingualism.

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Appendix A. Demographics Survey

Please answer each of the following questions to the best of your knowledge.

D1 How old are you?

_____

D2 How do you identify?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Do not wish to answer

D3 What is your level of education?

- ○ Less than high school
- ○ High school / GED
- ○ Some college
- ○ Associate degree (2 years)
- ○ Bachelor’s degree (4 years)
- ○ Professional degree
- ○ Doctorate degree

D4 This study is designed to test either monolingual English speakers or English/Spanish bilingual speakers. Does this describe you?

- ○ Yes, I'm a native English speaker and only speak English
- ○ Yes, I'm bilingual in English & Spanish
- ○ No, neither applies to me

D5 Which do you consider your dominant language?

- ○ English
- ○ Spanish

D6 At what age did you start learning Spanish?

- ○ Since birth
- ○ Age 5 - 10
- ○ Age 11 - 14
- ○ Age 15 - 18
- ○ After age 18

D7 At what age did you start learning English?

- ○ Since birth
- ○ Age 5 - 10
- ○ Age 11 - 14
- ○ Age 15 - 18
- ○ After age 18

D8 How would you rate your overall proficiency in Spanish?

- ○ 1 (very low)
- ○ 2 (low)
- ○ 3 (fair)
- ○ 4 (slightly less than adequate)
- ○ 5 (adequate)
- ○ 6 (slightly more than adequate)
- ○ 7 (good)
- ○ 8 (very good)
- ○ 9 (excellent)
- ○ 10 (perfect)

D9 How would you rate your overall proficiency in English?

- ○ 1 (very low)
- ○ 2 (low)
- ○ 3 (fair)
- ○ 4 (slightly less than adequate)
- ○ 5 (adequate)
- ○ 6 (slightly more than adequate)
- ○ 7 (good)
- ○ 8 (very good)
- ○ 9 (excellent)
- ○ 10 (perfect)

Appendix B. VISQ-R and Open-ended Questionnaire

Thank you for completing the demographics portion of the survey. In this next part, you will read a series of statements. Please rate how well each statement applies to you.

Q1 I think to myself in words using brief phrases and single words rather than full sentences.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q2 When I am talking to myself about things in my mind, it is like I am going back and forward asking myself questions and then answering them.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q3 I hear the voice of another person in my head. For example, when I act in a certain way I hear my mother's voice in my mind.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q4 I experience the voices of other people asking me questions in my head.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q5 I hear other people's voices nagging me in my head.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q6 My thinking in words is more like a dialogue with myself, rather than my own thoughts in a monologue.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q7 I think to myself in words using full sentences.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q8 My thinking to myself in words is like shorthand notes, rather than full, proper, grammatical sentences.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q9 I think in inner speech about what I have done, and whether it was right or not.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q10 When I am talking to myself about things in my mind, it is like I am having a conversation with myself.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q11 I talk silently in my head telling myself to do things.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q12 I hear other people's actual voices in my head, saying things that they have never said to me before.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q13 I talk back and forward to myself in my mind about things.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q14 My thinking in words is shortened compared to my normal out-loud speech. For example, rather than saying to myself things like ‘I need to go to the shops,’ I will just say ‘shops’ to myself in my head.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q15 If I were to write down my thoughts on paper, they would read like a normal grammatical sentence.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q16 I hear other people's actual voices in my head, saying things that they actually once said to me.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q17 I talk silently in my inner speech telling myself not to do things.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q18 I evaluate my behavior using my inner speech. For example, I say to myself, 'that was good' or 'that was stupid'.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q19 I talk to myself silently in an encouraging way.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q20 In my head I talk to myself in a critical way.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q21 Certain words or sentences repeat in my head.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q22 I think to myself in the second person, saying things like “You can do this” or “You forgot to do that”.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q23 When I think in words, it feels more like I am speaking than listening.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q24 When I think in words, it is like listening to a recording of my voice.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q25 My thinking in words is like a speech or a monologue, rather than a conversation.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q26 I am in control of my inner speech.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q27 I calm myself down by talking silently to myself.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q28 What I say in my inner speech makes me feel anxious.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q29 I use metaphors and expressions in my inner speech, such as “This is such a nightmare”.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q30 My train of inner verbal thought can lead to me feeling very excited.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q31 My inner speech contributes to me feeling down and depressed.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q32 When angry, my inner speech can help calm me down.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q33 I am surprised by the content of my inner speech.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q34 There are certain words or phrases that I can’t get out of my head.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q35 When I think to myself in words about upsetting things, I can easily change topics in my mind and talk to myself about other things.

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never

Q36 In general, do you have a tendency to think in one language? If so, which one?

- ○ I find myself thinking in English more often
- ○ I find myself thinking in Spanish more often
- ○ I tend to think in both English and Spanish equally

Q37 Is there anything else you would like to share about thinking in English vs Spanish? This can be for instance content dependent (inner speech changes based on topic) or context dependent (inner speech changes based on location/people).

Q38 Is there anything else you would like to share about how you think? This can be for instance content dependent (inner speech changes based on topic) or context dependent (inner speech changes based on location/people).