# Bilingual Subtypes and Individual Bilingual Experiences Using Latent Variable Modeling; Latent Profile Analysis and Fuzzy Set Qualitative Comparative Analysis with the Language and Social Background Questionnaire.

by

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ABSTRACT

The bilingual experience is an often-studied multivariate phenomenon with a heterogeneous population that is often described using subtypes of bilingualism. "Bilingualism" as well as its subtypes lack consistent definitions and often share overlapping features, requiring researchers to measure a number of aspects of the bilingual experience. Different variables have been operationalized to quantify the language proficiencies, use, and histories of bilinguals, but the combination of these variables and their contributions to these subtypes often vary between studies on bilingualism. Research supports that these variables have an influence not only on bilingual classification, but also on non-linguistic outcomes including perceptions of self-worth and bicultural identification. To date, there is a lack of research comparing the quantification of these bilingual subtypes and these non-linguistic outcomes, despite research supporting the need to address both. Person-centered approaches such as latent profile analysis (LPA) and fuzzy set qualitative comparative analysis (fsQCA) have been applied to describe other multivariate constructs with heterogeneous populations, but these applications have yet to be used with bilingualism. The present study integrates models of bilingualism with these analytic methods in order to quantitatively identify latent profiles of bilinguals, describe the sets of conditions that define these subtypes, and to characterize the subjective experiences that differentiate these subtypes. The first study uses an existing data set of participants who completed the Language and Social Background Questionnaire (LSBQ) and performs LPA and fsQCA, identifying latent profiles and the sets of conditions that these subtypes. The following studies use a second set of bilinguals who also completed the LSBQ as well as a supplementary questionnaire,

characterizing their identification with biculturalism and their feelings of self-worth. The analyses are repeated with these data to describe the profiles within these data and the subjective experiences in common. Finally, all analyses are repeated with the combined datasets to develop a final model of bilingual subtypes, describing the differences in language use and history within each subtype. Results demonstrate that latent models can be used to consistently characterize bilingual subtypes, while also providing additional information about the relationship between individual bilingual history and attitudes towards cultural identification.

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Bilingualism is a prominent experience across the world, with some estimates suggesting that over half of the world population learns and uses two or more languages in their daily life. As such, researchers in a variety of fields study these individuals to better understand the differences or commonalities that bilinguals may have with people who speak only one language, or a different combination of languages, or who use their two languages in different situations. Despite the widespread interest in researching bilingualism, the term lacks a universally accepted operational definition, and many studies vary how the participants are qualified as bilingual (Paap, Johnson, & Sawi, 2015). As bilingualism cannot be directly assessed, it has been operationalized in many different ways (Surrain & Luk, 2019), each with benefits and drawbacks to researchers and participants. Part of the reason for this is that there are many different ways for individuals to acquire and eventually use their linguistic skill, making it difficult for researchers to compare some speakers to others.

Bilingualism is multivariate in nature and requires researchers to determine which specific variables or combinations of variables are necessary conditions of the experience for their study. Researchers generally define their bilingual population through a combination of variables that distinguish them from either monolingual populations or other bilingual experiences, in order to investigate specific differences between the defined groups. One area of research that reflects this sort of comparative approach is the bilingual cognitive advantage debate, which proposes that individuals who speak more than one language may confer specific cognitive benefits, particularly in executive functions such as control and inhibition (Bialystok, 2007). Multiple literature reviews and meta-analyses suggest the existence or absence of such an individual bilingual advantage

may be dependent on participant's specific linguistic experiences, with researchers finding support for and against the hypothesis (Bialystok, Craik, & Luk, 2012; Donnelly, Brooks, & Homer, 2019; Nichols, Wild, Stojanoski, Battista, & Owen, 2020; Paap & Greenberg, 2013). Within bilingualism, comparisons between distinct subtypes of bilinguals defined by the language experiences that characterize each group remain challenging to compare across studies, with calls for more clarity and validation of the differences between these subtypes as they are compared in by researchers (de Bruin, 2019). Recent studies suggest single measures alone are not representative of the bilingual experience, and that individual differences across several variables may be a key influence on the presence or absence of cognitive differences, such that each variable should be assessed in tandem with other measures to gain a better understanding of an individual's overall language practices and history in their unique bilingual experience (Anderson, Mak, Keyvani Chahi, & Bialystok, 2018; Jiao, Grundy, Liu, & Chen, 2020). Some of the key variables with influences on bilingualism that researchers investigate include age of acquisition (AoA), language proficiency, contexts of language use, and individual's perceptions of and identification with biculturalism (Birdsong, 2006; Gollan, Montoya, Cera, & Sandoval, 2008; Gollan, Weissberger, Runnqvist, Montoya, & Cera, 2012; West, Zhang, Yampolsky, & Sasaki, 2017). Each of these variables can differ greatly between individual bilinguals and can be measured quite differently between studies.

**Factors in Bilingualism**

AoA is a measure of the age at which a bilingual began acquiring each of their languages. Often, this is used to classify subtypes of bilinguals such as in the cases of

early and late bilinguals. In both subtypes, the bilinguals are considered fluent in each language, but early bilinguals began learning each language at a younger age, usually pre- or young adolescence, whereas late bilinguals began learning their second language later than their early teens (Luk, De Sa, & Bialystok, 2011). Some studies report meaningful cognitive differences in non-linguistic tasks between early bilinguals and monolinguals, but not for late bilinguals and monolinguals (Luk et al., 2011). However, other studies find that late bilinguals may sometimes show similar cognitive results to monolinguals (Pelham & Abrams, 2014), and still others show equivocal findings between all three groups (Paap, Johnson, & Sawi, 2014). Within the literature, early and proficient bilinguals are suggested to have the most potential for cognitive differences and advantages over monolinguals (Luk et al., 2011; Yow & Li, 2015), although these findings are not always replicated even with well-defined bilingual groups (Paap et al., 2015), further supporting the need for more research and clearer definitions of these groups of bilinguals.

As with the operational definition of bilingualism, AoA faces challenges in that there is no clearly defined age or cutoff point used to delineate early and late bilinguals. Studies often use different cutoff points for the same umbrella term of early and late bilinguals, and while this age falls in adolescence, some of the ages used include prior to seven, ten, or thirteen years of age. Furthermore, these values often change depending on the age group of bilinguals being studied, as in the case of studies investigating young children using a cutoff age prior to three years to define early bilinguals (Kapa & Colombo, 2013). Additionally, AoA is a self-reported measure, or in the case of younger children it is often reported by caretakers but is generally reliably reported when the

definition is clearly operationalized. However, some measures of AoA concern the age when the bilingual began learning the second language while others ask for the age of second language fluency (Marian, 2018). Due to these factors, it may be difficult to account for between-subject variance in self-report measures, as some bilinguals may be able to use the beginning of formal language learning as an AoA, while other groups of bilinguals might define their AoA as the age they were first exposed to their second language.

Some researchers have proposed that a more reliable measure of AoA is the self-reported onset age of active bilingual use, indicated by the age at which a bilingual began using both languages on a daily basis. Research suggests this may better account for dual-language proficiency and fluency in an individual than the simpler measure using age of language exposure does (Luk et al., 2011). Age of active language use shares similar properties to the age of language immersion or immigration, the age at which a bilingual began living in an environment where the L2 was the dominant language. The two constructs have each been suggested to impact other aspects of bilingualism including proficiency, language interference, and possibly structural changes in the brain (Li, Zhang, Yu, & Zhao, 2019), but age of active bilingualism accounts for the fact that not all individuals begin using their second language immediately after immigration. Still, while both age of active use and immersion differ from the traditional AoA, all three variables are associated with an age at which an individual began some aspect of their bilingual experience and should be considered separately from other variables.

Language proficiency is another frequently used measure for researchers to qualify participants as bilingual, and generally consists of some combination of language

ability in speaking, understanding, and potentially reading and writing in the target language. For bilinguals, this is often measured by assessing both of an individual's languages and comparing each language's level of proficiency to that of a monolingual native speaker's ability. However, this method has problems both in validity and reliability, as researchers note that proficiency is often confounded with AoA, evidenced by early bilinguals tending to have higher proficiency scores than late bilinguals (de Bruin, 2019; Paap et al., 2014). While these variables share close ties, several studies have compared high and low proficiency bilinguals with similar language backgrounds, and results suggest that high proficiency groups most often cognitively differ from low proficiency bilinguals in children, but these findings are not always replicated in many age groups for adults (Paap et al., 2014; Singh & Mishra, 2013; von Bastian, Souza, & Gade, 2016), suggesting that there is more than just overall proficiency involved in these results.

Language proficiency can be assessed either through proficiency tests or through participant self-report measures, at least in the case of older subjects. Proficiency tests are often used to determine a bilingual's relative ability in each language (Bialystok & Barac, 2012; Tao, Taft, & Gollan, 2015). Often, picture naming tasks are used to assess expressive vocabulary as many have been normed for multiple sets of languages, allowing studies to investigate several different participant language combinations (Gollan et al., 2012). For receptive vocabulary, a number of tests have been developed such as the Peabody Picture Vocabulary Test (PPVT-III). However, direct assessment using these tools is not always practical and research suggests that many of these assessments, which are generally normed for monolingual speakers of the language, may

even be unfairly biased against bilingual speakers (Restrepo & Silverman, 2001; Saenz & Huer, 2003). Furthermore, relying on proficiency testing to qualify participants can greatly reduce the amount of variability within a sample by restricting the number of specific language combinations researchers are able to test, as in the case of when a measure is only available in one or a few languages. Additionally, some models of bilingualism suggest that specific language combinations influence performance outcomes in tasks such as lexical access (Kastenbaum et al., 2019), further limiting the applicability of using solely proficiency tests to qualify bilingual participants.

With regard to self-reported proficiency measures, findings are similarly mixed for validity and reliability to qualify bilinguals. While some studies show reasonable correlations between self-reported and objective measures of proficiency (de Bruin, Carreiras, & Duñabeitia, 2017; Marian, Blumenfeld, & Kaushanskaya, 2007), as well as caretaker and teacher reports of bilingual children's proficiency (Bedore, Peña, Joyner, & Macken, 2011), others find low reliability in perceived proficiency for bilinguals' non-dominant language (Gollan et al., 2012). This suggests that lower proficiency bilinguals may not have reliable self-report measures of their language abilities, further complicating the validity of using proficiency as the sole measure to qualify groups of bilinguals. Additionally, these findings suggest that proficiency measures may be confounded by other participant factors unrelated to actual proficiency. Research has shown that bilinguals with different language backgrounds and histories tend to under- or over-estimate their proficiency with some relation to their specific backgrounds (Tomoschuk, Ferreira, & Gollan, 2019).

In Tomoschuk et al.'s (2019) study, Spanish-English and Chinese-English bilinguals were asked to rate their relative proficiencies in each of their languages as well as complete a picture naming task and oral proficiency measurement in both of their languages. Results showed that both groups had comparable scores between the two objective measures of proficiency, but starkly differed in their own self-ratings of proficiency. The Chinese-English bilinguals had more extreme self-ratings relative to their objective scores than the Spanish-English bilinguals did. Lower-proficiency Chinese-English bilinguals self-rated their Chinese proficiency the same as low-proficiency Spanish-English bilinguals self-rated their Spanish proficiency, whereas higher-proficiency Chinese-English bilinguals had higher self-ratings than high-proficiency Spanish-English bilinguals. At the same time, the majority of Chinese-English bilinguals had lower self-ratings than Spanish-English bilinguals did for each group rating of their own English proficiency. Further group differences were found in self-rating reliability between the groups when language dominance and method of second language acquisition were included as moderators. Bilinguals who had spent considerable time in a culture where both languages were present had higher self-ratings of each of their languages, compared to those self-ratings where participants had spent less time in a culture of one of their proficient languages. The complex interactions between language proficiency, culture, and language history that appear in these results support that self-rating measures must be considered as part of a holistic view of individual bilingual measures. That is, while some studies find reliability for self-ratings among bilinguals, these findings demonstrate that differently proficient bilinguals appear to have systematic bias in their own self-assessment, as well as further bias that may be

wholly unrelated to their proficiency such as individual language histories. Overall, research supports that while language proficiency is an important moderating variable for a number of bilingual outcomes, using proficiency measures alone may not be enough to qualify individuals as bilinguals, nor to differentiate between theorized types of bilinguals.

Another important factor to consider is the individual language context of use and history that has historically been used to differentiate between bilingual groups. Early research on bilingual cognitive outcomes suggested that the "balanced bilingual" produced the most consistent advantage over monolinguals, as these individuals must frequently switch between their languages, thus theoretically transferring to a cognitive advantage in switching-related tasks, although these initial findings continue to be contested (Paap et al., 2014). However, research does support that bilinguals who more frequently use both of their languages or have more "balanced use" between each perform differently from bilinguals who have more clear language dominance, even when controlling for language proficiency and AoA (Anderson et al., 2018; Yow & Li, 2015). That is, bilinguals who are able to use their languages often and in different contexts regularly perform different from bilinguals who have isolated language use cases in cognitive and social outcomes. Furthermore, Anderson et al. (2018) and other research suggests that while the "balance" matters in bilinguals, specific contexts of use and differences in these contexts should be used to help qualify and differentiate bilinguals.

In Anderson et al.'s (2018) study, researchers developed and tested the Language Social and Background Questionnaire (LSBQ) as a tool for measuring many different aspects of the bilingual experience, including daily contexts of individual use. The

questionnaire asks respondents to detail their developmental language use and experience, such as the languages spoken at their home or in early schooling, as well as their current daily use and frequency in each of their languages such as during specific activities, with friends, online, etc. Following analysis, the items on the questionnaire were found to cluster into three factors including non-English home use, non-English social use, and English use, supporting that measuring and quantifying contexts of use can be used to differentiate bilinguals. The study predominantly consisted of bilinguals living in Canada, where English and French are considered official languages, but the subject pool featured a large number of languages spoken by participants other than those two, accounting for the non-English factors resulting from analysis. Furthermore, the questionnaire items that comprised the non-English home use and non-English social use demonstrated that these contexts of use relate differently to bilingual individuals' overall language history and experience.

While Anderson et al. (2018) used the LSBQ to measure contexts of language use as a means of qualifying participants as bilingual, other research has focused on using similar measures to characterize differences between bilinguals through the concept of language entropy. Gullifer and Titone (2019) define entropy as "the relative balance or diversity in the daily usage of two or more languages," and suggest that this balance is a crucial measure to determine a bilingual language representation, access, and control, as well as for assessing individual differences between bilinguals. Using the Language Experience and Proficiency Questionnaire (LEAP-Q) and the Language History Questionnaire (LHQ), two questionnaires for qualifying bilingual participants similar to the LSBQ, Gullifer et al. (2019) assessed participant responses to identify individual

differences in a large group of bilinguals. Results suggested that individuals showed strong variation across communicative contexts, in that bilinguals with higher entropy also demonstrated more varied contexts of use for their languages. For instance, many of the bilinguals with lower entropy reported that they only spoke a single language at home with their family, and that this language was not the dominant language of the culture they lived in and thus was not used outside of the home context. Thus, the contexts these individuals used each of their languages in were largely isolated from one another. This further suggests that certain bilingual experiences could be considered as indicators of specific types of bilinguals, and that these experiences can be measured and characterized. Notably, entropy was able to be used to predict individual aspects of participants' second language, including their own self-reported ability in the language (Gullifer & Titone, 2019), suggesting that these contexts of language use can influence other non-linguistic outcomes in bilinguals.

Gullifer's (2019) study highlights the importance of language contexts in assessing bilingual ability and individual differences between bilinguals, and other research supports the validity of measuring these variables in order to distinguish bilinguals. The LSBQ includes a host of questions for participants to outline the specific instances where they use each of their languages, including at home, with siblings, at work, while shopping, on social media, browsing the internet, etc. (Anderson et al., 2018), and prior research on cognitive differences between bilinguals and monolinguals has suggested that frequency of language switching may be a moderating variable for the presence or absence of a theoretical advantage for bilinguals (Paap & Greenberg, 2013; Verreyt, Woumans, Vandelanotte, Szmalec, & Duyck, 2016). In this view, bilinguals who

use both of their languages frequently and in many contexts would have different individual profiles than those who use each of their languages in highly specific or isolated situations. Indeed, a number of studies suggest that any bilingual advantage would most likely be present in participants from areas that support these balanced experiences, such as the Basque Country in Spain where both Spanish and Basque are commonly spoken, or Quebec in Canada where both French and English are treated as official languages (Kroll & de Groot, 2005). Despite the early belief in this, research does not always support these hypotheses (Paap et al., 2015), although it should be noted that individual variation has always been thought to moderate differences between participants (Kroll & de Groot, 2005). One potential source of this variance may be the influence that cultural language beliefs has on individuals' perception of using and willingness to use each of their languages (Jia, Aaronson, & Wu, 2002; Vega, 2018).

Social and cultural perception of different languages plays an important role in how bilingual individuals identify with and use their languages (Turner & Reynolds, 2010; Vega, 2018). Societies that accept or even encourage bilingualism allow speakers to use both of their languages in a variety of contexts, as in the case of Canada's French-English bilinguals, Basque Country bilinguals, or even Belgian society where three official languages are recognized. On the other hand, bilinguals in other contexts report facing discrimination when using a "low-status" language in certain contexts, and cultural attitudes may discourage use of these languages over time (Hurtado & Vega, 2004). In these instances, language entropy could be lower, as bilinguals would be less inclined or even less able to use one of their languages in certain contexts, as the cultural norms may discourage their specific bilingual practices. Studies have investigated the self-

perceptions of bilinguals in a number of situations, including self-esteem, speech perception, and cultural identity (Ramírez-Esparza & García-Sierra, 2014).

Anecdotally, researchers have noted that many bilinguals report feeling "different" when switching between their languages, and some empirical evidence supports this phenomenon (Ozańska-Ponikwia, 2012; Ramírez-Esparza & García-Sierra, 2014). In a prior study, researchers used a personality index to investigate the role of language of administration on the resulting measures (Ramírez-Esparza, Gosling, Benet-Martínez, Potter, & Pennebaker, 2006). Results showed that not only did bilingual individuals have different results depending on which language the index was administered in, but that the differences observed were consistent with the individual's cultural perception of the language. That is, when Spanish-English bilingual responded in English, they were rated more extraverted, agreeable, and agreeable relative to their own responses to the same test when performed in Spanish. These differences were hypothesized to reflect their own beliefs about themselves as well as cultural perceptions when using each of their languages, suggesting that the language administration itself was not solely responsible for the personality shift, but rather internalized beliefs related to the languages and bilingualism. These results also supported the Cultural Frame Switching (CFS) theory, which posits that bicultural individuals often shift values and attributes when presented with culturally salient information, particularly when they hold internal beliefs about these two cultures (Ramírez-Esparza et al., 2006). In a follow up study, the behavior of Spanish-English bilinguals was observed completing similar personality tests as well as social interviews, with all tasks being performed in both Spanish and English (Ramírez-esparza, Gosling, & Pennebaker, 2008). Results supported

that bilingual's self-perception differs between their languages, but also offered additional insight to how this manifested in behavior. Not only did Spanish-English bilinguals report finding themselves as less agreeable in Spanish than in English, but multiple reviewers rated their observable behaviors as more agreeable in Spanish than English when viewing recordings of their interactions with the audio removed. These results demonstrate that bilinguals may not only perceive themselves differently in each of their languages, but that their actual behaviors may change relative to their self-perceptions. Supporting these findings in other language and cultural combinations, additional research studied a group of fluent Polish-English bilingual adults and asked subjects to complete several personality scales as well as rate perceptions of their "feeling different while using L2" on a scale (Ozańska-Ponikwia, 2012). Results showed that bilingual individuals with higher emotional intelligence traits reported higher "feeling different" scores, while overall most participants had some self-perception of changes in body language or behavior when using their L2. Researchers suggest that these findings support behavioral changes that accompany language shifts, although researchers also found that it is possible only individuals with higher emotional intelligence were able to notice and report on subtler changes, but that all bilinguals adapted their behaviors to the linguistic and cultural norms accompanying the language switch.

Similar research has been conducted using other language and cultural combinations, in order to further investigate the role of cultural beliefs and language use in self-perception of bilinguals. Chen and Bond (2010) studied Chinese-English bilinguals, looking at the influence of differing cultural perceptions and norms on changes in individuals' self-perception and expression. In their study, researchers found

that Chinese-English participants were rated as more extroverted when interviewed in English or when interviewed by a Caucasian researcher. These results further support that not only does language influence the presentation of an individual's personality, but also that these outcomes are dependent on cultural perceptions and norms related to the specific languages. It may be that some cultural attitudes towards other languages influence bilinguals' comfort using their languages in daily life, and that this may impact their self-perception of their languages as a result of cultural attitudes even in situations where both languages are supported in the community. In a 2008 study by Lee, younger Chinese-English students living in Canada but attending Chinese-language schooling were asked to rate their self-esteem in both academic and social situations, as well as to rate their self-confidence in English and Chinese ability. Researchers found that students' confidence in their L2 English ability as well as their cultural identification with Chinese both correlated with their self-esteem in academics and social skills (Lee, 2008). Furthermore, the author suggests that these interactions between language and culture may be particularly salient in the population due to their age group. The results suggest that, particularly for immigrant children but also for non-native heritage speakers, the link between language abilities, cultural identification, and self-esteem is of note and demands further investigation. It may be that these influences on self-esteem are dependent on the culture around bilingualism that the individuals grow up in, with bilinguals who are more able to practice and use their languages having higher self-esteem of themselves as a result. It remains to be seen how cultures that are more or less accepting of particular groups of bilinguals impacts these individuals' perceptions of themselves in academic and social situations. Clearly, the interaction between culture and self-perception is

important for bilinguals, and manifests differently in measures of personality, behavior, and self-esteem in both academic and social situations.

Additional research further supports the influence of cultural norms, such that simply being presented with or reminded of bicultural concepts can impact psychological and linguistic outcomes (Zhang, Morris, Cheng, & Yap, 2013). In their study, researchers used bicultural cues to prime Chinese-English speaking students who were recent immigrants to the U.S. in order to investigate how heritage-language cues interfered with second-language processing and fluency. Researchers found that second-language processing was disrupted across all tasks when individuals were presented with heritage-culture priming, including visual primes such as Chinese faces and landmarks, as well as linguistic cues such as traditionally Chinese names and literal Chinese-to-English translations. The disruptions included decreased fluency in participants' second-language fluency during translations, descriptions, and storytelling tasks, but these results were only observed for heritage-culture priming tasks, while second-language priming events did not influence second-language processing. These results along with the earlier studies by Ramírez-Esparza et al. (2006) and (2008) all support the experience that not only do bilinguals have different perceptions of themselves in each of their languages and what using each language may imply culturally, but also that these perceptions can manifest in observable behaviors.

These studies suggest that cultural perceptions of bilingualism impact individual concepts of self as well as behaviors, but that different societies and individuals may hold different views of bilingualism. "Biculturalism" is related to bilingualism and the context that different languages are used, and has been defined as a proficiency with both an

individual's heritage culture and the dominant mainstream culture the individual is settled in (Schwartz & Unger, 2010). Thus, a bicultural individual is defined as having had significant and lengthy exposure to two cultures, including ethnicities, nationalities, region, religion, and social class (West et al., 2017). Similar to language entropy, higher degrees of biculturalism are associated with a stronger orientation to both the dominant and heritage cultures, and research suggests this has a positive association with adjustment in psychological, sociocultural, and health-related outcomes (Nguyen & Benet-Martínez, 2013). As with bilingualism, these findings appear moderated by individual factors, including attitudes of the dominant culture towards the heritage culture, individual proficiencies with the languages, and the presence of multicultural policies held by the host country. Additionally, because biculturalism is also a multivariate construct, there are several different theories relating to how it should be considered in bicultural individuals. A "unidimensional" bicultural model is framed such that an individual may "separate" or disidentify from their heritage culture and assimilate towards the mainstream culture or vice versa, balancing along a single spectrum of identity, while a "bidimensional" model allows separate cultural identities that a bicultural individual can differently identify or disidentify with (Ryder, Alden, & Paulhus, 2000). These two models differ in that the unidimensional model is a zero-sum model, where an individual may only fully identify with one culture at the loss of identification with the other, while the bidimensional model allows full identification or total dissociation from both simultaneously. Finally, a "transformative" model has more recently been proposed, which considers the specific ways in which bilinguals navigate their heritage and mainstream cultures as transforming their own unique sense of cultural

identity (West et al., 2017). With a transformative model, bicultural individuals develop characteristics of both their heritage and mainstream language cultures that are direct products of their experiences existing in these spaces and using their two languages.

Given this, it is possible that bilinguals with different language backgrounds in the same environment will have different subjective experiences relating to their own bilingualism. Biculturalism in any of these models may be more or less possible for some groups of bilinguals due to language policies within a given environment, and individuals with strong support for both of their languages may have stronger associations with biculturalism (Nguyen & Benet-Martínez, 2013), as well as possibly having higher levels of language entropy (Gullifer & Titone, 2019). While individuals with lower levels of both biculturalism and language entropy could certainly be classified as bilingual, it is possible that these individuals would have different results on language survey instruments due to these differences in language use and history. The LSBQ and other language surveys measure these factors through daily and private language use, often heavily weighting these items due to their validity in characterizing bilingualism. For bilingual individuals who frequently speak with their family in their heritage language or who are able to use both of their languages in their daily life, this may not impact the final group categorization. However, for those who are not able to frequently use both of their languages, these individual practices could fail to classify them as bilingual, thus excluding their bilingual experience from some studies, as well as potentially useful data for other individuals with similar language histories. Research supports how language practices contribute to these differences in measures such as composite scores, but suggest that there may be further influences from these experiences that may not be fully

reflected in such scores (Surrain & Luk, 2019). Clearly, it is important for bilingual researchers to qualify their participants through a combination of many variables that make up the bilingual experience. This must be done while not only carefully considering how to measure each variable of interest, but also establishing how the variables should be used to qualify each individual's bilingual experience and status. Finally, the challenge remains for how to treat the groups in a study once researchers have outlined these definitions.

**Operationalization of Bilingualism**

In the same way that each of these variables may be measured differently between studies, researchers also vary how to qualify bilingual participants and how the groups are defined (Valian, 2015). Some of the common methods for defining the groups include a binary "monolingual or bilingual" approach, a more nuanced categorical approach that allows for multiple types of bilinguals, or a more recent approach that considers bilingualism along a continuum. Each of these methods comes with benefits and drawbacks, and recent studies suggest that this decision may influence specific outcomes for bilingual research (Champoux-Larsson & Dylman, 2020), thus this choice is just as crucial for how a research question relates to the construct of bilingualism.

Treated as a categorical variable, participants may be grouped by researchers into the simple labels "bilingual" or "monolingual," and generally with a statement about how these conclusions were determined by researchers. Simple dichotomous labeling in this way groups all users of more than one language into the category "bilingual," making it easy for researchers to group monolinguals and bilinguals and use a wide range of analytic techniques for hypothesis testing. However, research suggests this approach is

not the most holistic method of characterizing the dynamic nature of bilingualism, and that this method does not account for the heterogeneity inherent in bilingualism and language use (Luk & Bialystok, 2013). In this approach, individuals who learned a second language later in life but rarely use it could be categorized the same as individuals who grew up speaking two languages and use both frequently. Some criticisms of the bilingual advantage for example suggest that this approach for qualifying bilinguals may have contributed to the equivocal findings (Valian, 2015), and that only specific types of language use or bilingual experiences may be a moderating factor to the presence of such an advantage (Woumans & Duyck, 2015). This dichotomous approach may be useful for some research comparisons and was useful in early studies that compared bilinguals to monolinguals using broad definitions, but these approaches often do not account for the multivariate nature of bilingualism in classifying participants. Luk et al. (2013) studied a large group of bilingual adults with an earlier version of the LSBQ that assessed many of the key variables associated with bilingualism and compared participant responses using a factor analysis. Results showed that both daily bilingual usage and English proficiency were identifiable factors that also related to self-rated proficiency in participants' languages. Furthermore, the factor analysis allowed researchers to differentiate between different "groups" of bilinguals who systematically differed across these variables. These results support the validity of using multiple measures to define multiple groups within a study of bilinguals, rather than applying a dichotomous grouping strategy. In general, modern research practices support this careful categorization and outlining of the many variables associated with the bilingual experience, as it is crucial to understanding

potential differences between monolinguals and bilinguals, or even between different groups of bilinguals (Jiao et al., 2020; Luk, 2015).

In light of this, other studies have incorporated another way of defining bilingualism through multiple "types" of language users, often using discrete groups like "balanced bilinguals," "heritage speakers," or "late bilinguals" (Byers-Heinlein & Werker, 2009; Kaushanskaya & Marian, 2009; Surrain & Luk, 2019). As these groups become more specific, research shows that variance and heterogeneity between groups increases in many aspects of performance (Luk, 2015; Virginia, 2015). Increasing the number of groups in a study allows for researchers to more clearly describe individuals within a group, and this is often achieved using many of the previously discussed variables. For instance, an "early bilingual" often refers to individuals who began learning their second language at a young age, whereas "late bilingual" refers to those who began learning at a later age, usually after the teenage years or late adolescence. Luk et al. (2011) investigated the role that the age of active bilingualism has on cognitive control outcomes, and divided participants into monolingual, early bilingual, and late bilingual using self-reported measures. Results supported that early bilinguals had an advantage in a flanker task of cognitive control over both monolinguals and late bilinguals. These findings provide further evidence that the dichotomous categorization of bilingualism may not accurately account for the heterogeneity within this group.

While increasing the categories used to define characterizations of bilingualism helps to inform research questions and results, these categories still suffer from a lack of a universal definition between studies (de Bruin, 2019), making interpretation difficult. These categories and their cutoff points are defined by the researchers in each study, and

while many use similar terms to one another, they can vary greatly between studies. As discussed earlier, bilinguals may be classified as "early" or "late" bilinguals, but some research has used a cut-off as low as seven years of age, while others use ten or older in adolescence (de Bruin, 2019; Yow & Li, 2015). Luk et al. (2011) defined an "early" onset age of bilingualism as prior to three, and "late" bilinguals beginning their second language after three, compounding the lack of universal definitions for AoA and final group categorizations. Furthermore, when research studies use sample-specific cutoff points such as medians or quartiles, comparisons between studies and reproducibility both become increasingly more difficult (Altman & Royston, 2006). At the same time, multiple measures could also be used together to qualify bilingualism, such as age of active bilingualism, overall language exposure, or diversity of current language use (Gullifer & Titone, 2019; Luk et al., 2011). This raises another possibility that individuals could meet the criteria for multiple groups within these variables, such as a late bilingual who has a high diversity of language use, or an early bilingual who now uses their second language almost exclusively. Such challenges require researchers to either create more finite categories or allow for the added heterogeneity within these groups.

More recent research suggests that bilingualism can be treated as a continuous variable, and that this may better reflect the dynamic and changing nature of the construct (Anderson et al., 2018; Luk & Bialystok, 2013). Using this approach, bilingualism exists as an ongoing interaction between a speaker's multiple languages, ranging from completely monolingual towards the concept of "balanced bilingual." Language entropy uses this model specifically in regard to bilinguals' language practices, and characterizes language use as a continuous balance between the two languages, demonstrating the

utility of this model of bilingualism (Gullifer & Titone, 2019). Research supports using this kind of a continuous model to investigate other bilingual differences, as individual differences in these measures are often associated with other outcomes. Gollan et al. (2011) studied bilinguals who had varying degrees of proficiency and use in each of their languages and examined potential correlations with the onset age of dementia as moderated by level of education. Participants completed proficiency testing in both of their languages, and results from both languages were used to assess a "bilingual index score" on which to compare participants. Importantly, researchers allowed participants to vary on this scale and did not categorize them further. Results showed that a higher degree of bilingualism was associated with a later onset age of dementia only in bilinguals with a lower level of education. These findings suggest first that considering bilingualism as a continuous variable is feasible for researchers, and second that by assessing bilingualism in such a way may reveal more precise relationships with other variables for specific research questions.

Generally, continuous approaches for defining bilingualism consider the language history and practices of an individual, from which a unique value is calculated for the purpose of the study. This is achieved by characterizing multiple variables such as proficiency, contexts of use, or acquisition history, and then constructing a single composite score from these variables to compare participants within a study. This approach still requires researchers to mathematically weight the different variables according to the impact each theoretically has on the final composite value, creating the potential for differences between studies. For instance, an individual could have learned their first and second languages from an early age, but now be speaking predominantly

their second language, and could have a comparable composite score to another individual who learned their second language later but has a more balanced use of both languages in their current daily life. While these individuals would be grouped differently in a study that uses discrete groups defined by their age of acquisition, the similarity of their composite score may be relevant if the study believes overall proficiency and current bilingual practices are more influential than other variables such as AoA. Furthermore, these continuous approaches are less readily interpreted between studies that do not use the same scale or measure, and often use composite score measures to differentiate monolingual and bilingual populations.

Composite scores as measures of bilingualism are comprised of multiple measures of different aspects of the bilingual experience, most commonly including questions about subject language acquisition history, at home language use with family, social language use among peers, friends, and within the community, and personal language practices such as reading, writing, shopping, or internal speech preferences (Anderson et al., 2018; Li et al., 2019). In order to measure all of these variables in a single composite score, several instruments have been developed to quantify and compare the characteristics of the bilingual experience, including the LSBQ (Anderson et al., 2018) and the LHQ (Li et al., 2019) among others. Each of these instruments uses a series of questions to help language users outline key features of their specific usage and history in their languages. The majority of these tools can be used to compare both monolinguals and bilinguals, but generally focus on carefully characterizing bilingual practices in order to understand individuals in the study. While these can be used on their own to qualify individuals as bilingual and are intended to be capable of doing so, the developers of both

the LSBQ and LHQ show good agreement between their instruments and other alternative measures including proficiency testing and behavioral testing suggesting that researchers can include additional measures in qualifying their subjects (Anderson et al., 2018; Li et al., 2019).

The LSBQ is a language survey instrument, based on research from the LHQ and LEAP-Q, but refined by Anderson et al. (2018) to be shorter than either the LHQ or LEAP-Q while being more representative of the continuum of bilingualism. The LSBQ accomplishes this by explicitly asking participants about the time spent in each activity on a Likert scale ranging from "Only English" to "Only the other language," creating a more continuous approach to both language history and current use. In their 2018 paper, Anderson et al. reported the validity and reliability of the instrument in assessing young adults' language experience, including self-reported monolinguals and bilinguals, as well as deriving a composite score from the instrument based on a 3-factor model best described by non-English home use and proficiency, non-English social use, and English proficiency. The authors found good agreement between the original categorical classifications of participants and the factor and composite scores, suggesting the LSBQ is reliable in measuring and assessing different aspects of the bilingual experience.

The model proposed by the LSBQ accounts for a variety of situations where individuals might use one or both of their languages, but ultimately categorizes these into factor scores and a single composite score to determine one's bilingual status. This is useful for researchers hoping to use the instrument to qualify participants' language experience in an attempt to detect subtle effects (Anderson et al., 2018), but as discussed previously these finite categories do not necessarily accurately reflect each individual's

bilingual experience. For instance, two bilingual individuals could have the same final composite score, but very different factor scores, or similar factor scores, but different contexts of language use. Additionally, Anderson et al. (2018) recommend quantile-based cut scores from their sample data, with specific recommendations for classifying monolingual and bilingual subjects. These cutoff scores may be useful for studies that need strong distinctions between monolinguals and bilinguals for their research studies, but the author's recommendation to classify composite scores that fall between these scores as "not strongly differentiated" would disqualify many individuals whose scores fall into the middle quantile. These data points reflect individuals with varied language experiences, including those who present as monolingual but have limited experience with a second language, or others who have may have a strong history of bilingual use within a specific period of their life or in particular situations, but not actively used throughout their entire personal language history.

Historically, these types of individuals have been challenging to identify in bilingual research and are often discarded, as was suggested by Anderson et al. (2018). At the same time, it is important to consider that these individuals may represent subpopulations of bilinguals, including heritage speakers, second language learners, or individuals who no longer use their first language after extensively using it during childhood (Surrain & Luk, 2019). None of these experiences are monolingual in nature, and do not necessarily meet the cut score criteria for clearly bilingual either, but they may still offer insights into the bilingual experience as a whole. These individuals may be better characterized not by a composite score to qualify them as bilinguals, but rather by

observing the characteristics of variables that make up their experiences and investigating how these interact with other behaviors and outcomes in their life.

Finally, the LSBQ survey assumes some degree of English proficiency, as the measure has been historically administered in English only. However, the calculation of the factor scores and composite score may not measure strictly "bilingualism and bilingual experience," but rather it may compare English use and proficiency against non-English use and proficiency. In the supplementary materials, the authors include a calculator with two example responses to the LSBQ, a "Monolingual Molly" and "Bilingual Betty." Molly's answers are English-only, in that she has never spoken, used, read, or written any language other than English, in which she is a highly proficient or native speaker. Her responses to the LSBQ items are all "0, All English," supporting that she only uses English in her daily life. Betty on the other hand is purported to be a "highly balanced and proficient bilingual," and is highly proficient in both English and a non-English language. However, across the LSBQ items Betty reports using only the non-English language for all of the activities listed, indicating "4, Only the other language [non-English]," or where appropriate responds that she switches languages with friends, family, and on social media with "4, Always." Contradictorily, the LSBQ includes two items that ask participants how much time in various activities is carried out in English and non-English, but allows participants to respond "4, All" to both of these items. As a result, when calculating the factor scores and composite score, the LSBQ heavily weights non-English use as being the same as bilingual, allowing a hypothetical high-proficiency non-English speaker to respond to the LSBQ and be assigned a composite score high enough to qualify as "bilingual," despite indicating no English

proficiency or use. This could be addressed by first changing the specific wording of the LSBQ to instead compare L1 and L2 language use and proficiency, rather than English and non-English. Afterwards, the composite and factor scores could be recalculated to weigh L1 and L2 responses as contributing to bilingual status, rather than specifically English and non-English.

Despite the possibility of mischaracterizing individual bilinguals, language survey tools like the LSBQ that allow for both categorical and continuous measures of the bilingual experience are useful tools for researchers, as they consider many of the variables that define bilingualism and allow for comparisons between individuals with different language histories. Particularly useful is the ability to observe the variance between participants who would be categorized as bilingual using simple definitions, but who have different uses for their languages, as this is one of the key problems in characterizing the bilingual experience itself. In order to study potential sources of variance within variables and the influence they have on specific outcomes, including classification as bilingual and potentially other social or cognitive differences, researchers have recommended the use of additional psychometric analyses to help define subpopulations while still considering language use and bilingualism along a continuum (de Bruin, 2019; Kremin & Byers-Heinlein, 2020).

**Mixture Models for Assessing Latent Constructs**

Research methods that can utilize benefits from continuous data and describe it in a more interpretable categorical form include latent class procedures and set-theoretic approaches, which use information from both types of data to provide meaningful theoretical models to describe the unobserved heterogeneity in a population. Approaches

using these methods are used to identify individuals or sets of individuals within a population who display similar profiles or constellations of characteristics that are related to specific outcomes, including latent profile analysis (LPA) and fuzzy-set qualitative comparative analysis (fsQCA). These approaches are considered "person-centric," in that these analyses assess different configurations of variables within individuals to form profiles from the sample that may vary in outcomes between one another (Wang & Hanges, 2011). While the classification of bilinguals has not been approached with these methods thus far, both analyses have been used in other fields where identifying specific individuals sharing a common outcome but with differing sets of variables contributing to the presence of said outcome, including research on alcoholism or learning strategies (Muthén & Muthén, 2000; Valaei, Rezaei, & Ismail, 2017). The focus of these person-centric techniques is to consider the whole of an individual through sets of traits, rather than on relationships between unique predictors and outcomes that traditional variable-centered approaches perform (Gabriel, Campbell, Djurdjevic, Johnson, & Rosen, 2018; Muthén & Muthén, 2000). With regard to bilingualism, these analyses offer unique benefits with the potential to advance research on the phenomenon and improve classification of individuals with differing language histories.

**Latent Profile Analysis**

LPA allows researchers to model the unobserved heterogeneity between individuals to identify constructs within data, yielding latent profiles that exist in the data (Gabriel et al., 2018; Wang & Hanges, 2011). LPA is particularly useful in that the resulting profiles not only account for classification error, but also offer the ability to compare different models both quantitatively and qualitatively. Quantitatively comparing

models can reveal profiles that differ across all levels of the variables that manifest the construct, while qualitatively comparing models allows researchers to define profiles that vary across each variable. Wang and Hanges (2011) argue that comparing qualitatively different profiles is one of the key benefits to LPA, as profiles that emerge using this approach are defined from one another by different sets of underlying variables, an advantage that would uniquely benefit researchers classifying bilinguals. The resulting latent profile parameters of different models can be compared using formal criteria, allowing researchers to make decisions about the number of classes and fit of each model, while also gaining understanding about what sets of variables comprise such profiles. LPA is similar to another analysis, latent class analysis (LCA), except that LCA requires categorical indicators, while LPA allows for continuous indicators (Muthén & Muthén, 2000). While both analyses are useful for understanding individual differences and the sets of variables that yield specific outcomes, LPA is more flexible by allowing continuous variables and thus potentially better suited to bilingual research which argues that many key variables require continuous measures.

LPA has already been applied in a number of social psychology topics, including classifying individual differences in leadership traits, learning strategies, and language ability groups (Gabriel et al., 2018; Kapantzoglou, Restrepo, Gray, & Thompson, 2015). Organizational psychology has utilized LPA, as the person-centric approach considers the sets of variables that lead to specific outcomes, including beliefs about leadership roles and emotional labor (Gabriel et al., 2018; Gabriel, Daniels, Diefendorff, & Greguras, 2015). In each of these studies, organizational researchers were able to identify latent profiles of employees based on sets of their individual characteristics. The resulting

profiles predicted specific outcomes, including leadership styles and beliefs, as well as overall job satisfaction and emotional wellbeing, all of which are latent constructs with real-world outcomes. Learning research has also used LPA to characterize similar constructs that are reliant on sets of variables rather than specific variables. Hickendorff et al. (2018) outlined how LPA can be applied to qualitative data in a variety of learning contexts, particularly because LPA does not describe a single learner but rather general patterns of behaviors. The authors also describe how subsequent latent profiles from prior research has been used to describe previously contradictory findings in symbolic and non-symbolic learning abilities, suggesting that LPA techniques could also be beneficial in bilingual research where contradictory findings are also prevalent. Finally, in the closest analogue to using LPA for classification of bilinguals, Kapantzoglou et al. (2015) used LPA to identify latent variables in language ability groups for predominantly Spanish-speaking children. Researchers used a combination of language measures and parent-teacher reports to investigate latent variables present in language impairment. Results showed that against traditional models that identified two language ability groups, LPA preferred a three-group model characterized by low grammaticality, low phonological working memory, and non-impaired groups. These findings further support that LPA and related techniques can be useful in furthering existing literature, while also being useful with regard to language constructs.

**Fuzzy-Set Qualitative Comparative Analysis**

In a complimentary fashion to LPA, fsQCA considers specific outcomes of the data and identifies explanatory conditions of variables that causally explain these outcomes (Gabriel et al., 2018; Misangyi et al., 2017). In this way, it differs from LPA

by explicitly considering an outcome and all possible configurations of the data, then calculating the probability that any given configuration can yield the given outcome, along with the likelihood of that configuration occurring given the data. fsQCA uses set theory and Boolean algebra to specifically analyze the factors and combinations of factors that are present and absent when a given phenomenon or outcome occurs in data. This process of analysis considers factors that are believed to be causes of these phenomenon as "conditions," and examines for causal links between these conditions and outcomes, and the cases and sets that exist in the data analyzed (Legewie, 2013). Importantly, fsQCA considers the causality of the outcomes along three lines of complexity; (a) conjunction, that outcomes are usually the result of multiple conditions; (b) equifinality, that multiple paths may lead to the same outcome; and (c) asymmetry, that sets of conditions related in one configuration may be unrelated or inversely related in another (Meyer, Tsui, & Hinings, 1993; Misangyi et al., 2017). Further contrasting from LPA, fsQCA allows configurations where conditions in the data are absent, helping researchers to determine necessary and sufficient conditions for any given outcome. In practice, fsQCA has been used to study the relationship between business models and firm performance, individual characteristics that lead to sustained behaviors, and societal conditions that led to specific economic outcomes (Gabriel et al., 2018; Rihoux, Ragin, Yamasaki, & Rihoux, 2012).

fsQCA has a stronger history in organizational research but still has been applied to social sciences in a variety of areas, although like LPA it has yet to be used for classifying bilingual individuals (Mello, 2013). In Mello's (2013) presentation, the author outlines the current published uses of fsQCA in social sciences, specifically discussing

the ways in which fsCA had been used both correctly and incorrectly to that point. Results showed that fsQCA was able to be applied to a variety of hypotheses, case numbers, and testable conditions, supporting the further use of the analysis across more fields of study. The author also suggests that at the time of publication, fsQCA had largely missed opportunities afforded by the analysis, including investigation of the "non-outcome," or quantifying the states and conditions that might lead to the opposite of the desired research outcome to be true. In order to complete this non-outcome analysis, researchers need to include cases that lead to the outcome as well as negative outcome cases, thus strengthening the confidence in the results of the study, namely that if a specific condition is shown to lead to both the outcome and the non-outcome, researchers should investigate the strengths of the conditions being used to assess for the outcome. By analyzing both the desired outcome and the non-outcome, fsQCA allows researchers to validate theoretically necessary and sufficient paths and conditions that yield a given outcome.

fsQCA considers each configuration of hypothesized causal variables and identifies their observed contributions towards a given outcome, offering specific benefits to researchers as a result of this causal complexity. It defines these configurations as "sets" while the individual memberships within these sets are "cases." For one, fsQCA examines a multitude of factors that each influence the occurrence of the outcome individually, as well as how the causal factors do so in conjunction with one another (Legewie, 2013). Additionally, by examining these different configurations and their relations to an outcome, fsQCA moves towards allowing researchers to identify, develop, and specifically describe what contributes to complex phenomenon. As fsQCA is a set

theoretic approach, researchers must identify and describe the outcome conditions for analysis, which is accomplished during the calibration stages. In "crisp set" QCA, all variables and outcomes are coded using binary responses, while fsQCA is coded using a continuous scale from 0 to 1 allowing for degrees of agreement. Since these are coded by the researcher, there is flexibility in assigning these values, including using a traditional logistic "s-shaped" distribution where membership is considered from 0 to 1, with probability of non-membership at one end of the distribution and probability of full-membership at the opposite. Researchers may also specify a "bell-shaped" distribution, with both ends representing non-membership or exclusion from the outcome, while full-membership or inclusion lies at the middle of the distribution, or vice versa in the case of an inverse bell (Duşa, 2019). With regard to bilingualism, this fuzzy membership approach is aligned with the view of bilingualism as a continuum with stronger degrees of monolingualism existing on either end of a spectrum. Set membership for bilinguals would exist in the middle, representing a more equal use of both of an individual's languages, while exclusion would occur as an individual predominantly uses one language over their other.

The final outcome of an fsQCA is to identify necessary and sufficient conditions found in a dataset for a given outcome. The output identifies the prevalence of cases where a given outcome occurs and analyzes each for the presence or absence of the defined conditions and describes the specific combinations of antecedent conditions as a set. With fuzzy sets specifically, an individual is allowed to be part of a set on a gradient level, such that a set of responses may be "completely" or "partially" in set. This allows for a level of uncertainty when analyzing which sets are associated with the outcome, and

provide good evidence for the necessary and sufficient antecedent conditions in said outcome. A truth table is generated from these fuzzy membership sets, and the necessary and sufficient conditions are analyzed in the QCA. A condition is identified as necessary if that condition is present in all cases of the outcome ($X \Leftarrow Y$), or Y is a subset of X, whereas a condition is sufficient if it is never present in the absence of the outcome ($X \Rightarrow Y$), or Y is a superset of X (Duşa, 2019). With regard to bilingualism, identification of the conditions where bilingualism is always the outcome or conditions that are always present when bilingualism is the outcome is crucial for researchers. For instance, researchers could identify a necessary condition of bilingualism as "understands two languages," such that the only individuals who are considered bilingual, the outcome, are those who also report understanding two languages, the condition. At the same time, the output considers sufficient or prevalent conditions, as in all cases where an individual is considered bilingual, the condition "understands two languages" is also present or highly prevalent. On the other hand, there are many conditions that are sufficient for bilingualism but not necessary, as the condition "frequently switches languages with friends" might be. The condition, "frequently switches languages with friends," would likely never be found in a case where an individual is not considered bilingual, thus defining it as a subset of bilingualism or a sufficient condition, but it may also be identified as not solely responsible for the outcome. By identifying the necessary and sufficient conditions of certain definitions of bilingualism, fsQCA could potentially be used by researchers to better qualify participants for future recruitment, or perhaps to investigate what levels of certain conditions such as L1 and L2 fluency or daily language use are necessary conditions of bilingualism. Furthermore, this approach could be

extended to better differentiate how variations in these conditions lead to alternative subtypes of bilingualism, as the population is heterogeneous and have different specific use cases for their languages. In this way, fsQCA and LPA are complimentary to one another in regard to bilingualism, in that both analyses allow researchers to use unobserved heterogeneity in a sample to model and describe variations in individual data. Furthermore, the results of these outputs can be applied to new datasets to provide validity of identifying theoretical subtypes of bilingualism.

The benefits of each analysis compliment what research suggests about the bilingual experience. First, that there are different "types" or groups of bilinguals who have different language histories and contexts of use, along with theoretically different behaviors and outcomes between these types (Luk, 2015). Second, that some individuals may fit the criteria for multiple profiles of bilingual, depending on the researcher-defined definitions of that profile (Champoux-Larsson & Dylman, 2020). Third, that different bilingual profiles may be assessed as achieving the same or similar composite scores on language surveys, and categorized as sufficiently bilingual or not strongly differentiated, despite having different personal language histories and daily contexts of use (Altman & Royston, 2006; Anderson et al., 2018). Finally, that bilingualism may be best characterized using a "grade-of-membership" model, with individuals being considered across a continuum of language use that includes degrees of monolingual and bilingual membership or "fuzzy set" assignment (Kremin & Byers-Heinlein, 2020). Each of these theories of bilingualism are addressed by applying mixture model analysis, particularly through LPA and fsQCA to the multivariate assessment of bilingualism in order to quantify different aspects of the qualitative experience.

Bilingual researchers have used multivariate assessments and surveys for determining bilingual status frequently, but new findings suggest that the field still requires consistent methods of categorizing and describing participants' language status (Anderson et al., 2018; de Bruin, 2019; Luk & Bialystok, 2013). To date, LPA and fsQCA have not been applied to language questionnaires like the LSBQ or LHQ with the goal of characterizing subtypes of bilinguals. In particular, individuals who are not strongly differentiated as bilingual or monolingual need to be reliably classified to understand the potential effects that different levels of language exposure may have. In order to better understand the full spectrum of the bilingual experience, while still maintaining comparability across studies, researchers need a tool for assessing bilingualism along a continuum while still being able to reliably classify different subtypes of language history, uses, and contexts. To that end, the LSBQ is well-suited to administer to young adult bilinguals, as it can be completed quickly and reliably, and the detailed questionnaire allows researchers to critically analyze several different domains of language use. Additionally, Anderson et al. (2018) have already demonstrated the utility of their existing dataset for factor analysis, suggesting that there is considerable variance within their sample to perform additional tests for latent variable modeling. Being a free-use language survey, the LSBQ could be used by bilingual researchers as part of their screening measures, and the results of LPA and fsQCA analyses could help these researchers readily characterize participants for more fine-grained analysis.

While the LSBQ serves as a useful measurement tool for researchers to compare subjects within and between studies, it is also possible that the questions asked in the survey do not account for the complete bilingual experience. For instance, the LSBQ

does not detail potentially useful qualitative experiences such as self-perception of bilingualism, cultural beliefs and norms, or bicultural practices. Anderson et al. (2018) were able to effectively qualify the majority of participants as monolingual or bilingual using the LSBQ, but it stands that the resulting categorization of bilinguals does not strongly differentiate between individuals with unique language experiences, histories, and practices. Given the findings that intrapersonal factors in bilinguals manifest in many domains, including self-perception of bilingualism (Ramírez-Esparza & García-Sierra, 2014), cultural beliefs and norms (Chen, 2015; West et al., 2017), and self-esteem in academic and social situations (Lee, 2008), the resulting characterization of individuals completing the LSBQ could potentially be improved upon by investigating the roles of these qualitative factors on bilingual expression. It may be that individuals who qualify as similarly bilingual on the basis of their composite score have different experiences with bilingualism, and that these differences are best characterized through measures beyond what is currently assessed in the LSBQ, such as self-esteem, perception, or cultural beliefs and norms. These differences could yield better classifications of bilinguals who have similar quantitative language factors, such as AoA or proficiency, but have qualitatively different experiences which may account for differences in some of the measures currently seen in the LSBQ. Conversely, it may be that similar bilingual experiences that can be characterized using responses in the LSBQ relate to these outcomes, such that researchers can predict individual's likely perceptions and self-esteem in certain settings given latent profile membership observed from their responses.

Another potential drawback in the current LSBQ design is that the questions and scale are designed from an "English-centric" perspective. More specifically, the majority

of the responses for daily and historical language use are judged along a Likert scale comparing English-use to "non-English use" or "only the [participant's] other language," as the instrument is generally administrated in English. However, the responses are then scored as "0" for "English-only" and "4" for "non-English only" or "only the other language." As a result, when quantifying participants' composite bilingual score using the accompanying calculator, more predominant English-use is always lower scoring than non-English use and thus contributes to a lower composite score. On the surface, this is one legitimate way of considering bilingualism, as it directly compares English-use to non-English use and weighs the frequency of responses in calculating a final composite score. However, for respondents who grew up learning a non-English language and who are now learning English and potentially even speaking more English than their first non-English language, this system of weighing the two languages does not accurately reflect their bilingual experience in the final composite score.

Consider two individuals, one who grew up speaking English and living in a place where English was the language of culture, and another who grew up speaking a non-English language in a place with a non-English language of culture. The first individual starts learning a non-English language in high school, and the second begins learning English at the same time. Some time after college, both individuals still speak their first language most frequently throughout the day and continue to only speak their first language with family members, but are approximately equally fluent in both despite limited second language social use. When taking the LSBQ, the first individual whose first language is English and who mostly speaks English may score above the suggested cut range of 1.23, but generally scores on the low end above this value. At the same time,

the other individual whose first language was a non-English one and who has exactly "mirrored" responses on these Likert scales, reflective of their use of English and non-English throughout their day, scores significantly higher, well above the cut score of 1.23. These individuals should be "similarly bilingual," in that each of them predominantly uses their L1 but are highly fluent late L2 learners and thus should have a similar composite score, yet the scoring for the LSBQ's Likert scales and following calculations heavily weights non-English use over English use, rather than considering these scales relative to AoA for a participant's languages. In this way, the current wording and scoring of responses to the LSBQ could be improved to better characterize bilingualism relative to individuals' language acquisition order.

**Current Study**

The purpose of this study is to investigate potential subtypes of bilingual individuals, as identified through latent profiles observed in the LSBQ by LPA and fsQCA, and to investigate potential improvements to the LSBQ to better characterize unique bilingual experiences that may characterize these subtypes. To accomplish this, the study consists of two parts to support the validity of these identified profiles for use in future studies. The first part uses an existing dataset of bilinguals and monolinguals collected for the analyses in Anderson et al. (2018) and examines for latent profiles by using the latent multivariate analyses presented here, LPA and fsQCA. The resulting profiles are assessed and compared to existing literature and bilingual subtypes, in an attempt to match these profiles to existing theoretical groups of bilinguals. Additionally, using the resulting profiles, the present study examines the LSBQ factor scores to identify potential sets of questions and participant responses that future researchers may use to

help characterize their participants; namely what necessary and sufficient conditions contribute to the identified latent profiles and bilingual classification. The first hypothesis asserts that participants' responses to the different items on the LSBQ will reveal latent profiles that qualitatively differ in their structure from one another, allowing researchers to characterize subtypes of bilinguals through these sets of responses. Furthermore, these profiles will relate to previously theorized subtypes in bilingual literature, supporting the utility of these analyses in characterizing the bilingual experience.

The second part of this study collects a sample of bilingual and monolingual young adults, comparable to the sample used in the first part. These participants' data was collected through online survey collection using the LSBQ as well as a series of supplemental follow-up questions investigating potential perceptual and self-esteem outcomes that bilinguals may face. This second sample represents a different geographic region than that of the participants from Anderson et al. (2018) in order to investigate additional potential heterogeneity that may be a result of differing geographics and cultural language practices. The sample from Anderson et al. (2018) consisted largely of Canadian citizens, where both English and French are official languages, although over 50 different languages were represented within this sample. However, the second sample was collected from the Southwest U.S. including Arizona, California, Colorado, Nevada, New Mexico, Texas, and Utah. This area of the United States has its own culture of bilingualism but only recognizes English as an official language, and thus may have qualitatively different experiences that contribute to bilingualism and the subtypes within bilingualism. The LPA and fsQCA are performed on this second sample and the resulting model structure and latent profiles are evaluated. As in the first part of the study, these

profiles are assessed to identify theoretical subtypes using existing literature and theories about bilingualism. Additionally, this study compares how these data from the second sample are classified using the profiles from Anderson et al.'s (2018) sample, investigating the validity of using those original profiles to describe new data. These comparisons allow researchers to consider what role, if any, language of culture has on latent bilingual profiles manifesting in the LSBQ, as well as whether these profiles can be applied to other bilingual samples to help researchers classify participants.

The participants in the second sample completed a series of follow-up questions about different aspects of their bilingual experience, including more specific details regarding their daily use practices, personal histories, and self-perceptions regarding bilingualism and biculturalism. In the third study, these supplementary questions are included in a separate LPA along with a reworked LSBQ questionnaire to investigate how self-perceptions relate to the items on the LSBQ and their utility in potentially better defining latent bilingual profiles. The reworked LSBQ questions address some of the initial concerns with the current version of the LSBQ, while the supplementary questions address areas not currently investigated by the LSBQ, including self-esteem, biculturalism, and attitudes towards language use in participants' lives.

As discussed previously, research suggests that bilinguals may have different perceptions of their identity as a result of their language experiences, and that these differences may manifest in both self-reported and objective measures of processing and fluency (Ramírez-Esparza & García-Sierra, 2014; Zhang et al., 2013). As it is currently written, the LSBQ does not include subjective measures of participants' self-perception when using their languages in each of their languages. It is possible that latent profiles of

bilinguals may be better characterized by individuals' perceptions of their languages and cultural contexts of bilingualism, and additional questions could be included to investigate individual perceptions of bilingualism. As previously noted, some bilinguals report feelings of discrimination when using one of their languages in specific contexts (Hurtado & Vega, 2004), while other research has found qualitative differences in self-report measures assessing personality traits and language skills (Ozańska-Ponikwia, 2012; Ramírez-Esparza & García-Sierra, 2014). Alternatively, it may be that the qualitative experiences of different bilingual individuals do not predict profile membership but rather that individuals within these groups share similar experiences and personal relationships to the cultures of their spoken languages. In this sense, bilinguals who only use their languages in specific contexts or for specialized purposes may have similar self-perceptions of their languages, relative to other bilinguals who use their languages in more varied contexts. For instance, bilinguals who only use one of their languages with close family members while using the language of culture in every other context throughout their typical day may have specific thoughts towards each of their languages that differ from those who have the opportunity to use their languages in different situations throughout their day. Supplementary questions are added to existing language surveys in order to better characterize these subjective experiences that bilinguals have, including their perception of using each of their languages in different contexts, and relate these responses to the latent profiles observed in subsequent analyses.

The second hypothesis of this study posits that the LSBQ is able to characterize a second sample of bilinguals in the same way that it can be used for Anderson et al.'s (2018) original sample, and that latent analyses including LPA and fsQCA can again be

used to identify and describe unique profiles within these samples. Furthermore, given the relationship of factors that make up the bilingual experience, the resulting profiles in each sample will share many characteristics, and it may be possible to use the same profiles to describe both samples. However, given the different cultural attitudes towards languages in the two samples, it is possible that the second sample may have different distributions of these profiles that reflect less prevalent language use in daily contexts and more frequent at-home use that typifies some bilingual experiences. Some of these differences will be reflected in the qualitative experiences described by bilinguals who share similar current language environments but have divergent language histories, practices, and cultural attitudes towards bilingualism. As such, the third hypothesis is that the supplemental questions can be added to describe the subjective experiences that differ between the latent profiles that emerge from the analyses. Furthermore, given the relationship between language use and bicultural identification and self-esteem, individual differences in these subjective areas may be predictive of bilingual subtype membership. The responses participants make in the supplemental portion are analyzed using LPA, fsQCA, and regression analyses in order to investigate this hypothesis. Finally, the utility of applying latent modeling to language surveys like the LSBQ can be further demonstrated by combining these data and reapplying the same analyses previously conducted. The fourth hypothesis is that by combining these data, a final model identifying latent profile analysis will describe the bilingual subtypes in the LSBQ, and that the fsQCA will support the similarity of these profiles to the previously identified profiles.

In summary, the hypotheses for this study are as follows. First, latent profile analysis can be applied to a language survey, identifying subtypes of bilinguals that can be classified using existing theories of bilingual subtypes, and fuzzy-set qualitative comparative analysis can further characterize the language experiences that define these subtypes. Second, repeating these analyses on a second set of bilinguals will result in profiles that are classified using the same or nearly the same subtypes of bilingualism. The additional fuzzy-set analysis on the resulting profiles will identify similar language experiences to those that defined the previous profiles from the first sample. Third, adding information from supplementary questionnaires about bicultural identification and self-esteem will help to better define the previously identified profiles, and that profile membership can be predicted by responses to these subjective experiences as the members within these profiles have shared experiences of language use. Finally, combining all available language survey responses and repeating the latent profile analysis will result in the reidentification of the same bilingual subtypes as in the previous analyses, with fuzzy-set analyses identifying the experiences that define these again.

## Study One

Study One applies both LPA and fsQCA to a large dataset of responses to the LSBQ in order to identify latent profiles in the sample and characterize the results as various subtypes of bilinguals. LPA is used to identify and describe a latent model, resulting in *k* profiles with standard mean estimates for each of the LSBQ items. Using these estimates, the samples are described using existing terminology for bilingual subtypes. Additionally, the study compares the *k* profiles along Anderson et al.'s (2018) LSBQ composite score to identify the proportion of individuals in each profile that meet both the suggested high-cut (1.23) and low-cut (-3.13) composite scores, and also visualizes the standard mean estimates for each profile across all items used in the LPA. The fsQCA is then performed, investigating the sets of conditions present in these data that meet the recommended cut scores, as well as how identified *k* profile membership contributes to these conditions for bilingualism. These sets of conditions are then described in terms of hypothetical real-world bilingual language use.

## Methods

### Sample

The total sample ($n$ = 408; female = 148) consisted of young adults ranging from 18 to 39 ($M$ = 21.27, $SD$ = 3.55) recruited from multiple studies between 2014 and 2015 (Anderson et al., 2018). All participants completed the LSBQ (Appendix A) as part of the studies they were recruited for, and their responses were aggregated for the purpose of assessing the validity of the LSBQ. The data include participant information for age, socio-economic status (SES) as approximated by parents' education, country of birth, as well as their responses to the LSBQ itself. Of the participants included, 261 indicated

having been born in Canada, a country where English is the dominant language, but French is also considered an official language. 112 participants reported having moved to an English-speaking country after being born in a non-English dominant country, although the age at which participants moved varies from before age 1 and as late as age 35. As the LSBQ was administered in English, all participants report some English speaking, listening, reading, and writing proficiency, but over 50 other languages were spoken by participants as well.

These data were filtered to include only participants who indicated some level of bilingual language proficiency, determined as those who answered above a score of 0 for speaking and understanding a second language, with 0 indicating "No Proficiency." This final sample included 257 participants (females = 99), with the average age of 21.27 years (*SD* = 3.84, range = 17-39). The average SES for this sample based on parents' education was 3.4 (*SD* = 1.13) indicating on average participants' parents had achieved a post-secondary degree or college diploma. Finally, 128 (49.8%) indicated being born in a country where English was not the majority language.

**Measures**

Participant responses for these data were collected as part of several research projects, with the LSBQ administered as part of the pre-study survey measures. The LSBQ consists of three sections. The first section, Social Background, contains questions about demographics, including participant age, education, country of birth, immigration to Canada, and parents' education. The second section, Language Background, asks participants to use a Likert scale to assess their proficiency in their languages for speaking, understanding, reading, and writing, with 0 indicating no proficiency and 100

as native proficiency. This section also asks participants to clarify where and when their languages were learned, including frequency of use for each language, ranging from "None" (0) to "All of the time" (4). The third section, Community Language Use Behaviors, asks detailed questions about how languages were used throughout participants' lives, including stages in education, specific social contexts, daily life situations, and different activities. The participants are required to score on a Likert scale the amount of time they spend in each of their languages for the given situation, ranging from "Only English" (0) to "Only the other language" (4). Additionally, this section asks about language switching practices and frequency. Anderson et al. (2018) provide a factor analysis structure that groups each question into one of three factors, including "Non-English Home Use and Proficiency," "Non-English Social Use," and "English Proficiency," which are used together to calculate a composite score of an individual's bilingualism, ranging from -7 to 32.

## Results

### Latent Profile Analysis

To test whether the LSBQ can be used to characterize latent profiles among bilinguals, the first study analyzed this sample of bilinguals using LPA and fsQCA methods. To perform the LPA, the R packages mclust and tidyLPA were used to first compare several possible solutions to the model. Indicators consisted of each LSBQ item that contributed to the identified 3-factor model originally suggested by Anderson et al. (2018). As these data included missing data due to participants not responding to each question, mclust used a non-parametric random forest to impute these missing data where appropriate (see tidyLPA, Rosenberg et al., (2019)). In total, 30 models are attempted to

be fit to these data. Each model included the same 42 indices, and class numbers ranged from $k = 1$ to $k = 10$ profiles, with each $k$ fit three times to force the model to have equal variances and zero covariances (Model 1), equal variances and equal covariances (Model 3), and varying variances and varying covariances (Model 6).

The resulting solutions to all models were compared using the Bayesian Information Criteria (BIC), sample size adjusted BIC (saBIC), bootstrap likelihood ratio test (BLRT), corrected Akaike Information Criteria (C-AIC), and considering entropy values for individual classification. Consideration of these fit statistics follow recommendations that the BIC and saBIC are both more robust to overestimating the number of classes than other information criteria such as the Akaike Information Criteria (AIC) (Nylund, Asparouhov, & Muthén, 2007), while the C-AIC has been found to perform well in class enumeration simulations (Peugh & Fan, 2013). The BLRT compares the -2 log-likelihood (-2LL) from the $k$ profile model to a simulated $k$ - 1 profile model with similar parameters and generates a sampling distribution for the -2LL under the null hypothesis to estimate a $p$-value (Grimm, Houpt, & Rodgers, 2021). If the BLRT p-value is less than alpha ($a = 0.05$), the k profile model is significantly different and thus preferred over the $k - 1$ model as it contains additional information about the data. If the BLRT p-value is above alpha, the k profile and $k - 1$ profile model fits are not statistically significant, and parsimony prefers the less parameterized model with fewer profiles, the $k - 1$ model.

Of the attempts to fit the models to the data, only 16 models converged without error. Results from all models are shown in Table 1, including additional fit statistics that were not used for model selection and class enumeration. Model 6, with varying

Table 1

*Fit Statistics of Latent Profile Analyses for Anderson et al. (2018) Data.*

| *Classes* | *Model* | *BIC* | *CAIC* | *SABIC* | *BLRT* | *BLRT p* | *Entropy* | *-2LL* | *AIC* | *AWE* | *CLC* | *KIC* | *ICL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 37866.37 | 37950.37 | 37600.06 | *NA* | - | 1 | -18700.12 | 37568.25 | 38582.49 | 37402.25 | 37655.25 | -37866.37 |
| | 3 | 33248.70 | 34193.70 | 30252.76 | *NA* | - | 1 | -14002.41 | 29894.82 | 41325.57 | 28006.82 | 30842.82 | -33248.70 |
| | 6 | 33248.70 | 34193.70 | 30252.76 | *NA* | - | 1 | -14002.41 | 29894.82 | 41325.57 | 28006.82 | 30842.82 | -33248.70 |
| 2 | 1 | 34827.90 | 34954.90 | 34425.27 | 3277.076 | <0.010 | 0.9888081 | -17061.58 | 34377.17 | 35911.66 | 34125.15 | 34507.17 | -34830.13 |
| | 3 | 33262.79 | 34250.79 | 30130.53 | 224.515 | <0.010 | 0.9903783 | -13890.15 | 29756.31 | 41707.30 | 27782.29 | 30747.31 | -33264.09 |
| | 6 | 32557.46 | 34448.46 | 26562.42 | *NA* | *NA* | 1.0000000 | -11032.08 | 25846.16 | 48721.77 | 22066.16 | 27740.16 | -32557.46 |
| 3 | 1 | 33291.78 | 33461.78 | 32752.83 | 1774.728 | <0.010 | 0.9891454 | -16174.22 | 32688.44 | 34743.15 | 32350.42 | 32861.44 | -33293.57 |
| | 3 | 33397.28 | 34428.28 | 30128.69 | 104.127 | <0.010 | 0.9853124 | -13838.09 | 29738.18 | 42209.40 | 27678.15 | 30772.18 | -33400.20 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 4 | 1 | 32852.10 | 33065.10 | 32176.82 | 678.295 | <0.010 | 0.9715402 | -15835.07 | 32096.15 | 34671.11 | 31672.09 | 32312.15 | -32859.95 |
| | 3 | 33453.69 | 34527.69 | 30048.78 | 182.197 | <0.010 | 0.9943164 | -13746.99 | 29641.98 | 42633.41 | 27495.97 | 30718.98 | -33455.01 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 5 | 1 | 32725.28 | 32981.28 | 31913.68 | 365.429 | <0.010 | 0.9819533 | -15652.36 | 31816.72 | 34911.88 | 31306.68 | 32075.72 | -32731.13 |
| | 3 | 33692.79 | 34809.79 | 30151.57 | -0.500 | 1.00 | 0.9887630 | -13747.24 | 29728.48 | 43240.13 | 27496.45 | 30848.48 | -33696.62 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 6 | 1 | 32574.46 | 32873.46 | 31626.54 | 389.435 | <0.010 | 0.9816894 | -15457.64 | 31513.28 | 35128.67 | 30917.25 | 31815.28 | -32580.55 |
| | 3 | 33798.36 | 34958.36 | 30120.81 | 133.040 | <0.001 | 0.9790333 | -13680.72 | 29681.43 | 43713.33 | 27363.39 | 30844.43 | -33808.00 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 7 | 1 | 32626.37 | 32968.37 | 31542.13 | 186.696 | <0.010 | 0.9830522 | -15364.29 | 31412.59 | 35548.19 | 30730.55 | 31757.59 | -32632.71 |
| | 3 | 33848.84 | 35051.84 | 30034.97 | 188.140 | <0.001 | 0.9917938 | -13586.65 | 29579.30 | 44131.40 | 27175.29 | 30785.30 | -33852.11 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 8 | 1 | 32702.19 | 33087.19 | 31481.62 | 162.793 | <0.010 | 0.9846525 | -15282.90 | 31335.79 | 35991.61 | 30567.76 | 31723.79 | -32708.03 |
| | 3 | 33982.70 | 35228.70 | 30032.50 | 104.740 | <0.001 | 0.9929541 | -13534.28 | 29560.55 | 44632.86 | 27070.54 | 30809.55 | -33986.08 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 9 | 1 | 32894.08 | 33322.08 | 31537.19 | 46.716 | 0.307 | 0.9788786 | -15259.54 | 31375.08 | 36551.13 | 30521.03 | 31806.08 | -32904.92 |
| | 3 | 34088.17 | 35377.17 | 30001.65 | 133.160 | <0.001 | 0.9948457 | -13467.70 | 29513.41 | 45105.94 | 26937.40 | 30805.41 | -34090.13 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 10 | 1 | 32956.29 | 33427.29 | 31463.08 | 176.400 | <0.001 | 0.9822054 | -15171.34 | 31284.68 | 36980.94 | 30344.64 | 31758.68 | -32965.13 |
| | 3 | 34220.11 | 35552.11 | 29997.27 | 106.660 | <0.001 | 0.9950930 | -13414.37 | 29492.74 | 45605.49 | 26830.74 | 30827.74 | -34222.05 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |

variances and covariances, failed to converge for all $k > 2$ estimates, suggesting that the number of indices being estimated were too complex for models with higher numbers of latent classes. While allowing for more unconstrained parameters, such as varying variances and covariances, generally results in better fit statistics, one tradeoff is that these models often have difficulty replicating the same fit statistics, making it hard to determine the "best" model (Spurk, Hirschi, Wang, Valero, & Kauffeld, 2020). Furthermore, with the addition of each observed variable and as *k* increases, the variances and covariances that must be estimated also increase exponentially, making these models computationally difficult to converge. The present model includes 42 observed variables meaning that for each class *k*, 42 variances and 861 covariances would need to be estimated should these parameters remain unconstrained. For model 3, equal variances and equal covariances, all $k > 4$ resulted in errors where at least one identified latent class had less than 1% of the sample assigned to it. That is, throughout the $n = 257$ sample used in identifying the model, fewer than 3 individuals were assigned to at least one of the *k* profiles identified. Reviewing the results and estimated profiles from these data, oftentimes a given latent profile using these parameters had no identified members within the sample, indicating these results require further interpretation and consideration as a proposed latent profile has no supporting datapoints in the set of individuals.

In light of these model selection issues common across mixture models, one suggestion in latent profile analysis is to assume local independence and homogeneity of correctly identified latent profiles (Lubke & Neale, 2006). Local independence states that within a correctly identified *k* profile, the observed variable means are uncorrelated and that all off-diagonal covariances are zero, while homogeneity assumes that the main

diagonal covariances within a *k* profile are constrained to equality. These two principles can be assumed as the heterogeneity that leads to the varying variances and covariances within a *k* profile has already been identified by the model in the latent profile extraction and enumeration process. These assumptions along with evidence that models 6 and 3 failed to converge with higher *k* profile models suggest that Model 1 may best identify the latent profiles within these particular data.

The BIC (32,574.46) and C-AIC (32,873.46) values both supported a $k = 6$ profile Model 1 with equal variances and zero covariances over all other models that converged, while the BLRT was found to be significant in Model 1 configurations for all $k < 9$. However, the saBIC (26,562.42) supported a $k = 2$ profile Model 6 with varying variances and varying covariances. Entropy for each model that converged was high, with all values above 0.98, suggesting that classification was excellent in each model with the majority of individuals being clearly classified into one of the *k* profiles.

The final selected model was the $k = 6$ profile Model 1 solution, as this had the most supporting fit statistics including the BIC and C-AIC, sufficient entropy, and was supported by the assumptions of local independence and homogeneity of identified latent profiles. The standard mean estimates for each LSBQ item in the $k = 6$ model are shown in Table 2. The LSBQ composite scores of all individuals were then grouped by identified profiles for this model and compared to visualize how each profile relates along this score, seen in Figure 1. This density graph of these composite scores grouped by identified latent profile suggests that the composite score alone may not be sufficient in identifying the latent profiles, supporting the use of the full item set in the LSBQ. The standardized mean estimates of each profile for all LSBQ items were then compared to

Table 2

*Standard Mean Estimates for LSBQ Items Grouped by Identified k = 6 Profile.*

| | *Profile* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 "Balanced" | | 2 "Proficient" | | 3 "Moderate" | | 4 "n-ELL" | | 5 "Receptive" | | 6 "ELL" | |
| *Item* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* |
| Grandparents | 3.814 | 0.122 | 3.677 | 0.072 | 0.517 | 0.200 | 0.324 | 0.078 | 2.635 | 0.244 | 3.993 | 0.007 |
| Infancy | 3.630 | 0.128 | 3.525 | 0.094 | 1.132 | 0.305 | 0.128 | 0.052 | 2.190 | 0.306 | 3.800 | 0.117 |
| Switch w/ Family | 2.550 | 0.199 | 2.814 | 0.115 | 2.095 | 0.261 | 0.477 | 0.098 | 2.417 | 0.199 | 1.466 | 0.204 |
| Non-English Understanding | 91.797 | 1.906 | 83.96 | 1.924 | 77.03 | 7.087 | 30.82 | 3.208 | 68.91 | 5.391 | 95.00 | 1.820 |
| Non-English Speaking | 89.112 | 2.115 | 81.45 | 2.081 | 68.20 | 7.772 | 21.03 | 2.375 | 45.09 | 7.270 | 93.20 | 2.181 |
| Relatives | 3.398 | 0.114 | 2.876 | 0.159 | 1.223 | 0.257 | 0.225 | 0.063 | 1.701 | 0.238 | 3.619 | 0.156 |
| Preschool | 3.204 | 0.166 | 3.024 | 0.130 | 1.267 | 0.244 | 0.110 | 0.047 | 1.611 | 0.259 | 3.800 | 0.121 |
| Parents | 3.233 | 0.149 | 2.906 | 0.111 | 1.098 | 0.238 | 0.149 | 0.046 | 1.459 | 0.245 | 4.000 | 0.000 |
| Non-English Listening Frequency | 2.788 | 0.116 | 2.382 | 0.088 | 1.873 | 0.212 | 1.060 | 0.135 | 2.453 | 0.182 | 2.884 | 0.170 |
| Non-English Speaking Frequency | 2.640 | 0.101 | 2.231 | 0.083 | 1.669 | 0.170 | 0.663 | 0.113 | 1.697 | 0.177 | 2.893 | 0.158 |
| Home | 2.824 | 0.141 | 2.296 | 0.128 | 0.904 | 0.221 | 0.130 | 0.049 | 1.313 | 0.215 | 3.520 | 0.227 |
| Primary | 2.088 | 0.141 | 2.016 | 0.116 | 1.405 | 0.189 | 0.541 | 0.076 | 1.203 | 0.182 | 2.960 | 0.184 |
| Religious | 2.812 | 0.124 | 2.129 | 0.164 | 1.433 | 0.233 | 0.255 | 0.087 | 0.900 | 0.236 | 3.106 | 0.175 |
| Siblings | 1.931 | 0.159 | 1.431 | 0.150 | 0.587 | 0.145 | 0.091 | 0.043 | 0.294 | 0.194 | 3.171 | 0.183 |
| English Listening Frequency | 3.102 | 0.088 | 3.017 | 0.085 | 3.232 | 0.141 | 3.909 | 0.045 | 3.266 | 0.119 | 2.712 | 0.135 |
| Praying | 2.384 | 0.148 | 1.521 | 0.162 | 1.367 | 0.279 | 0.330 | 0.107 | 0.576 | 0.238 | 2.970 | 0.199 |
| High School | 1.391 | 0.117 | 1.156 | 0.086 | 1.356 | 0.204 | 0.546 | 0.072 | 0.958 | 0.135 | 2.120 | 0.171 |
| English Speaking Frequency | 3.102 | 0.086 | 3.123 | 0.085 | 3.194 | 0.096 | 3.911 | 0.054 | 3.514 | 0.127 | 2.369 | 0.165 |
| Work | 0.616 | 0.113 | 0.195 | 0.051 | 0.450 | 0.160 | 0.059 | 0.028 | 0.123 | 0.064 | 0.486 | 0.083 |
| School | 0.311 | 0.091 | 0.128 | 0.046 | 0.455 | 0.162 | 0.097 | 0.038 | 0.068 | 0.047 | 0.720 | 0.123 |
| Health Care | 0.247 | 0.091 | 0.143 | 0.053 | 0.091 | 0.082 | 0.036 | 0.025 | 0.035 | 0.039 | 0.720 | 0.192 |
| Shopping | 0.624 | 0.115 | 0.318 | 0.075 | 0.403 | 0.139 | 0.037 | 0.027 | 0.145 | 0.097 | 0.708 | 0.124 |
| Social Activities | 1.303 | 0.119 | 0.411 | 0.099 | 0.684 | 0.127 | 0.071 | 0.041 | 0.071 | 0.061 | 1.590 | 0.187 |
| Email | 0.480 | 0.087 | 0.099 | 0.034 | 0.452 | 0.132 | 0.001 | 0.009 | 0.036 | 0.046 | 0.960 | 0.114 |
| Friends | 1.397 | 0.127 | 0.458 | 0.102 | 0.820 | 0.129 | 0.125 | 0.050 | 0.171 | 0.088 | 1.800 | 0.225 |
| Extracurricular | 0.956 | 0.146 | 0.247 | 0.070 | 0.454 | 0.165 | 0.021 | 0.019 | 0.073 | 0.057 | 1.279 | 0.179 |
| Roommates | 0.626 | 0.086 | 0.216 | 0.041 | 0.443 | 0.150 | 0.035 | 0.023 | 0.069 | 0.021 | 1.757 | 0.307 |
| Text | 1.299 | 0.127 | 0.256 | 0.062 | 0.727 | 0.155 | 0.054 | 0.032 | 0.040 | 0.056 | 1.840 | 0.148 |
| Social Media | 1.192 | 0.123 | 0.144 | 0.051 | 0.560 | 0.152 | 0.039 | 0.028 | 0.037 | 0.045 | 1.880 | 0.187 |
| Movies | 0.978 | 0.127 | 0.462 | 0.100 | 1.000 | 0.104 | 0.090 | 0.049 | 0.232 | 0.125 | 1.360 | 0.207 |
| Internet | 0.665 | 0.106 | 0.171 | 0.051 | 0.592 | 0.142 | 0.053 | 0.037 | 0.035 | 0.045 | 1.880 | 0.217 |
| Switch on Social Media | 2.294 | 0.202 | 0.608 | 0.152 | 1.321 | 0.292 | 0.132 | 0.052 | 0.382 | 0.125 | 2.184 | 0.217 |
| Neighbors | 0.483 | 0.124 | 0.259 | 0.091 | 0.096 | 0.087 | 0.100 | 0.057 | 0.086 | 0.081 | 0.993 | 0.319 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TV | 1.022 | 0.127 | 0.609 | 0.100 | 0.822 | 0.174 | 0.126 | 0.065 | 0.138 | 0.097 | 2.080 | 0.247 |
| Lists | 0.595 | 0.143 | 0.071 | 0.030 | 0.045 | 0.053 | 0.018 | 0.017 | 0.000 | 0.012 | 2.000 | 0.173 |
| Reading | 0.585 | 0.104 | 0.330 | 0.061 | 0.678 | 0.159 | 0.092 | 0.041 | 0.002 | 0.033 | 1.760 | 0.134 |
| Switch w/ Friends | 2.815 | 0.114 | 1.375 | 0.129 | 1.843 | 0.182 | 0.341 | 0.084 | 0.670 | 0.176 | 2.354 | 0.177 |
| English Understanding | 95.35 | 1.282 | 95.41 | 1.200 | 96.73 | 1.875 | 98.37 | 0.648 | 95.91 | 2.066 | 78.52 | 2.695 |
| English Reading | 94.02 | 1.505 | 94.91 | 1.306 | 94.66 | 2.577 | 96.89 | 1.189 | 95.68 | 1.893 | 72.12 | 2.914 |
| English Writing | 88.78 | 2.398 | 91.25 | 2.007 | 92.31 | 3.230 | 96.06 | 1.204 | 91.78 | 3.437 | 65.92 | 3.392 |
| English Speaking | 92.91 | 1.754 | 93.85 | 1.479 | 94.66 | 2.581 | 97.29 | 1.021 | 95.75 | 1.843 | 70.32 | 3.453 |
| English Writing Frequency | 3.327 | 0.104 | 3.451 | 0.098 | 3.486 | 0.182 | 3.925 | 0.072 | 3.670 | 0.145 | 2.244 | 0.153 |

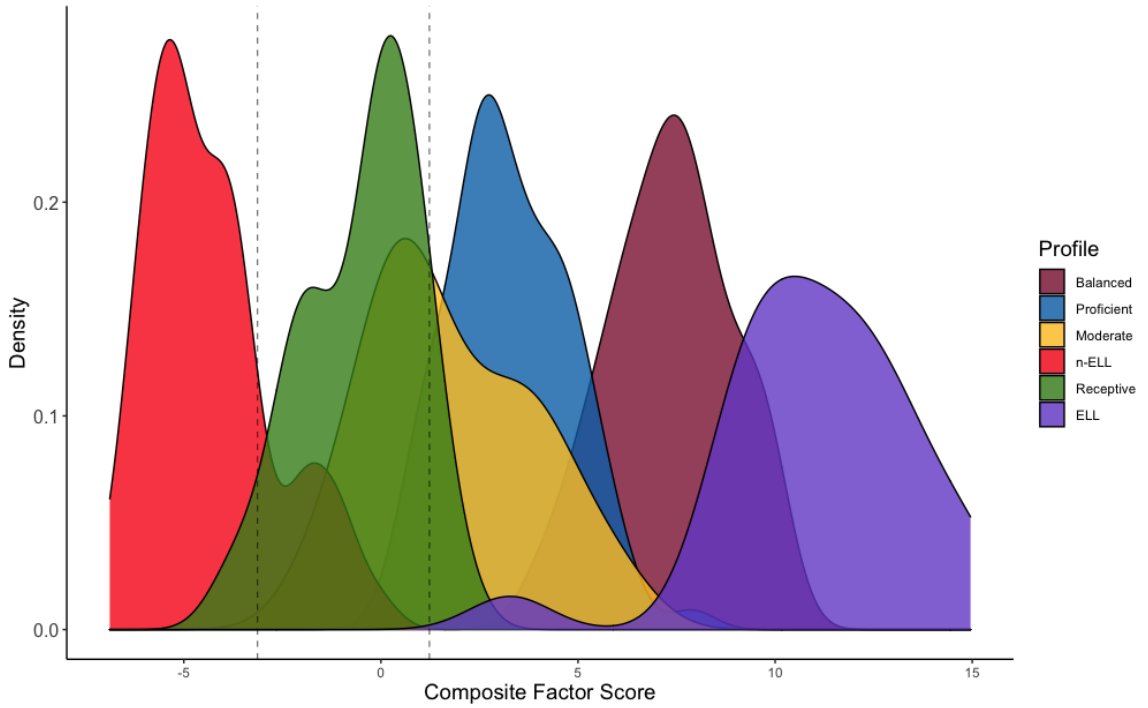


*Figure 1. Density Graph of LSBQ Composite Scores Grouped by Identified Latent Profile for Model k = 6*

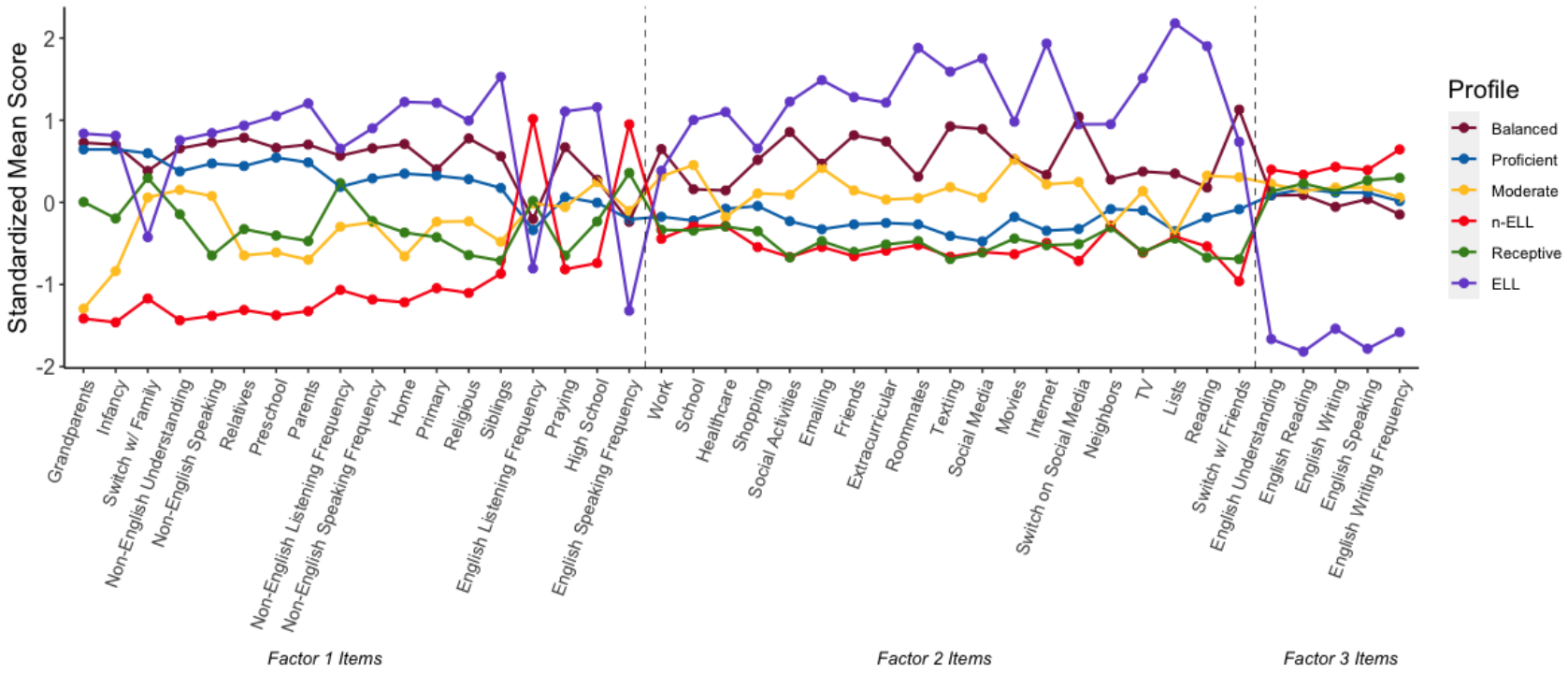


*Figure 2. Standard Mean Estimates for LSBQ Items Grouped by k = 6 Profiles.*

understand how the profiles differed across the entire questionnaire (Figure 2). This graph suggests that there is reasonable distinction between each of the $k = 6$ profiles across the whole LSBQ, as well as between the profile estimates for each set of factor score items. Overall, this model provided good evidence that $k = 6$ profiles were preferred over other $k$ classes, supporting that 6 latent profiles accurately describe these data in the LSBQ.

Reviewing the estimates in Figure 2 and Table 2, these profiles can be defined by their language use and proficiency features. Using Anderson et al.'s (2018) proposed 3-factor model for the LSBQ, the estimates for these profiles somewhat align with the factors for non-English home use and proficiency, non-English social use, and English proficiency and use. Profile 1 represents "balanced" bilinguals, who have high non-English and English proficiency and report using both languages throughout their developmental history, but who appear to use slightly more non-English in all aspects of their daily lives relative to the rest of the sample. Profile 2 is a "proficient" bilingual, as this profile has high English proficiency with above average non-English proficiency and use but has a slight preference for English in social activities. Profile 3 is best described as "moderate" proficiency bilinguals, as this profile has high English proficiency with average non-English proficiency, lower than that of profile 2's "proficient" bilinguals. "Proficient" bilinguals also appear to differ from the previous two profiles by having much higher English home use and more early developmental English use and exposure. Profile 4 is a low-proficiency "non-English language learner (n-ELL)," who appear to be fluent English speakers that use English throughout their daily lives, who may be learning a non-English language but have yet to become proficient in this non-English language.

Reviewing the estimates for Profile 5 suggest these individuals should be defined as "receptive" bilinguals, who have high English speaking and understanding proficiency, but low or non-proficient non-English speaking ability along with average or below-average non-English understanding proficiency. Finally, Profile 6 would be best defined as low proficiency "English language learners (ELL)," who have high non-English proficiency and use, but who have the lowest English proficiency and frequency of use in the sample.

**Fuzzy-Set Qualitative Comparative Analysis**

Following the LPA, fsQCAs were performed to investigate the conditions found in these data of several outcomes, including the resulting profile memberships from the *k* = 6 LPA model and meeting Anderson et al.'s (2018) cut score criteria for bilingualism. The same dataset used for the LPA was supplied for the fsQCA, but profile membership from the LPA was included as an additional outcome. Using the R package QCA, the dataset was first calibrated for fsQCA, which used direct assignment for each item using a bell-shaped curve for grade of membership all items except where noted (Duşa, 2019). Using the direct assignment method, membership values range from 0 to 1, with 0 representing full exclusion from set membership and 1 full inclusion in set membership, and the values between 0 and 1 representing grades of membership between inclusion and exclusion. Calibration for the LSBQ composite scores was defined as crisp rather than fuzzy as this was considered an outcome variable, and two variables were created with the first following Anderson et al.'s (2018) high-cut score recommendation of 1.23, and the other following their low-cut score for monolingualism of -3.13. Scores above each of the respective cut score value would be considered bilingual as an outcome, while

scores at or below these levels would be outside of bilingual membership. Factors 1 and 2 were related to English and non-English daily use, home use, and developmental history, with lower values representing more L1 use or preference and higher scores representing more L2 use or proficiency. These were calibrated to fuzzy membership using a bell-shaped curve, to accurately characterize that values in the middle ranges are associated with more even L1 and L2 usage, while extreme values on either end represent L1 or L2 monolingual tendencies.

The thresholds for each factor were based on the quantile data from the full monolingual and bilingual dataset, similar to Anderson et al.'s (2018) original composite cut score generation method. Using this full dataset ensured that L1 monolingual data would contribute to the calculation of these thresholds, such that bilinguals with significant L1 use in a given factor would have similar fuzzy scores to monolinguals who only have L1 use. Factor 1 was calibrated with scores below -4.62 or above 16.20 excluded from bilingual membership or considered monolingual, scores between 0.44 and 10.15 representing bilingual membership inclusion, and scores between these ranges as a degree of fuzzy membership between bilingual and monolingual. Factor 2 was calibrated such that scores below -6.59 or above 6.84 were fully excluded from bilingual membership, and scores between -3.23 and 3.48 were fully included in bilingual membership, and values between these ranges were treated as approaching bilingual Factor 2 membership.

Factor 3, representing English use and proficiency, was calibrated to a logit scale and thresholds derived from the same full participant data as with the thresholds for Factors 1 and 2. Scores below -15.91 were considered fully outside of membership, with

scores above 1.6 representing full membership. Finally, predicted profile membership was calibrated to a crisp set, as membership status is binary in nature, and was calibrated similar to dummy coding in regression. Six condition variables were created for each of the $k = 6$ profiles, and values were coded such that an individual received a 1 if they were a member of that particular *k* profile, and 0 if they were not. Using these calibrations for each QCA, a fuzzy truth table was generated with the specified conditions and outcomes.

While the LSBQ has a number of items that can all be calibrated to be used in fsQCA, given the complexity of truth table generation and the QCA minimization process, it is not currently possible to include all of these individual parameters in the LSBQ that make up the factor scores for fsQCA. In crisp set QCA, which uses binary causal conditions and outcomes, it is estimated that 30 independent variables can be included, but fsQCA being more computationally demanding has a limit of 12 to 13 conditions (Dusa, 2019). The LSBQ has 42 individual predictor variables, making it computationally impossible with current technology to include each of these variables into even a crisp set QCA. Furthermore, the Factor 1 and Factor 2 components each had beyond the 13-condition limit as well, not allowing us to investigate the QCA solutions that would contribute to these factors individually as a part of an investigation into the LSBQ composite scores. Thus, the fsQCA evaluated the contribution of each factor score towards the outcome of bilingualism, as defined by Anderson et al.'s (2018) high-cut and low-cut composite scores on the LSBQ (1.23 and -3.13). Finally, each of the $k = 6$ profiles were evaluated with the factor scores to investigate the individual profile sets that contribute towards high-cut bilingual membership.

The outcome of being classified as bilingual by Anderson et al.'s (2018) high cut score of 1.23 was investigated by individual factor scores, with results for this analysis shown in Table 3. The black circles (●) represent the presence of a condition, while the crossed-out circles (⊗) denote the absence of a condition, and blank spaces indicate a "do not care" situation where the solution makes no causal suggestion about the presence or absence of the given condition (Fiss, 2011). The high-cut composite score fsQCA found two solutions with moderate to high overall solution consistency (.792) and solution coverage of .321. The first set required the presence of Factor 1 and Factor 2 with a consistency score of .793, and the second set required the exclusion from all three factors with a set consistency of .776. The fsQCA was repeated for the low-cut composite score (-3.13), and three sets were found for this solution, with high overall solution consistency (.961) and coverage (.614). The first set necessitated only the presence of Factor 2 with a set consistency of .966, while the second and third sets required either membership in or exclusion from both Factors 1 and Factor 3, yielding high set consistency scores of 1.00 and .891, respectively.

Additional fsQCAs were performed using the information for latent profile membership, evaluating the sets of factor score membership for each profile that was associated with the high cut score, also seen in Table 3. Profile 1 "balanced" had two sets for this Anderson et al. (2018) bilingual classification and yielded perfect solution consistency (1.00). The first set required the presence of Profile 1 membership, the absence of Factor 1, and the presence of Factor 3. The second solution required the presence of Profile 1 membership, the absence of Factor 2, and the presence of Factor 3. The fsQCA found two sets for the Profile 2 "proficient" bilinguals, both of which

Table 3

*Fiss Configuration Chart for Anderson et al.'s (2018) Data.*

| | *Composite Score* | | | | | *Profile* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High Cut* | | *Low Cut* | | | *1 - Balanced* | | *2 - Proficient* | | *3 - Moderate* | | *4 – n-ELL* | | *5 - Receptive* | *6 - ELL* | |
| *Profile* | - | - | - | - | - | ● | ● | ● | ● | ● | ⊗ | ⊗ | ⊗ | ⊗ | ● | ● |
| *Factor 1* | ● | ⊗ | | ⊗ | ● | ⊗ | | ⊗ | ● | ● | ● | ⊗ | ⊗ | ● | ⊗ | ⊗ |
| *Factor 2* | ● | ⊗ | ● | | | | ⊗ | | ● | ⊗ | ● | ● | ⊗ | ● | ⊗ | |
| *Factor 3* | | ⊗ | | ⊗ | ● | ● | ● | ● | | ● | ⊗ | ● | ⊗ | ● | | ⊗ |
| Consistency | .793 | .776 | .966 | .891 | 1.00 | 1.00 | 1.00 | .987 | .964 | .862 | .854 | .852 | .869 | .876 | 1.00 | 1.00 |
| Raw Coverage | .192 | .146 | .330 | .138 | .369 | .217 | .256 | .228 | .166 | .045 | .040 | .169 | .146 | .172 | .152 | .086 |
| Unique Coverage | .176 | .130 | .145 | .083 | .186 | .009 | .048 | .180 | .117 | .045 | .040 | .143 | .119 | - | .071 | .006 |
| Solution Consistency | .792 | | .961 | | | 1.000 | | .976 | | .858 | | .870 | | .876 | 1.000 | |
| Solution Coverage | .321 | | .614 | | | .265 | | .346 | | .086 | | .288 | | - | .158 | |

required Profile 2 membership, and had high overall solution consistency (.976). The firstset found included the absence of Factor 1 and the presence of Factor 3 and Profile 2 membership, while the second set found only required Factor 1 and Profile 2 membership. The Profile 3 “moderate” bilingual fsQCA yielded two sets for the high-cut score and had high overall solution consistency (.858). The first set found required the presence of Profile 3 membership, Factor 1, and Factor 3, along with the absence of Factor 2. The second set required the absence of Profile 3 membership, suggesting this solution should be carefully considered as this could be difficult to interpret in this context, along with the presence of both Factors 1 and 2, and the absence of Factor 3. The fsQCA solution for Profile 4 “n-ELLs” had two sets, although these should be interpreted with caution given both required the absence of Profile 4 membership. However, this solution still had high overall consistency (.870). The first set required exclusion from Profile 4 membership, the absence of Factor 1, and the presence of both Factors 2 and 3, while the second solution required the absence of all 3 factors and Profile 4 membership. The Profile 5, “receptive” fsQCA found only one set for a high-cut composite score and had high consistency (.876). However, this set should be interpreted carefully, as it required the absence of Profile 5 membership in addition to the presence of Factors 1, 2, and 3, suggesting no configuration that included “receptive” bilingual membership achieved this high-cut composite score. Finally, the evaluation for Profile 6 “ELLs” found two sets and had perfect overall solution consistency (1.00). The first set required the presence of Profile 6 membership and the absence of both Factors 1 and 2, while the second set required Profile 6 membership and the absence of Factors 1 and 3.

## Discussion

Results from the LPA support that the LSBQ can be used to identify latent profiles of bilinguals, and results suggest a $k = 6$ profile model that differentiates between these bilingual subtypes. Furthermore, mean estimates from the identified profiles can be used to characterize each as a theorized bilingual subtype, and fsQCA demonstrates specific differences within these subtypes that contribute towards bilingual status. Figure 2 compares the standardized mean estimates of each of the LSBQ items grouped by latent profile, while Table 2 shows the actual mean estimate for each profile. The mean estimates for latent Profile 1 "balanced" suggest that these individuals tend to use only slightly more non-English in nearly all areas of their life relative to the sample, but also report higher non-English. Notably, the estimates for early developmental experiences such as infancy and preschool indicate more non-English use and exposure, suggesting these individuals grew up in a non-English preferring household. These individuals may have grown up in a simultaneous bilingual household, as suggested by the frequent switching practices with their family, but also appear to be able to switch frequently in their daily lives, as evidenced by the estimates for switching with friends and on social media. "Proficient" individuals are proficient in both of their languages, with stronger trend towards using more English in their daily lives compared to "balanced" bilinguals, and may have also grown up in a simultaneous bilingual household as in the previous profile. The mean estimates for "proficient" and "balanced" bilinguals suggest individuals in both profiles often use a non-English language at home with frequent switching amongst family, and both tend to use non-English and English in their social life, consuming media, and completing daily tasks. However, "proficient" bilinguals

indicate less social switching with friends or on social media, as well as slightly lower non-English proficiency. These “proficient” individuals likely have caretakers, parents, or other family who prefer to use a non-English language and thus exposed them to this language early in life, but who live in a community that speaks predominantly English with fewer opportunities to use their non-English language relative to “balanced” bilinguals. Both of these types of bilinguals appear to have grown up speaking both languages due to the slight community English preference, and may have served as infrequent translators for their caretakers who appear to slightly prefer non-English language use. Profile 3 estimates defined these members as “moderate” bilinguals, as these individuals appear to have only average non-English proficiency and but have some non-English use in their social lives and daily activities, although a clear preference towards English is still present. Additionally, the early developmental history of this profile suggests “moderate” bilinguals in this sample grew up in an English-speaking home and tended to use English more often through these stages of life. This profile may best represent individuals whose families are traditionally English speaking but who now live in an environment where using both English and a non-English language is more common, or potentially have a partner who speaks a non-English language. While the LSBQ includes an item asking about language use with subjects’ partner, the item is not included in the composite score calculation and was often incomplete in the data as a result, thus it was not estimated for these profiles. The estimates in Table 2 support that these “moderate” bilinguals still most frequently use English, but the individuals in these profiles may have their own unique situations where a non-English language is used and

where they have achieved some moderate non-English proficiency for speaking and understanding, contributing to their bilingual status.

The estimates for Profile 4, "n-ELLs," suggest these individuals speak almost predominantly English at home and with their family as well as throughout their daily lives and in social activities. This profile is likely comprised of English-speakers who have learned an L2 through schooling or private study, rather than from family or community. Given the estimates through early developmental years as well as the low non-English proficiency estimates, it is likely this group is only recently beginning to learn their L2, or briefly used an L2 without achieving fluency or proficiency. Profile 5 appears to be best described as "receptive" bilinguals. These estimates show a mix of English and non-English language use in their early developmental years and with older relatives, but with low reported switching of among family. However, beginning in preschool a preference for English use begins, with an establish dominance of English in their social lives, similar to the estimates of low-proficiency n-ELLs. Additionally, the estimates for non-English speaking are significantly lower than their non-English understanding, both in frequency and proficiency. These individuals likely represent bilinguals that use predominantly English in both their current daily lives, who have a limited degree of non-English speaking proficiency, perhaps due to only a few family members that are also bilingual and who they themselves may understand English but prefer speaking non-English. As such, these "receptive" profile members may not have had a need or personal desire to develop proficient non-English speaking abilities or may not have received support to do so. Finally, Profile 6 estimates show a clear preference for non-English use at home as well as in their daily and social lives, while also reporting

low English proficiency relative to the rest of the sample. These individuals are likely low proficiency "ELLs" or L2 English learners who have not yet mastered English or do not feel confident in their English ability, while also not being required to frequently use English in their daily lives. Notably, Figure 2 and Table 2 suggest that outside of items for switching practices and English proficiencies, the estimates for "ELLs" and "n-ELLs" are somewhat reversed around the Likert scale for these responses. That is, for many of the items where the "n-ELL" estimate was between 0 and 2, the "ELL" estimate was between 2 and 4. Notably however, items in Factor 2 associated with larger community interactions such as Work, Health Care, or Shopping were still estimated between 0 and 2, indicating more English use. Relative to the rest of the sample however, these estimates were higher than other profile estimates indicating these individuals were more likely to report using a non-English language in these situations than others (Figure 2). These findings suggests that the LPA is identifying and differentiating the "n-ELL" and "ELL" profiles based on their specific language use.

Overall, these profile estimates and the clear differences between them support that the LSBQ can be analyzed with LPA to identify subtypes of bilingual usage. As demonstrated, each of these profiles somewhat match types of bilinguals previously discussed in extant literature and their potential uses of their languages, notably the "proficient," "balanced," and "receptive" profiles, as well as the low-proficiency "ELL" and "n-ELL" subtypes. "Proficient" bilingual estimates describe a bilingual who grew up in a house where a non-English language was spoken by most of their older family members, reflected by the estimates for non-English use in Infancy and Preschool, as well as with their parents, grandparents, and other relatives. However, given the

estimated preference towards English-use in most day-to-day activities as well as in their social lives, it is possible that these proficient individuals grew up or currently live in environments where English is the dominant language. Members of this profile may include "first generation English-language learner" bilinguals, whose parents speak predominantly a non-English language and who grew up hearing and learning this non-English language to some degree of proficiency, before beginning to learn English in their early school years and living in an English-dominant society (Ortega, 2019). In-line with observations about young English-language learners often using English with their siblings and non-English with older family members, the estimate for languages spoken with siblings is $M = 1.43$ ($SE = 0.15$), which is near the middle of scale, "Both English and the non-English language equally," although with a slight preference towards "Mostly English," while estimates for languages spoken with older relatives show a trend towards "Mostly the non-English language" or "Only the non-English language." Furthermore, the estimates for this profile begin with a preference for non-English early in life, including languages used during Infancy and Preschool, and gradually shift towards an English preference in Primary, High School, and nearly all items relating to current daily usage. Kohnert and Bates (2002) observed a similar "L1 to L2" shift in young adolescent bilinguals, who began using a non-English language with their family but gradually became more English dominant as a result of English-only schooling and community preference. However, it appears this particular profile retained non-English proficiency and still somewhat uses this language at home as well as in daily life, resulting in more proficient bilingual practices than other profiles such as the "receptive" profile.

The estimates for Profile 5 “receptive” bilinguals, seen in Figure 2 and Table 2, a relatively even mix of English and non-English use early in their life and with older family members in particular, but has a preference for English as early as Preschool as in the “proficient” bilingual profile, and clearly dominant preference for English later in life as well as in current daily social use. However, one of the most striking aspects of this profile is the low estimates for non-English proficiency for understanding ($M$ = 68.91, $SE.$ = 5.39) and speaking ($M$ = 45.09, $SE$ = 7.27). These estimates for non-English understanding, the early mix of English and non-English, as well as the current daily English use, all suggest that these individuals would best be described as receptive bilinguals. These bilinguals had exposure to two languages from birth, likely through older family members, but grew up in communities or regions that spoke predominantly English and did not develop strong non-English language skills. Furthermore, while the non-English understanding estimate is still low relative to the entire sample, the non-English speaking is notably even lower, suggesting these individuals are less fluent speaking their non-English language despite having a moderate ability to understand this language.

The identification of this profile is critical for bilingual research, and potentially serves to validate aspects of the recommended cut scores for the LSBQ. Historically, receptive bilinguals are considered qualitatively different from those bilinguals who can fluently speak both of their languages but remain challenging for researchers to clearly classify (Sherkina-Lieber, 2020). As discussed earlier, one method for qualifying individuals as bilingual is to measure the proficiency in both languages, including language production. Using this methodology, a receptive bilingual who has low

proficiency in one of their languages may fail to meet the necessary qualifications by research standards. However, as Sherkin-Lieber (2020) discusses, receptive bilinguals can still engage in key aspects of the bilingual experience, including conversations so long as the other participant is able to understand both languages as well. With regard to the LSBQ, the identification of these receptive bilinguals who clearly have some bilingual experiences but not necessarily the researcher defined prerequisites for "strongly bilingual" serves to support the validity of a cut score that distinguishes between monolinguals and bilinguals. The current $k = 6$ profile model suggestion was derived from a sample that included individuals who reported some level of non-English language understanding or speaking proficiency but did not consider the composite score when filtering out monolingual participants. On further review, the composite score mean ($M = -0.50$, $SD = 1.44$) for "receptive" individuals classified suggests most of these individuals would score below Anderson et al.'s (2018) recommended cut score of 1.23 for bilingual, but would still be above the monolingual cut score of -3.13 (Figure 1).

Profile 4 estimates show a clear preference for English use in all items of the LSBQ, as well as lower reported proficiency and use in their non-English language relative to the English proficiency and use estimates, suggesting these individuals are "n-ELLs." These individuals are English speakers living in an English-speaking community who have begun learning a second language at some point in their lives. Given the estimates skewing heavily towards English speaking in their early development, it is likely these individuals have only recently begun learning an L2, or briefly did at one point in their life such as during high school or college. The opposite language acquisition order appears in this sample within these profiles as well, with Profile 6

"ELLs" showing a clear preference for non-English use in all LSBQ items and reporting the lowest levels of English proficiency. These individuals are likely ELLs who spend much of their daily lives in communities that speak their non-English language, further reflected by higher estimates for non-English language speaking and listening frequency.

As discussed earlier, these two profiles for "n-ELLs" and "ELLs" reflect one possible disadvantage to the way the LSBQ is currently set up, in that the wording of the tool most directly compares English to non-English language use, rather than L1 to L2 language use. In theory, the ELLs and n-ESLs in these profiles are similar in their bilingual use and behavior, in that both have a strong preference for their L1 and are apparently learning an L2 that does not match the dominant language of their community, which estimates suggest is their L1. However, because the LSBQ imposes clear decisions with regard to English-language use in the phrasing of the questions, ELLs and n-ELLs are identified as separate "types" of bilinguals due to their English and non-English language acquisition order. While this distinction is certainly valid and often important for many types of bilingual research, it is only one way of considering bilingualism. As seen in Table 2, these two profiles' item estimates nearly mirror one another's around the middle of the Likert scale, suggesting the key difference in the LPA was the specific language combination ordering of English and non-English use in these individuals. The scores used in the Likert scale reflect a directional "English versus non-English" scale, rather than a possibly more appropriate "L1 versus L2" scale, influencing their identification in the LPA as well as their bilingual classification by way of the LSBQ composite score.

The fsQCA results suggest several associated outcomes for the LSBQ cut scores as well as how each these latent profiles differently associate with the composite score for bilingualism, providing further support for these profiles representing different subtypes of bilinguals. First, the suggested "high-cut score" of 1.23 for the composite score had two solutions, the first requiring the presence of both Factor 1 and Factor 2, and the other with the absence of all three factors. The "low cut score" of -3.13, which was considered a differentiation point between monolinguals and "not strongly differentiated," had three solutions. The first required only the presence of Factor 2, while the second and third required either the presence or absence of both Factors 1 and 3. It is important to recall that while the composite score and Factor 3 score are both assigned using a logistic scale, both Factors 1 and 2 use a bell-shaped curve where the middle of the curve represents full membership, and either tail represent full non-membership. For the high cut score solutions, there is one solution that required this middle range for membership in two factors, which represents more balanced use between a participant's English and non-English language use for their language history and daily use. This provides great support for the utility of the LSBQ high cut in identifying individuals who use two or more languages across their lifespan. On the other hand, the alternative solution was the absence of all three factors, including Factor 3, which would be associated with low English use and proficiency. Given this information, it is likely that participants who scored a composite score higher than 1.23 with the absence of these three factors likely were predominantly non-English speakers who had low or minimal English use, proficiency, and exposure. These findings highlight one area where the current design of

the LSBQ could be redesigned to better identify and characterize bilingualism across a continuum of experiences and not solely from an English versus non-English perspective.

Additionally, the fsQCAs investigating the identified latent profiles and the conditions that contribute to each of these outcomes further supported the utility of the LSBQ as a means of characterizing bilinguals. Each profile had a different set of circumstances that led to a composite score of 1.23, also providing further evidence in support of the correct identification of these latent profiles. When paired with the information for profile estimates, clear patterns in the similarities and differences between each identified profile begin to emerge. Profile 1 "balanced" bilinguals have two potential solutions, both requiring sufficient English proficiency, but differing in their use of non-English either at home or in their social life. The LPA estimates of this profile suggest a slight preference for non-English use at home as well as for social use, suggesting that either fsQCA solution satisfies the conditions of bilingualism for this particular group. Respondents identified as "balanced" bilinguals are likely those who receive high quality language input in both their English and non-English languages, but this non-English input and use can occur in either their home or their social settings. This differs from the "proficient" bilingual response patterns, which also has two solutions. The first solution is the same as "balanced" bilinguals, which is sufficient non-English and English use at home as well as sufficient English proficiency, but the second solution only requires bilingual membership for both at-home and social language use, and not English proficiency. In considering the estimates shown on Figure 2, both "proficient" and "balanced" bilinguals have similar Factor 1 estimates, but that "balanced" estimates for Factor 2, social language use, tends to fall closer to the middle of the scale and have

higher levels of switching outside of the home, contributing towards the more "balanced" bilingualism. With this information, it can be seen that individuals who are "balanced" can achieve bilingual status with either sufficient English proficiency or meeting this balanced use of English and non-English use in social settings. As previously discussed, these "balanced" estimates may include individuals who are "first generation English language learners," and these results support this conclusion. As these individuals grow up in a non-English speaking home, they generally live in an English-speaking country or city, and have opportunities to speak both of their languages in different situations. In order to be considered sufficiently bilingual however, members would need to have a high level of English proficiency or have enough daily exposure to English and non-English in order to meet the necessary balance between speaking two languages to qualify as bilingual, in which both situations are represented by the solutions from the fsQCA.

The fsQCA solutions for "moderate" bilinguals had two solutions, but it is important to note that one of these solutions required the absence of the profile membership in order to meet LSBQ bilingual inclusion. However, this solution roughly matches the earlier discussed bilingual "high-cut" score fsQCA that required the presence of Factors 1 and 2, but adds important information regarding the profile. Primarily, "moderate" profile membership must be absent along with the absence of Factor 3 and the presence of Factors 1 and 2 in order to achieve a sufficient bilingual composite score. Considering this as well as the distribution of the profile composite scores, seen in Figure 1, it can be concluded that "moderate" bilingual membership in this sample generally entails strong degrees of English use, which with the current format of the LSBQ

composite score results in a lower score for these individuals. Thus, non-membership in the profile would be required in order to meet the high-cut bilingual score, given the standard estimates that reflect higher degrees of English use within this profile. The fsQCA resulted in another solution however, which required the presence of "moderate" membership as well as Factors 1 and 3 but with the absence of Factor 2. Comparing this solution to the item standard estimates for the profile, the slight bias of the LSBQ to more heavily weight non-English use becomes more apparent. The estimates for Factor 1 items in "moderate" bilinguals suggest a strong preference for English use at home with moderate switching behavior, while Factor 2 items are slightly more balanced between the two languages. The fsQCA suggests that in order for these individuals to be classified as sufficiently bilingual, these individuals need to have slightly more non-English use at home as well as less balanced language use in their social lives, or alternatively needed higher levels on non-English proficiency. In fact, reviewing the truth table for this configuration revealed that only 8 members of "moderate" met the high-cut criteria, while the remaining 14 members of this profile fell short of these criteria. It may be that the overall low number of individuals in this class did not provide sufficient data for the fsQCA to characterize the solutions that yielded a bilingual output, and additional respondents matching this profile would provide a better understanding of the necessary conditions for bilingual membership.

The two solutions for the "n-ELL" fsQCA both required the absence of profile membership in order to meet sufficient bilingual criteria. While this profile had a higher number of respondents identified in this particular profile than in "moderate," the truth table revealed that no combination of factors and "n-ELL" membership resulted in the

sufficient conditions for bilingual classification according to the QCA. Considering this information along with the LSBQ item standard estimates for the profile, it can be seen that these members have a strong preference for English use at home as well as in social and daily activities. Furthermore, this profile has the highest mean estimates for English proficiency relative to the whole sample, while also having the lowest estimates for non-English proficiency. These results from the fsQCA support that this profile characterizes "n-ELLs," as members of this profile would not meet more stringent definitions of bilingual in most research contexts, despite some degree of second language experience.

There was only a single fsQCA solution for the "receptive" profile related to bilingual inclusion, but it required the absence of profile membership in order to meet these criteria. Results showed that the presence of Factors 1, 2, and 3 along with the absence of "receptive" membership was the only solution for bilingualism. As previously discussed, this profile likely consists of receptive bilinguals who had early life language exposure to a non-English language but who had a clear preference towards English use by the early school years and who began using their non-English language significantly less than English through their development. This fsQCA solution would support this, as once again the truth table found no cases where a "receptive, English preferred" individual had the outcome of sufficiently bilingual.

The results of the fsQCA for "ELLs" also support the earlier identification and naming of this profile. The two solutions for this profile both include profile membership, but both require the absence of Factor 1, as well as the absence of either Factor 2 or Factor 3. It is important to remember that calibration of both Factors 1 and 2 were set to a bell-shaped assignment, such that absence of this condition could be on either side of the

curve. In the case of "ELLs," given the estimates for English and non-English use and proficiency seen in Figure 2, it is likely that these individuals are excluded from bilingual membership in these factors due to higher levels of non-English use and proficiency along with low English proficiency. Therefore, the solutions for the fsQCA that lead to the composite score being ranked sufficiently bilingual further reflect the previously discussed issue with regard to how language-specific combinations are weighted in calculating the final composite score. "ELLs" that are found to be sufficiently bilingual through the composite score did not meet the fsQCA defined conditions for bilingual inclusion in either Factor 1 or Factor 2, and instead had high levels of non-English use and proficiency that contributed to the high LSBQ composite score but not the fsQCA inclusion. It is possible that some of these individuals could still be considered bilingual using other measures, but most of these individuals are likely still learning English as their second language and would not meet stricter definitions of bilingualism.

A potential issue was identified with the LSBQ instrument wording, in that the sets of questions asking participants about the frequency of their language use allowed for impossible combinations of responses. Participants were able to say that of the time they spent speaking, listening to, reading, and writing, "All" of it was in both English and their non-English language. It is likely that these participants split their time between both their English and non-English languages frequently and in many different scenarios during their daily lives, but another interpretation to this type of bilingual use could be to respond to both scales saying "Some" or even "Most" of the time was spent in English as well as their other language. In this interpretation, language use is viewed on a balancing continuum between two languages, as in the "balanced" bilingual examples discussed

earlier. It is entirely plausible that many of the participants who responded with "All" might agree that their time in each of these activities is evenly split between their two languages, thus both interpretations must be considered. On the other hand, other bilinguals with less frequent use of one of their languages may similarly respond with "Some" of their time spent in a given activity. For instance, a bilingual who does not have access to much reading material in one of their languages, or whose reading skills in that language are not as high as their other language may only spend "Some" of their time reading that language, while another bilingual with excellent reading skills and access to reading materials in both of their languages may also interpret the question as a balance between their two languages and respond with "Some" of their time to the same question. These two use cases should not be considered identical and may reflect very different bilingual experiences, thus the scales could be reframed to better represent a single interpretation of frequency of language use relative to an individual's L1 and L2, rather than the combination and order of acquisition of two specific languages.

An additional issue that has been mentioned throughout this study concerns the function of the composite score relative to the concept of bilingualism existing as a continuum. As it is currently implemented, the LSBQ calculates a composite score for individuals comparing English use to non-English use, and rates a certain score above 1.23 as being considered bilingual. Thus, the interpretation of this scale can be thought of as a logistic scale, or "S" shaped; any score above this cut value is associated with an individual who is bilingual. However, on closer analysis of the measure, a hypothetical individual who responds to the LSBQ with answers consistent to only using a non-English language, despite the administration of the tool in English, would yield a

composite score of 26.79, well above the 1.23 cut score. While careful researchers would undoubtably notice this individual based on their factor and composite scores being several standard deviations beyond the Anderson et al. (2018) sample, the logic of this hypothetical scenario shows that the composite score scale could be readjusted to include a "high cut" score, in order to accurately differentiate non-English monolinguals within the composite score. In this way, the scale could be reinterpreted as fitting a more normal or "bell shaped" distribution, with either end of the tails representing an individual that is more monolingual, and the middle ranges consisting of bilinguals.

However, given that the LSBQ is administered in English, it may be difficult or impractical to try to collect a solely non-English monolingual sample with the LSBQ in its current iteration, as a translated version still offers its own problems. If the LSBQ were translated, it may at first appear to be a reasonable way of conceiving a bilingual high cut composite score, but this would ultimately still be comparing English to all translated non-English languages. As discussed earlier, another adjustment could be to compare L1 to L2 use and interpret the composite score scale as a balance between L1 use and L2 use. Such a scale would interpret higher composite scores as more L2 use and proficiency relative to a participant's L1, and individuals above a hypothetical high cut score would be individuals who are not explicitly monolingual, but rather those who have shifted from using an L1 towards predominantly L2 use, such that they may no longer fit certain definitions of bilingualism while at the same time not fitting a monolingual profile. Kohnert and Bates' (2002) "L1 to L2 shift" bilinguals are one example of what this may look like, in which these individuals now have a clear preference for L2 use paired with high L2 proficiency, thus no longer fitting a monolingual definition, but may

also no longer be considered strongly bilingual if their L1 use and proficiency suffers atrophy. In this case, combining these recommendations to present the LSBQ in an "L1 versus L2" Likert scale format as well as adopting a second exclusionary "high cut" composite score could allow researchers to identify these "L1 to L2 shift" bilinguals, and decide to include them in bilingual studies where appropriate. As it stands though, using the LSBQ in its current format heavily weights non-English use, demonstrated by the somewhat higher composite scores for "ELL" individuals over their similar "n-ELL" counterparts in Figure 1. This requires researchers to carefully consider the individual responses to the LSBQ in addition to the composite score classifications. However, by using an "L1 versus L2" format in the LSBQ, researchers would still be required to consider high composite scores with care, but the language-specific effects may be lessened.

## Study Two

Study Two builds on the results from Study One by repeating the LPA and fsQCA processes with a second, geographically distinct sample of bilinguals in order to support the validity of using these methods to characterize bilingual subtypes and investigate the role, if any, that geographic location and language policy differences may have in bilingual subtypes and identification. The results from Study One are first used to perform a power analysis using Tekle, Gudicha, and Vermunt's (2016) "shortcut BLRT" method in order to determine and justify the minimum necessary sample size to repeat the LPA. The LSBQ is then readministered along with several supplementary questionnaires to bilinguals currently residing in the Southwest U.S., specifically Arizona, California, Colorado, Nevada, New Mexico, and Utah. The LPA is then repeated using the same

LSBQ items and methods as in Study One and the resulting models are assessed to select a final latent model for these data. These resulting *k* profiles are compared along the LSBQ composite score, visualizing the proportion of each profile that met the low-cut and high-cut values for this measure, as well as comparing the mean standard estimates for each profile across the LSBQ items used in these analyses. Following this, the fsQCA is repeated as in Study One and the sets of conditions are identified contributing to the low-cut and high-cut composite scores, as well as the differences in these sets associated with *k* profile membership. Finally, the identified latent profiles are described in terms of hypothesized bilingual subtype and the language use conditions in each, and these findings are compared to the previous model and latent profiles identified in Study One in order to investigate the second hypothesis of this study.

## Methods

### Power Analysis

Prior to data collection for Study Two, the existing dataset from Study One is used in order to conduct a power analysis for Study Two. This power analysis used the same participants from Study One who responded as having some experience speaking or understanding a second language ($n$ = 257), and the LPA $k$ = 6 model from Study One was used as the hypothesized model. Using these profile estimates and recommendations from Nylund, Asparahouv, and Muthén (2007) and Tekle, Gudicha, and Vermunt (2016), two power estimation techniques for LPA models were performed. Using the hypothesized model parameters, a $k$ + 1 model was estimated as the alternative hypothesis and sample "exemplary" data was generated repeatedly using these model

parameters ($b$ = 500). The $k$ null hypothesis and $k$ + 1 alternative hypothesis LPA models with similar parameters was fit to each generated sample, and the BIC, saBIC, and LRT values were estimated for each $b$ iteration. Power was then estimated as the proportion of simulated samples where the alternative model $k$ + 1 is preferred through a rejection of the null $k$ model, as these data are fit to exemplary data generated under the alternative hypothesis. As Tekle, Gudicha, & Vermunt (2016) discuss, this method, the "power based on proportion of $p$ values" (PPP) method, is computationally demanding and only increases with sample size and parameters estimated. Results from the present study corroborated this, with attempts to run this process taking well over 24 hours to complete, and results finding that over half of the model estimations often failed to converge for a given iteration. As each iteration required explicitly stating a new $n$, this method is time consuming for determining a minimum sample size.

Tekle, Gudicha, & Vermunt's (2016) procedure for a "shortcut BLRT" method was then followed, using the same $k$ + 1 profile parameters to generate a single exemplary data set ($n$ = 1000). The shortcut BLRT method begins by drawing a random sample of size $n$ from this exemplary dataset before fitting both a $k$ profile model to each iteration ($b$ = 500), and estimating a critical value alpha ($C_a$) as the quantile at [$b$(1-$a$)]th position of the numerically ordered $LR_0$ statistics. The $k$ + 1 model is then fit to repeated draws from the exemplary dataset of the same sample size $n$ to estimate this $LR_1$, and power is estimated as the proportion of these statistics that exceed $C_a$. As the exemplary dataset represents the population parameters under $H_1$, the power estimate from this shortcut BLRT method is directly related to the sample size $n$ needed to correctly detect the $H_1$ $k$ + 1 model, thus preventing a type I error. After increasing the sample size to $n$ =

1,000, the hypothesized $k = 6$ profile solution was still slightly preferred over the 7-profile model, suggesting that even a large sample size has difficulty supporting a $k + 1$ profile solution. The profile estimates for the $k + 1$ model were then reviewed, and several model parameters were identified that may have led to difficulties in detecting a $k + 1$ solution under the $H_1$, supporting the $k = 6$ model solution.

The selection of $k$ in mixture model research is particularly important because this choice impacts nearly all aspects of the resulting model estimates and parameters. $k$ selection is directly defined by the researcher during model selection, and the data are fit to the latent structure using the set $k$ value. As such, given two models fit to the same dataset, individuals who fall into one profile in the $k$ profile model may not be similarly defined in a $k + 1$ profile model, as the parameter structure cannot be assumed to be the same between models. When an additional $k$ +1 profile is coerced on the model, subjects will be forced to fit that additional $k + 1$ profile without regard for how the subject was defined in a $k$ profile model, as the number of datapoints has not increased in the dataset. The fact that a given model has converged and assigned profile membership does not imply that this model fits better than an alternative model, requiring researchers to consider various fit statistics and information criteria between the two models.

Tein, Coxe, and Cham (2013) discussed several aspects of class selection directly related to LPA enumeration, and simulated datasets while varying key variables including sample size, class separation, and number of indicators. Results showed that when the degree of class separation was small (Cohen's $d = 0.2$) or medium (Cohen's $d = 0.5$), none of the common model selection criteria alone were able to correctly identify the true number of $k$ classes under any condition. These data suggested that an increase in the

number of indicators, sample size, and class separation all improved the ability to correctly identify *k*, but was limited with a suggestion to have a high degree of class separation (Cohen's $d \geq 0.8$), a large sample size ($n > 500$), and at least 10 indicator variables included in the model (Tein, Coxe, & Cham, 2013). The data also showed that by increasing at least one of these variables, the ability to detect the true *k* improved using BIC and other fit statistics. The authors also note the monotonic effects of the number of indicators on power, while also suggesting there may be a limit to this effect due to the increase in parameters needing to be estimated. Given the present study's model includes 42 indicators, it is likely that the power of a smaller *n* is improved from the additional indicators. While Tein, Coxe, and Cham (2013) were able to simulate their effect sizes by adjusting the pairwise item Cohen's *d* values, the present $k = 6$ model class separation was investigated through Mahalanobis' *D* and entropy.

Mahalanobis' *D* is "the multivariate expansion of Cohen's *d*," and when applied to LPA can be used to compare each class' separation from one another in a pairwise progression (Tein et al., 2013). Under the same local independence and homogeneity assumptions present in latent profile analysis, the covariance matrix is assumed to be the identity matrix, which simplifies the Mahalanobis' *D* equations to the Euclidean distance. Using this, the Euclidean distance calculated for each latent profile is an estimate of profile separation using the standardized means of each profile. The standardized means are used in this case, as Euclidean distance is affected by the unit of measure. The resulting Euclidean distances are shown in Table 4 and suggest that there is sufficient class separation in the 6-profile model. As Tein, Coxe, and Cham (2013) point out

Table 4

*Mahalanobis' D of Profile Estimates for k = 6 Profiles, Model 1*

| | *Balanced* | *Proficient* | *Moderate* | *n-ELL* | *Receptive* | *ELL* |
|---|---|---|---|---|---|---|
| *Balanced* | 0 | 4.018 | 5.011 | 9.232 | 6.419 | 6.150 |
| *Proficient* | | 0 | 4.144 | 6.888 | 3.319 | 8.785 |
| *Moderate* | | | 0 | 5.181 | 3.750 | 9.152 |
| *n-ELL* | | | | 0 | 4.092 | 13.203 |
| *Receptive* | | | | | 0 | 10.952 |
| *ELL* | | | | | | 0 |

however, both the Mahalanobis' *D* and Euclidean distance are impacted not only by the distance between indicators but also by the number of indicators. As the present study includes 42 indicators, it is possible that both of the measures in Table 4 are influenced by the number of indicators and should not be considered using the strict Cohen's *d* guidelines of power (.2 = low, .5 = moderate, .8 = high, etc.), but rather should be considered as general estimates of class separation.

Additional support for the $k = 6$ model was identified in the entropy measure for this model. Entropy is a measure of aggregated classification uncertainty in a mixture model (Tein et al., 2013). As the degree of uncertainty increases, the normalized entropy value decreases in the scale of 0 to 1, with 0 being complete uncertainty in profile classification and 1 being absolute certainty. Previous research has suggested that similar to power, entropy values greater than .80 represent higher certainty in profile classification, thus such a model is "highly discriminating" and class separation is assumed to be high (Tein et al., 2013). Entropy for the $k + 1$ model was 0.964, slightly lower than the *k* profile model (entropy = 0.982), suggesting that there is slightly more uncertainty in assigning individual profile membership, although this difference should not be considered significant. In general, entropy appears to be a poor measure for class enumeration when considered on its own, with Monte Carlo simulation research suggesting that entropy alone is not a reliable method unless the classes were considered highly separated (Cohen's $d > 0.8$). It is instead recommended that entropy may be considered in conjunction with other measures, but should not be used as the sole measure for assessing profile enumeration and *k* selection (Spurk et al., 2020). Given the high class separation indicated through Mahalanobis' *D* in the $k = 6$ model, entropy may

be considered at least somewhat reliable in conjunction with these other data. Entropy for the $k = 6$ model was estimated at 0.982, suggesting that there was very little uncertainty in classification of the individuals to the latent profiles.

Finally, on further examination one profile in the $k = 7$ model was identified as having less than a 1% chance of occurring in any sample, with the original dataset used from Study One ($n = 257$) having only 3 individuals classified in this profile. Given the low probability of one class in the $k = 7$ model occurring, along with converging support for the $k = 6$ solution across a number of fit statistics including the BIC, a sample size of $n = 200$ was considered sufficient to detect a $k = 6$ profile model in the LSBQ, given the number of indicators present and high degree of class separation assumed.

**Participants**

Data collection techniques were approved by the Arizona State University (ASU) Institutional Review Board, and all individuals provided informed consent prior to participating. The study included 208 bilingual young adults over the age of 18. 177 participants were recruited through a professional survey collection service (Qualtrics), and 31 participants were collected through convenience sampling and self-selection from ASU's campus and departmental newsletters. All participants collected through Qualtrics' services were compensated directly through Qualtrics, while participants collected at ASU were entered into a drawing for a chance to receive one of five gift cards. Study Two's sample was limited to include bilinguals who reported speaking both of their languages for at least 1 year, as well as currently living in the American Southwest, defined as Arizona, California, Colorado, Nevada, New Mexico, Texas, and Utah. This area was selected in order to study bilingual experiences where English is the

only officially recognized language, but in a geographic area that also has strong community support for some non-English languages. This is somewhat in contrast to Study One's geographic location, where both English and French are recognized as official languages and many services are required to be offered in both languages. In this way, many of the bilingual participants in Study One may have had more consistent and widespread support for using each of their languages throughout their daily life. However, Study One also featured a number of language combinations other than English and French, so this difference did not necessarily directly impact the entire sample. Participants in Study Two were first given an informed consent protocol detailing the purpose of the survey, and continuing the survey indicated their consent although no signatures were collected. The survey was only administered in English, including all questions and responses, requiring participants to have English as one of their languages including some reading and writing proficiency.

**Measures**

All participants first completed the LSBQ in full followed by several additional measures, all administered online (Appendix B). Responses were collected entirely online using Qualtrics and were processed in accordance with the original LSBQ guidelines to develop factor scores and a composite score for each individual. This online version of the LSBQ included all of the original questions, but instead of making a direct English to non-English language comparison, used participant responses for their L1 and L2 in order to populate the Likert scales. That is, rather than a scale of 0 indicating "only English" and 4 indicating "only non-English," a choice of 0 on the same Likert scale was labeled as "only [the participant's unique L1]" with the online platform filling in their earlier

response to their L1, and the same process for their L2. In this way, the Likert scales of the LSBQ were set up to directly compare L1 versus L2 usage and proficiency, rather than a specifically directional English versus non-English comparison but were still able to be reverted to an English versus non-English post-hoc comparison by the research team. Finally, in addition to the LSBQ items, participants completed a series of follow-up questions for use in Study Three, which collected a set of additional overall frequency of language use questions, and supplementary questionnaires collecting information on individuals' feelings about and identification with biculturalism, as well as self-esteem and self-confidence.

## Results

### Latent Profile Analysis

To test the validity of using responses to the LSBQ characterize bilingual latent profiles, the data were analyzed using the same LPA and fsQCA techniques outlined in the first study. These analyses used only the same LSBQ questionnaire items available in Study One in order to directly compare the resulting latent profile model structure and class enumeration, as well as to compare necessary and sufficient items for the resulting profiles. As in Study One, the R packages mclust and tidyLPA were used to perform the LPA, with the same 42 LSBQ items as indicators for the analyses. These data did not include missing data, as it was necessary for participants to answer all questions for each section to proceed to the next section of the LSBQ. Thus, multiple imputation was not required for these data as it was in Study One.

As in Study One, these analyses again attempted to fit 30 models to these data, ranging from the *k* number of classes to estimate from *k* = 1 to 10, and across 3 different models; Model 1, equal variances and covariances set to zero; Model 3, varying variances and equal covariances; and Model 6, varying variances and covariances. The results of each attempt to fit the model, seen in Table 5, were then compared using the BIC, C-AIC, saBIC, and BLRT, as well as considering entropy values for class enumeration. Of the 30 models that were attempted to be fit, only 10 successfully converged without substantial error messages. As seen in Study One, Model 6 failed to converge for any $k > 2$, suggesting the number of parameters required to estimate for this model were too complex to complete without error. However, unlike in Study One, for all $k > 4$ solutions that were fit across any model, less than 1% of cases were assigned to one of the resulting profiles or the model failed to converge entirely. No models that converged but assigned fewer than 1% of cases to any given profile were considered for final class enumeration and model selection, due to the low *n* in latent profiles of the solution.

The two lowest BIC values found in the resulting table were from $k = 1$ class solutions using Model 3 and Model 6 configurations (22,583.26), although both models were the same value due to the nature of this particular combination of *k* and model structure. These findings would suggest that there is no latent heterogeneity to be identified in these data, and that the sample should be treated as a single population. Additional BIC values supported progressively increasing $k = 2$, 3, and 4 class Model 3 solutions (22,707.85; 22,855.10; 22,992.85). The C-AIC also supported the same $k = 1$ class Models 3 and 6 solutions with the same value (23,528.26), followed by a $k = 4$ Model 1 solution (23,609.56). The saBIC values were found to be similar for all of the 5

Table 5

*Fit Statistics of Latent Profile Analyses for Southwest U.S. Bilingual Data.*

| *Classes* | *Model* | *BIC* | *CAIC* | *SABIC* | *BLRT* | *BLRT p* | *Entropy* | *-2LL* | *AIC* | *AWE* | *CLC* | *KIC* | *ICL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 26963.86 | 27047.86 | 26697.71 | - | - | 1 | -13257.753 | 26683.51 | 27662.21 | 26517.51 | 26770.51 | -26963.86 |
| | 3 | 22583.26 | 23528.26 | 19589.04 | - | - | 1 | -8769.641 | 19429.28 | 30460.23 | 17541.28 | 20377.28 | -22583.26 |
| | 6 | 22583.26 | 23528.26 | 19589.04 | - | - | 1 | -8769.641 | 19429.28 | 30460.23 | 17541.28 | 20377.28 | -22583.26 |
| 2 | 1 | 24477.86 | 24604.86 | 24075.46 | 2715.515 | <0.010 | 0.9905906 | -11899.995 | 24053.99 | 25534.74 | 23801.97 | 24183.99 | -24478.85 |
| | 3 | 22707.85 | 23695.85 | 19577.39 | 104.917 | 0.277 | 0.9603378 | -8717.183 | 19410.37 | 30943.42 | 17436.29 | 20401.37 | -22711.78 |
| | 6 | 25671.71 | 27562.71 | 19680.10 | 1960.859 | 0.069 | 0.9992183 | -7789.212 | 19360.42 | 41436 | 15580.42 | 21254.42 | -25671.75 |
| 3 | 1 | 23688.76 | 23858.76 | 23150.12 | 1018.609 | <0.010 | 0.9816228 | -11390.691 | 23121.38 | 25104.18 | 22783.35 | 23294.38 | -23691.9 |
| | 3 | 22855.10 | 23886.1 | 19588.39 | 82.267 | <0.05 | 0.978155 | -8676.049 | 19414.1 | 31449.15 | 17354.05 | 20448.1 | -22858.75 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 4 | 1 | 23396.56 | 23609.56 | 22721.67 | 521.720 | <0.001 | 0.9696441 | -11129.831 | 22685.66 | 25170.51 | 22261.6 | 22901.66 | -23404.42 |
| | 3 | 22992.15 | 24066.15 | 19589.20 | 92.462 | 0.129 | 0.9712573 | -8629.818 | 19407.64 | 31944.73 | 17261.58 | 20484.64 | -22997.65 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 5 | 1 | 23267.15 | 23523.15 | 22456.02 | 358.924 | <0.001 | 0.9795425 | -10950.369 | 22412.74 | 25399.6 | 21902.7 | 22671.74 | -23272.46 |
| | 3 | 23092.79 | 24209.79 | 19553.59 | 128.880 | <0.001 | 0.9798668 | -8565.378 | 19364.76 | 32403.86 | 17132.72 | 20484.76 | -23097.52 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 6 | 1 | 22813.84 | 23112.84 | 21866.47 | 682.820 | <0.001 | 0.9783086 | -10608.959 | 21815.92 | 25304.81 | 21219.88 | 22117.92 | -22821.39 |
| | 3 | 23143.27 | 24303.27 | 19467.82 | 179.034 | <0.001 | 0.9806619 | -8475.861 | 19271.72 | 32812.85 | 16953.68 | 20434.72 | -23148.39 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 7 | 1 | 22926.50 | 23268.5 | 21842.88 | 116.852 | <0.001 | 0.9802214 | -10550.533 | 21785.07 | 25775.98 | 21103.03 | 22130.07 | -22933.91 |
| | 3 | 23217.37 | 24420.37 | 19405.68 | 155.414 | <0.001 | 0.9812914 | -8398.154 | 19202.31 | 33245.46 | 16798.27 | 20408.31 | -23223.02 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 8 | 1 | 22674.06 | 23059.06 | 21454.20 | 481.956 | <0.001 | 0.9825141 | -10309.555 | 21389.11 | 25882.05 | 20621.08 | 21777.11 | -22681.14 |
| | 3 | 23379.93 | 24625.93 | 19432.00 | 66.950 | <0.001 | 0.9840082 | -8364.679 | 19221.36 | 33766.54 | 16731.33 | 20470.36 | -23385.5 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 9 | 1 | 22860.78 | 23288.78 | 21504.67 | 42.794 | <0.001 | 0.9841423 | -10288.158 | 21432.32 | 26427.28 | 20578.28 | 21863.32 | -22867.29 |
| | 3 | 23528.53 | 24817.53 | 19444.35 | 80.918 | <0.001 | 0.9887188 | -8324.22 | 19226.44 | 34273.64 | 16650.42 | 20518.44 | -23531.77 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 10 | 1 | 22927.46 | 23398.46 | 21435.11 | 162.832 | <0.001 | 0.9852196 | -10206.742 | 21355.48 | 26852.47 | 20415.45 | 21829.48 | -22933.66 |
| | 3 | 23604.77 | 24936.77 | 19384.35 | 153.266 | <0.001 | 0.9897376 | -8247.587 | 19159.17 | 34708.4 | 16497.15 | 20494.17 | -23607.63 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |

most preferred configurations, slightly favoring *k* = 2 and 3 class Model 3 solutions (19,577.39; 19,588.39) over two identical SABIC values for *k* = 1 Models 3 and 6 (19,589.04) and the *k* = 4 Model 1 solutions (19,589.20). The BLRT for *k* = 2 Model 3 (104.92) was not significant however, suggesting that there was no statistically significant difference between the *k* = 1 and *k* = 2 Model 3 solutions. The *k* = 3 (82.27) and 4 (92.46) Model 3 solutions as well as the *k* = 4 Model 1 (527.72) solution all had significant BLRT values, supporting their selection over a *k* - 1 model of the same configuration. Finally, entropy was found to be relatively high for all converged models considered, greater than 0.98 in all cases, suggesting that each solution effectively classified individuals to the latent classes.

Given the inconsistent support for any one *k* class and model solution, additional factors were considered when deciding on the best-fitting model for these data, including minimum *n* per *k* class identified, Mahalanobis' *D*, and the previously stated variance and covariance assumptions for latent models (Lubke & Neale, 2006). As such, the Model 1 solutions were preferred, as these structures assume equal variances and zero covariances for the *k* latent profiles, presuming that the additional heterogeneity is accounted for in the identified latent profiles. The Mahalonbis' *D* was compared for the *k* = 2 (*D* = 4.2), 3 (*D* = 3.9), and 4 (*D* = 5.2) solutions, with results indicating that the *k* = 4 solution had the highest distance between groups. Finally, the *k* = 4 profile Model 1 solution had sufficient *n* in each profile to further support this *k* solution over others, with at least 20 identified members in each profile. Each of these pieces of evidence in convergence with the fit statistics for these models suggest that a *k* = 4 Model 1 solution best fits these data for identifying latent profiles in the LSBQ. Reviewing the item mean standard estimates

in Table 6 for this $k = 4$ Model 1 solution identified 4 subtypes of bilinguals, including profile 1 “balanced” bilinguals, profile 2 “L2 learners,” profile 3 “proficient” bilinguals, and profile 4 “L1-L2 shift” bilinguals. The LSBQ composite score density graph grouped by $k = 4$ profile can be seen in Figure 3, and the resulting standardized mean estimates grouped by $k = 4$ profile are visually compared in Figure 4 and listed in Table 6.

**Fuzzy-Set Qualitative Comparative Analysis**

As in Study One, following the LPA and identification of bilingual subtypes in these data, the fsQCA was conducted to investigate necessary and sufficient conditions of bilingualism identified through the LSBQ items. Using the same direct assignment method described in Study One, a fuzzy-set truth table was generated for the responses in the LSBQ items, including the resulting factor and composite scores, as well as the identified $k = 4$ Model 1 profiles. fsQCAs were then performed to identify the sets of conditions contributing to the same high-cut and low-cut LSBQ composite scores (1.23 and -3.13), along with the individual sets of conditions for the $k = 4$ latent profiles with the results of all of these fsQCAs seen in Table 7.

The fsQCA solution for the high-cut composite score resulted in only one set, with the exclusion of membership for all of Factors 1, 2, and 3 leading to high-cut composite score membership. However, the overall solution had low consistency (.089) and low set consistency (.598), suggesting that other variables not included in this fsQCA may better explain the high-cut composite score outcome. The fsQCA for the low-cut composite score resulted in two sets for the solution. The first set required full membership for all of Factors 1, 2, and 3, while the second set required exclusion from Factors 1 and 3 with membership in Factor 2. This solution had high consistency (.975)

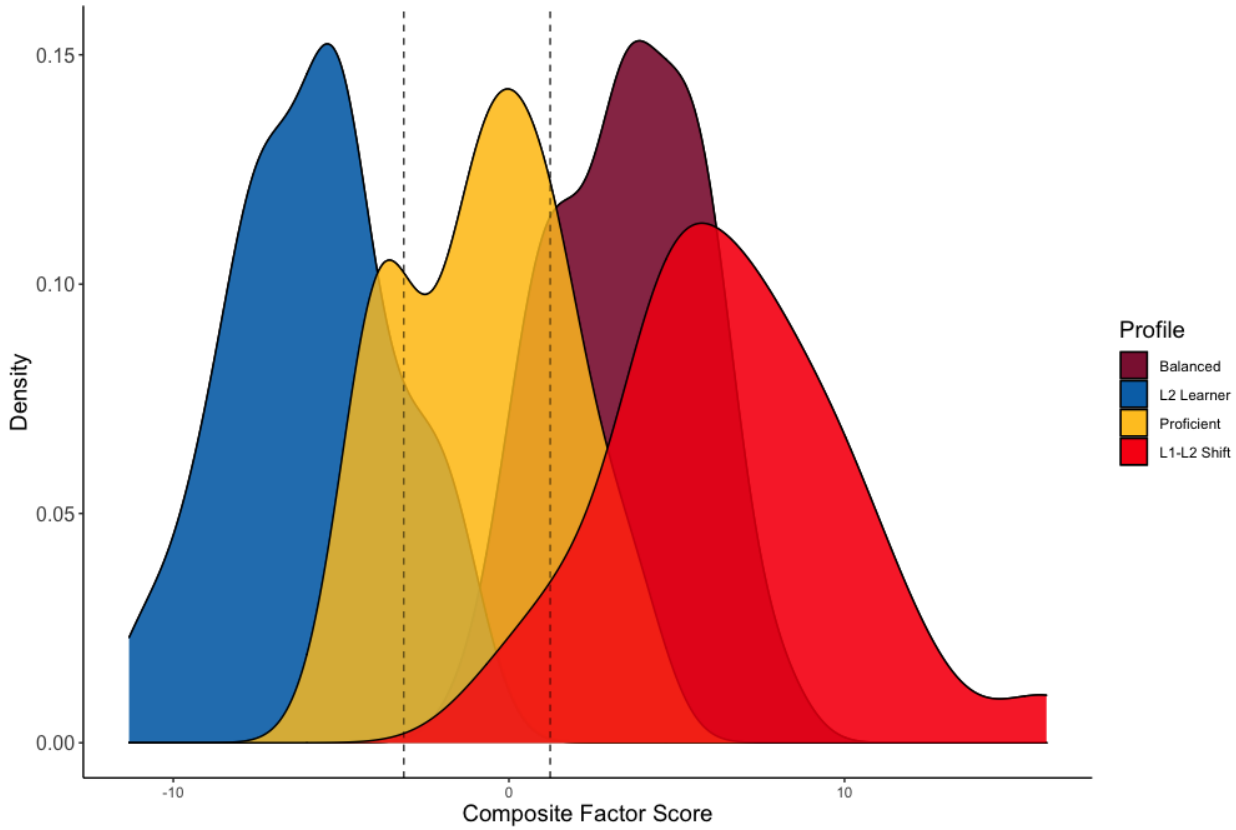


*Figure 3. Density Graph of LSBQ Composite Scores Grouped by Identified Latent Profile for Model k = 4.*

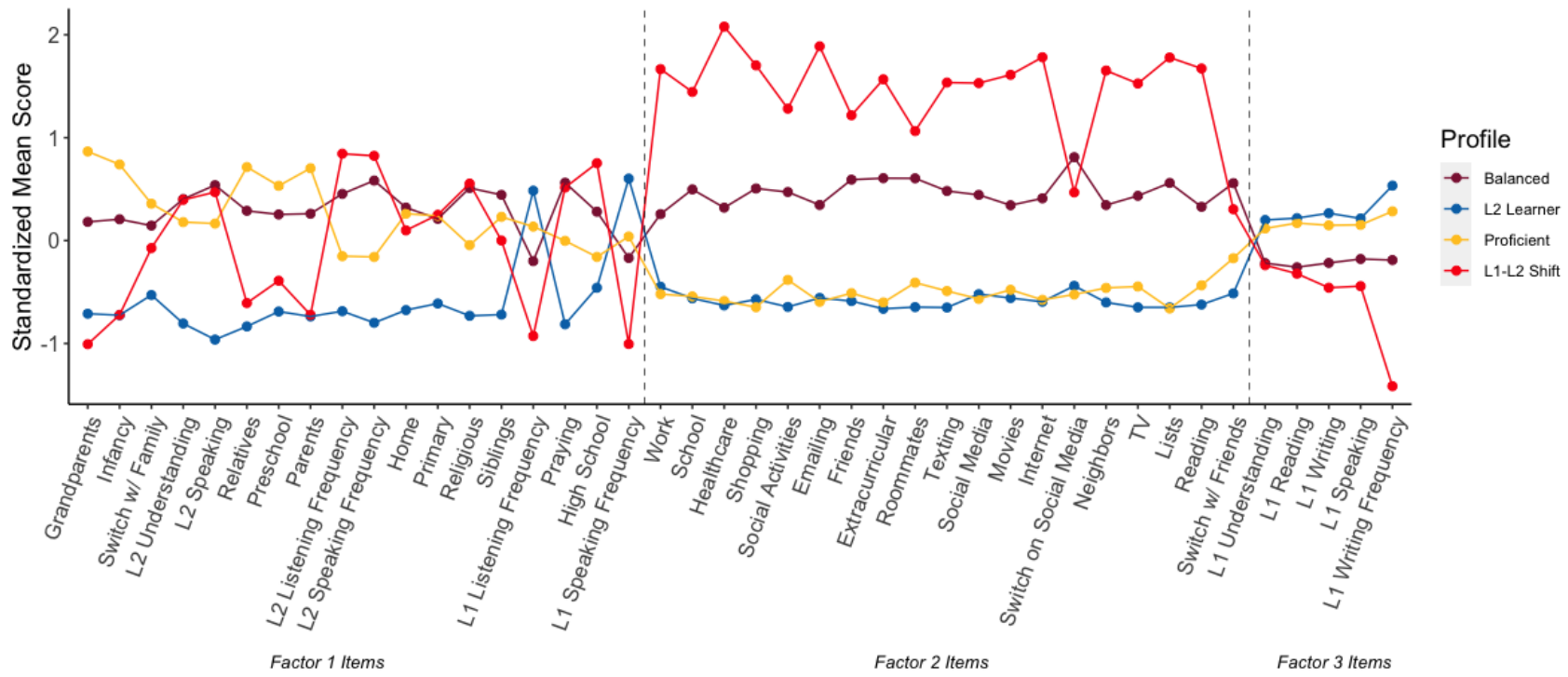


*Figure 4. Standard Mean Estimates for LSBQ Items Grouped by k = 4 Profiles.*

Table 6

*Standard Mean Estimates for LSBQ Items Grouped by Identified k = 4 Profile.*

| | *Profile* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 "Balanced" | | 2 "L2 Learner" | | 3 "Proficient" | | 4 "L1-L2 Shift" | |
| *Item* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* |
| Grandparents | 2.482 | 0.307 | 1.002 | 0.489 | 3.588 | 0.206 | 0.574 | 0.270 |
| Infancy | 2.061 | 0.249 | 0.720 | 0.328 | 2.787 | 0.190 | 0.743 | 0.275 |
| Switch w/ Family | 2.325 | 0.135 | 1.528 | 0.216 | 2.582 | 0.125 | 2.067 | 0.214 |
| L2 Understanding | 9.046 | 0.277 | 6.561 | 0.440 | 8.563 | 0.304 | 9.044 | 0.244 |
| L2 Speaking | 8.973 | 0.251 | 5.793 | 0.434 | 8.237 | 0.311 | 8.896 | 0.237 |
| Relatives | 2.092 | 0.232 | 0.628 | 0.265 | 2.612 | 0.181 | 0.928 | 0.237 |
| Preschool | 1.798 | 0.173 | 0.616 | 0.202 | 2.124 | 0.209 | 1.011 | 0.319 |
| Parents | 2.075 | 0.225 | 0.708 | 0.303 | 2.647 | 0.213 | 0.750 | 0.281 |
| L2 Listening Frequency | 2.583 | 0.156 | 1.524 | 0.103 | 1.997 | 0.100 | 2.919 | 0.180 |
| L2 Speaking Frequency | 2.571 | 0.155 | 1.369 | 0.102 | 1.912 | 0.094 | 2.772 | 0.155 |
| Home | 1.750 | 0.119 | 0.735 | 0.141 | 1.663 | 0.172 | 1.520 | 0.242 |
| Primary | 1.517 | 0.133 | 0.719 | 0.119 | 1.535 | 0.144 | 1.556 | 0.279 |
| Religious | 1.933 | 0.125 | 0.424 | 0.115 | 1.278 | 0.270 | 2.009 | 0.268 |
| Siblings | 1.564 | 0.118 | 0.365 | 0.120 | 1.338 | 0.190 | 1.119 | 0.308 |
| L1 Listening Frequency | 2.952 | 0.140 | 3.455 | 0.076 | 3.198 | 0.087 | 2.413 | 0.165 |
| Praying | 1.942 | 0.154 | 0.197 | 0.102 | 1.203 | 0.270 | 1.905 | 0.271 |
| High School | 1.518 | 0.148 | 0.881 | 0.108 | 1.126 | 0.113 | 1.926 | 0.213 |
| L1 Speaking Frequency | 3.037 | 0.131 | 3.576 | 0.092 | 3.186 | 0.077 | 2.450 | 0.176 |
| Work | 1.361 | 0.181 | 0.579 | 0.123 | 0.496 | 0.129 | 2.924 | 0.226 |
| School | 1.431 | 0.149 | 0.293 | 0.085 | 0.317 | 0.128 | 2.437 | 0.291 |
| Healthcare | 1.355 | 0.218 | 0.159 | 0.061 | 0.209 | 0.114 | 3.585 | 0.151 |
| Shopping | 1.703 | 0.117 | 0.512 | 0.148 | 0.413 | 0.199 | 3.042 | 0.208 |
| Social Activities | 1.629 | 0.127 | 0.518 | 0.139 | 0.792 | 0.195 | 2.444 | 0.204 |
| Emailing | 1.359 | 0.185 | 0.310 | 0.106 | 0.272 | 0.144 | 3.146 | 0.196 |
| Friends | 1.793 | 0.110 | 0.680 | 0.151 | 0.764 | 0.208 | 2.413 | 0.168 |
| Extracurricular | 1.771 | 0.126 | 0.406 | 0.137 | 0.458 | 0.214 | 2.820 | 0.189 |
| Roommates | 1.559 | 0.149 | 0.189 | 0.075 | 0.452 | 0.189 | 2.081 | 0.293 |
| Texting | 1.614 | 0.100 | 0.462 | 0.152 | 0.609 | 0.220 | 2.709 | 0.211 |
| Social Media | 1.527 | 0.134 | 0.558 | 0.146 | 0.515 | 0.208 | 2.635 | 0.152 |
| Movies | 1.664 | 0.161 | 0.703 | 0.177 | 0.784 | 0.178 | 3.042 | 0.163 |
| Internet | 1.518 | 0.177 | 0.398 | 0.143 | 0.421 | 0.174 | 3.030 | 0.159 |
| Switch on Social Media | 2.380 | 0.115 | 0.865 | 0.238 | 0.741 | 0.358 | 1.963 | 0.242 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Neighbors | 1.428 | 0.155 | 0.297 | 0.109 | 0.476 | 0.177 | 3.042 | 0.259 |
| TV | 1.785 | 0.126 | 0.633 | 0.171 | 0.844 | 0.205 | 2.961 | 0.162 |
| Lists | 1.508 | 0.163 | 0.195 | 0.083 | 0.175 | 0.146 | 2.857 | 0.188 |
| Reading | 1.444 | 0.147 | 0.462 | 0.105 | 0.642 | 0.160 | 2.850 | 0.222 |
| Switch w/ Friends | 2.375 | 0.120 | 1.081 | 0.232 | 1.498 | 0.319 | 2.074 | 0.269 |
| L1 Understanding | 9.503 | 0.215 | 9.882 | 0.085 | 9.799 | 0.089 | 9.483 | 0.345 |
| L1 Reading | 9.435 | 0.239 | 9.899 | 0.061 | 9.844 | 0.061 | 9.372 | 0.414 |
| L1 Writing | 9.298 | 0.237 | 9.812 | 0.099 | 9.677 | 0.103 | 9.039 | 0.364 |
| L1 Speaking | 9.503 | 0.216 | 9.864 | 0.074 | 9.799 | 0.068 | 9.261 | 0.413 |
| L1 Writing Frequency | 2.968 | 0.148 | 3.668 | 0.102 | 3.425 | 0.115 | 1.785 | 0.269 |

Table 7

*Fiss Configuration Chart for Southwest U.S. Bilinguals.*

| | *Composite Score* | | | *Profile* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High Cut* | *Low Cut* | | *1 - Balanced* | | | *2 – L2 Learner* | | *3 - Proficient* | | | *4 – L1-L2 Shift* | | |
| *Profile* | - | - | - | ● | ● | ● | ⊗ | | ⊗ | ● | | ● | ● | ⊗ |
| *Factor 1* | ⊗ | ● | ⊗ | ⊗ | | ● | ⊗ | ● | ● | ⊗ | ● | ⊗ | ⊗ | ● |
| *Factor 2* | ⊗ | ● | ● | | ⊗ | ● | | ● | ⊗ | | ● | ⊗ | ● | ● |
| *Factor 3* | ⊗ | ● | ⊗ | | | ● | | ● | | ● | ● | | | ● |
| Consistency | .598 | .994 | .882 | 1.00 | 1.00 | .995 | .974 | .995 | .985 | .925 | .995 | 1.00 | 1.00 | .995 |
| Raw Coverage | .598 | .155 | .031 | .296 | .305 | .131 | .624 | .131 | .136 | .199 | .131 | .120 | .160 | .131 |
| Unique Coverage | - | .139 | .016 | .054 | .059 | .124 | .603 | .109 | .126 | .182 | .104 | .017 | .058 | .131 |
| Solution Consistency | .089 | .975 | | .999 | | | .977 | | .960 | | | .998 | | |
| Solution Coverage | - | .170 | | .482 | | | .734 | | .438 | | | .308 | | |

and both sets had high consistency as well (.994, .882), indicating that these sets often led to the specified low-cut composite score outcome.

The additional fsQCAs were then performed, including information regarding individual profile membership status from the $k = 4$ Model 1 solution, to investigate how different latent profiles may contribute to bilingual identification. Due to the extremely low consistency in the initial high-cut composite score fsQCAs, the low-cut composite score was used for these profile analyses, as opposed to the high-cut criteria in Study One's fsQCAs involving profile membership. Each profile was individually investigated using a crisp definition, as in Study One. Including profile 1 "balanced" membership found three sets for the solution to low-cut composite score membership, with high overall solution consistency (.999) and coverage (.482). The first set only required profile 1 membership and exclusion from Factor 1, while the second set required profile 1 membership and absence of Factor 2. The third set required profile 1 membership as well as the presence of all Factors 1, 2, and 3. The fsQCA for profile 2 "low-proficiency L2 learner" found two sets, and also had high overall solution consistency (.977) and coverage (.734). However, the first set required the exclusion from profile 2 and the absence of Factor 1, while the second set made no assumptions regarding profile membership and required the presence of all three factors. The profile 3 "proficient" bilinguals fsQCA had high solution consistency (.960) and coverage (.438) as seen in the previous profile analyses and resulted in three sets. The first set required exclusion from profile 3 and the absence of Factor 2, but the presence of Factor 1. The second set required membership of profile 3 and the presence of Factor 3 along with the absence of Factor 1. The third set made no assumptions regarding profile membership, but required

the presence of Factors 1, 2, and 3. Finally, the profile 4 "L1-L2 shift" fsQCA solution found three sets and had high overall consistency (.998). The first set required profile 4 membership along with the absence of both Factors 1 and 2, while the second set also required profile 4 membership and Factor 2, but the absence of Factor 1. The third set required exclusion from profile 4 as well as the presence of all Factors 1, 2, and 3.

## Discussion

Study Two found LPA results that differed from those obtained in the sample from Study One, suggesting that there may be additional factors in classifying bilingual subtypes contributing to these differing findings. These results did not fully support the second hypothesis, as an alternative model of bilingual subtypes was identified. While the LPA from Study One supported a $k = 6$ Model 1 solution, Study Two's LSBQ-only LPA supported a $k = 4$ Model 1 solution, and as a result also had different item estimates for each profile, although there does appear to be many similarities between these $k = 4$ profile estimates and several of the previous $k = 6$ estimates. These similarities suggest that while the final models identified are different, it is possible to use latent modeling to quantify the attributes that define bilingual subtypes existing within specific datasets and relate them to quantitatively similar categories between studies.

The $k = 4$ solution for the Southwest U.S. bilingual sample gave item estimates for each profile across the LSBQ that were similar to some of the profiles from the previous $k = 6$ model. Reviewing the item mean standard estimates for both models found similarities between balanced bilinguals, low-proficiency L2 learners, and proficient. While the model from Study One had two additional profiles over the Study Two model, the relative similarities in item mean standard estimates from two separate samples of

bilinguals suggests that both of these models are identifying similar constellations of LSBQ responses that can be used to characterize specific types of bilingual experiences.

The "balanced" bilinguals for both studies had similar item mean standard estimates when comparing Figure 2 with Figure 4. Both profiles had item estimates at or near the mean score of the sample, with items in Factors 1 and 2 slightly above the exact mean indicating an L2 preference, and items in Factor 3 slightly below the mean indicating lower L1 or English use and proficiency. As discussed in Study One, the "balanced" bilingual estimates suggest proficiency in both L1 and L2, but may tend to use slightly more L2 in their daily lives. Particularly for the Study Two "balanced" sample, this provides some insight into how sociopolitical factors may define particular bilingual users, as the Southwest U.S. does not have explicit legal support for non-English languages, thus these Study Two "balanced" bilinguals appear to be able to find communities within this area that allow them to use and practice their non-English languages, despite the English dominance present in the community.

The additional information from the fsQCA (Table 7) as well as the composite score density graph (Figure 3) for the "balanced" profile revealed how the current LSBQ composite score method may be classifying individuals with lower item scores reflecting this L1-L2 balance. The Study Two fsQCA found three sets for "balanced" bilinguals that led to a composite score at least above the low-cut defined in Anderson et al. (2018), wherein the first two required exclusion from Factor 1, L2 home use and proficiency, and Factor 2, L2 social use. Both solutions had perfect consistency, suggesting that for "balanced" bilinguals who fall outside of the middle range of either one of these factors meet Anderson et al.'s (2018) bilingual criteria. Given the profile estimates for this

profile, these findings would suggest that "balanced" bilinguals who meet the composite score criteria are likely scoring higher than the mean in one of these two factors, representing more L2 use in one of these two factors. However, while this may be the case, many of the "balanced" bilinguals do not meet the high-cut bilingual score as seen in Figure 3, even though the mean item estimates and set configurations from the fsQCA for this profile would suggest they likely meet other operationalizations of bilingualism.

Profile 2 "L2 learner" estimates appear very clearly related to "n-ELLs" in Study One, which as previously discussed represent L1 and English language users who have learned or begun to learn a non-English L2 through private study rather than through family or community exposure. Again reviewing Figure 4 and Table 6, "L2 learner" item mean estimates suggest these individuals predominantly use their L1, English, at home and throughout their social life, and have the highest L1 use and proficiency out of the entire sample, while at the same time they have the lowest L2 speaking (5.79) and understanding (6.56) out of the entire sample. Furthermore, Figure 3 shows that the LSBQ composite scores for these individuals is below Anderson et al.'s (2018) high-cut bilingual score and often below even the low-cut score, similar to what was observed in "n-ELLs." The fsQCA for "L2 learners" supports this conclusion, as no configuration that included profile membership was identified as consistently contributing to even the low-cut outcome used for these analyses. Most importantly, the identification of these "L2 learners" in Study Two supports that the previous identification of "n-ELLs" in Study One accurately characterizes a group of low L2 use and proficiency individuals who may not yet be classified as bilinguals.

Another identified group from these analyses was “proficient” bilinguals whose item mean estimates closely resembled the same Study One “proficient” bilinguals. Figure 4 and Figure 2 show both of these profiles as having stronger familial L2 or non-English use including early life use, but a preference towards social L1 or English use, as well as more L1 and English dominance beginning in primary and high school. Of note is that the mean item estimates for both L1 and L2 speaking frequency are near the mean for the sample, with L1 only slightly preferred, indicating responses to these items were similar for both L1 and L2 frequency. Furthermore, this group has higher L1 and English proficiency relative to Study Two’s “balanced” and “L1-L2 shift” bilinguals, supporting the comparison between the two study’s “proficient” bilingual profiles. As discussed in Study One, “proficient” individuals are likely those who were exposed to two languages early in their life but whose family predominantly spoke a non-English language, as explained by the early developmental and familial preference towards non-English. However, by growing up in a predominantly English sociocultural environment particularly in the U.S. schooling system where English is the language of instruction, a stronger L1 or English proficiency and preference developed over time.

While the profile 4 “L1-L2 shift” estimates were not as readily identified as resembling any one profile from Study One, the estimates do appear to match a more extreme version of the earlier discussed “proficient” bilinguals as well as the same observed shift seen in previous bilingual literature (Kohnert & Bates, 2002). The “L1-L2 shift” item estimates also suggest strong early and developmental L1 use and exposure as seen in “proficient” bilinguals, and particularly with non-sibling family members, but over time a clear preference towards L2 social use and low L1 frequency and proficiency

developed in their daily lives. As in "proficient" bilinguals, this L1 towards L2 shift appears to coincide with entry into the U.S. schooling system, as the preference towards L2 language use begins by primary school and is pronounced by high school. However, the profiles differ mainly in the characterization of L1 and L2 as defined by the participants in their responses. It appears the "proficient" bilinguals consider their English and non-English languages as L1 and L2 respectively, suggesting they experienced simultaneous acquisition of both. The "L1-L2 shift" members consider their non-English language as their L1 and English as an L2, and the shift towards L2 use and proficiency is more drastic than seen in "proficient" bilingual estimates. All of the items in Factor 2, L2 social use, have the highest mean estimates of any profile in this model, while Factor 3, L1 proficiency, are the lowest estimates. These estimates appear to also describe a bilingual experience where an individual grows up speaking and being exposed to a family L1 that differed from the cultural L2, and over time the L2 became dominant while the L1 was likely not supported outside of limited family use and exposure. Further review of the individuals identified as "L1-L2 shift" members confirmed that all but one of these individuals listed English as their L2 and began learning a non-English language as their first language, suggesting that this feature can be used to define the profile. While "proficient" bilingual estimates suggest individuals in that profile maintained both of their languages, likely due to the early or simultaneous L1 and L2 exposure from their family, "L1-L2 shift" estimates suggest that these individuals did not get the same dual-language support and the non-English L2 dominance over their L1 became significantly pronounced. It may be that "proficient" bilingual family members also have semi-proficient or fully proficient L1 and L2 abilities, thus providing

a developmental environment that is more representative of a simultaneous bilingual experience even though the L2, a non-English language, is not an officially supported language in the Southwest U.S. On the other hand, the "L1-L2 shift" family members may not have been able to support this dual-language L1 and L2 environment, or actively encouraged the "L1-L2 shift" individuals to practice only their L2, or the "L1-L2 shift" individual may have developed their own personal preference towards L2 use. In any of these cases, L1 speaking and proficiency atrophied over time while the L2 became dominant outside of limited familial and at-home use

While the language practices of both "proficient" and "L1-L2 shift" profiles match particular bilingual experiences discussed in the literature, Figure 3 actually suggests that the LSBQ composite score may be characterizing many of these "proficient" members as "not strongly differentiated," despite the earlier discussed bilingual proficiency seen in their item estimates. Furthermore, "L1-L2 shift" bilinguals may be more "polarized" in their language use, contributing to a higher LSBQ composite score than the more distributed use seen in "proficient" bilinguals. The fsQCAs for both of these related profiles further reveal how their language uses and practices contribute to these composite score differences. The fsQCA solution for "proficient" bilinguals was comprised of three sets, but only included one that specifically required the profile membership, along with the absence of Factor 1 and the presence of Factor 3. In considering the mean item estimates and the composite density graph for this profile along with this particular configuration, it is likely that the configuration represents those individuals who had higher L2 home use and proficiency, paired with L1 social use and average L1 proficiency, thus meeting the LSBQ composite score criteria. While this may

be the only configuration identified as meeting the LSBQ bilingual criteria, it is important to note that based on the L1 and L2 estimates displayed throughout this identified profile, it is likely these individuals would meet many researcher's bilingual criteria, supporting the need for considering additional factors when making decisions about bilingual status. It is possible that by using the information from this model, including these profile estimates, individuals who were previously categorized in the "not strongly differentiated" group on the LSBQ composite score could be identified as meeting these "proficient" criteria, and be defined as sufficiently bilingual.

The fsQCA for "L1-L2 shift" also found three sets for its solution, but two involved explicit profile membership, while the third actually required exclusion from the profile. The first set required profile membership as well as the absence of both Factors 1 and 2, while the second set required profile membership and the absence of Factor 1, but the presence of Factor 2. Again, using these configurations in tandem with the mean item estimates and the composite density graph, it appears the LSBQ is characterizing these individuals with "polarized" language use and experience as sufficiently bilingual more often than those "proficient" individuals who might have more balanced overall language use. Rather than relying strictly on composite score outcomes, it may be prudent to match responses to one of these identified profiles based on their responses and categorize them as such. While both profiles have experience using an L1 and L2, the early developmental experience and support as well as individual differences in identification with these languages appears to greatly impact their LSBQ composite score outcomes and labeling as bilingual through that measure.

One limitation to these data is that the LSBQ was intentionally administered using a "language neutral" Likert scale approach that compared L1 to L2 use rather than specifically English versus non-English as was done in Study One. While participant responses can be converted to match the values participants would have chosen had the scales been identically English versus non-English, it is possible that by presenting responses in this systematically language contrasting manner could alter individual responses due to the perception of seeing "non-English" or similar wording, rather than seeing the language they identify as speaking (Ramirez-Esparza et al., 2006). Additionally, by converting the scores to reflect this manner of scaling, repeating the LPA does not guarantee identifying participants to the same profiles in either of the LPAs. This is a reflection of the purely data-driven nature of LPA, in that it uses response variables and latent structures within these data directly to map potential profiles, rather than necessarily "understanding" what responses reflect in real world practice. Reviewing the selected $k = 4$ Model 1 solution for the LPA, converting the participant responses to force an "English versus non-English" comparison, and again fitting the same $k = 4$ model results in different $n$ per $k$ profiles, and the members of groups previously identified are not necessarily assigned to the same group in this new analysis. Given that the purpose of this study is to identify a more universally applicable approach to identifying and characterizing bilingualism, an L1 versus L2 comparison may be more apt for these purposes and future research, particularly if the LSBQ is administered to subjects who do not speak English as their L1 or L2.

Additionally, as in Study One this version of the LSBQ included several frequency of language use items that only considered a participant's language one at a

time, allowing for participants to interpret and respond to these questions in varying manners. Due to this wording, one cannot know which participants who may have responded to using "only their L1" and "only their L2" both with a 4, "All of the time," would have identical real world frequency of language use to other participants who interpreted these questions as a maximum proportion of 100%, and thus would have responded to these items with a score of 2, in line with this alternative interpretation. Furthermore, because LPA is data driven and considers only the actual response values, it could easily attempt to characterize participants with these different responses as fitting different profiles, even if they may have the same or nearly the same bilingual experiences. The resulting LPA model profile estimates could be influenced by these discrepancies as well, raising or lowering the mean L1 and L2 frequency scores due to these alternative interpretations. Reviewing Figure 4 and Table 6, it does appear that no identified profile has above or below average frequency of listening or speaking for both the L1 and L2, suggesting that differences in interpretations or responses may not be apparent in the LPA, leaving it unknown if these profile estimates are influenced by differences in interpretation, or if subjects largely considered and responded to these items similarly.

## Study Three

Study Three uses the information from the LSBQ with several reworked items in tandem with supplementary questionnaires designed to measure participants' identifications with their language's cultures, acculturation, perceptions of biculturalism, and self-esteem and self-efficacy. As previously discussed, several items in the current LSBQ allow for multiple interpretations including impossible combinations for frequency

of language use. This study investigates the additional items that were included following participant completion of the original LSBQ and requires participants to respond using a single interpretation of their frequency of language use. This study also investigates subjective associations with bilingualism, particularly identification with an individual's sociolinguistic cultures, perceptions of biculturalism, acculturation, and reported self-esteem. Each of these have previously been linked to bilingualism as influenced by language use practices, individual proficiency, or mainstream cultural assumptions of the languages (Chen & Bond, 2010; Lee, 2008; West et al., 2017; Zhang et al., 2013). Using the LSBQ with reworked items and the supplementary questionnaires, the LPA is repeated as in the previous studies, and once again the resulting profile estimates are characterized to describe the bilingual subtypes identified and compared to previous latent models. The fsQCA is then used to identify the sets of conditions in the supplementary conditions alone that contributed to bilingual classification and profile membership. Finally, a set of regressions are performed to answer whether individuals' identification with their linguistic cultures, quantified biculturalism and acculturation, or self-esteem predict bilingual status and profile membership.

## Methods

### Participants

Study Three used the same sample from Study Two, $n$ = 208 bilinguals from the Southwest U.S. All data for both studies was completed online during the same session for each participant following informed consent.

**Measures**

The majority of the original LSBQ items were included, but several of the original language-specific frequency questions were removed from the analyses in this study in favor of an alternative overall frequency questions. These additional "overall language use" questions were added to the end of the LSBQ survey, after participants had completed the LSBQ as it was originally written (Appendix B). These questions asked participants, "On a typical day, approximately how much time do you spend in each of your languages for the following activities?" The activities asked about in this scale were "Speaking to other people," "Listening to other people," "Reading," "Writing," and "Thinking to myself." Responses were on a 5-point Likert scale, including "Only [the participant's L1]," "Mostly [the L1]," "Both [L1] and [L2] equally," "Mostly [the L2]," and "Only [the L2]." This question was designed to address the earlier discussed issue regarding how uncertainty in how individuals consider the frequency of their language use. By using this particular scale for responses, it requires participants to consider the amount of time spent using each of their languages as it adds up to a maximum of 100% of the time in that particular activity. In addition to this, participants are also asked to describe the frequency with which they "think" in each of their languages. Research has previously found differences in private speech between language dominant groups, reflecting their internal thoughts and demonstrating differences in their interpersonal and intrapersonal. All other questions from the original LSBQ remained unchanged in these analyses. Supplemental questions include information on self-perceptions about their language use, identification with bilingualism and the cultures of their languages, as well as their perceptions of their self-esteem. Each of these supplemental sections was adapted

from previous research surveys, including the Language Efficacy and Acceptance Dimensions Scale (LEADS; Neugebauer, 2011) the Short Acculturation Scale (SAS; Marin, Sabogal, VanOss Marin, Otero-Sabogal, & Perez-Stable, 1987), the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1989), and the Multicultural Identity Integration Scale (MULTIIS; Yampolsky, Amiot, & De La Sablonnière, 2016).

The LEADS was scored separately for each of a participant's stated L1 and L2, reversing the numbering of all negatively valanced question, and then calculating a mean for the two languages. A higher score on the LEADS indicates more positive beliefs towards an individual's language, including more acceptance of the language and its associated culture, stronger belief in one's competency using the language, and more comfort in speaking the language around others (Neugebauer, 2011). The SAS was also scored as a calculated average of a participant's responses on a Likert scale, with higher mean scores associated with higher feelings of perceived acculturation from the L1 (Marin et al., 1987). The RSES was scored as a total sum of a participant's responses to each question on the questionnaire, with negatively valanced questions being reverse scored. Higher total on the RSES are then associated with more feelings of self-efficacy and self-confidence (Rosenberg, 1989). The MULTIIS questionnaire contained items from three different facets of multilingual identification; "categorization" pertaining to an individual's identification with one cultural group over another by viewing one as predominant, "compartmentalization" defined as an individual having multiple but uniquely separate and temporally distinct cultural identities, and "integration" wherein an individual's multiple cultural identities are considered cohesive and connected into a unified internal pattern (Yampolsky et al., 2016). Bilinguals with high bicultural identity

integration would have higher scores on the integration component and lower compartmentalization and categorization scores, reflecting a higher degree of assimilation toward the mainstream culture while maintaining a strong heritage identity, including viewing these two identities as compatible or overlapping (West et al., 2017). Alternatively, higher compartmentalization or categorization scores would indicate an internal sense of conflict or separation between the bicultural individual's languages and cultures. Each of these areas are separated into their own subscale of the MULTIIS, and scoring is completed with a separate mean for each section.

## Results

### Latent Profile Analysis

Additional LPAs were performed on participant responses to the reworked LSBQ with the inclusion of the LEADS, SAS, RSES, and MULTIIS supplementary questionnaire scores to investigate the relationship with cultural identification and reported self-esteem. 38 of the original LSBQ items were included, but the language-specific frequency questions were omitted, while "language neutral" overall frequency questions were included instead. For the supplementary measures, the LEADS was scored for participants' L1 and L2 separately, average SAS rating, RSES sums, and the MULTIIS component scores for Categorization, Compartmentalization, and Integration.

As in the previous LPA investigations, analyses attempted to fit 30 models to these data, following the same parameters including fitting a range of *k* from 1 to 10 and three different model types. Resulting models are compared using the same fit statistics as before, including the BIC, C-AIC, SABIC, BLRT, and entropy. The results of these

Table 8

*Fit Statistics of Latent Profile Analyses for Southwest U.S. Bilingual Data with Additional Supplementary Questionnaires.*

| *Classes* | *Model* | *BIC* | *CAIC* | *SABIC* | *BLRT* | *BLRT p* | *Entropy* | *-2LL* | *AIC* | *AWE* | *CLC* | *KIC* | *ICL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 31568.86 | 31666.86 | 31258.34 | - | - | 1.000 | -15522.888 | 31241.78 | 32383.93 | 31047.78 | 31342.78 | -31568.86 |
| | 3 | 27649.53 | 28923.53 | 23612.88 | - | - | 1.000 | -10424.752 | 23397.50 | 38269.55 | 20851.50 | 24674.50 | -27649.53 |
| | 6 | 27649.53 | 28923.53 | 23612.88 | - | - | 1.000 | -10424.752 | 23397.50 | 38269.55 | 20851.50 | 24674.50 | -27649.53 |
| 2 | 1 | 28679.21 | 28827.21 | 28210.28 | 3156.518 | <0.01 | 0.992 | -13944.629 | 28185.26 | 29911.19 | 27891.24 | 28336.26 | -28679.84 |
| | 3 | 27812.92 | 29136.92 | 23617.85 | 103.484 | 0.485 | 0.985 | -10373.010 | 23394.02 | 38849.85 | 20747.99 | 24721.02 | -27814.15 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 3 | 1 | 27752.40 | 27950.40 | 27125.04 | 1193.688 | <0.01 | 0.976 | -13347.785 | 27091.57 | 29401.28 | 26697.52 | 27292.57 | -27757.80 |
| | 3 | 27999.70 | 29373.70 | 23646.20 | 80.098 | <0.001 | 0.989 | -10332.961 | 23413.92 | 39453.50 | 20667.90 | 24790.92 | -28001.84 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 4 | 1 | 27247.94 | 27495.94 | 26462.15 | 771.344 | <0.001 | 0.983 | -12962.113 | 26420.23 | 29313.68 | 25926.19 | 26671.23 | -27252.22 |
| | 3 | 28161.21 | 29585.21 | 23649.29 | 105.368 | <0.001 | 0.993 | -10280.277 | 23408.55 | 40031.88 | 20562.54 | 24835.55 | -28162.17 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 5 | 1 | 27185.25 | 27483.25 | 26241.04 | 329.340 | <0.001 | 0.985 | -12797.330 | 26190.66 | 29667.86 | 25596.63 | 26491.66 | -27189.82 |
| | 3 | 28232.20 | 29706.20 | 23561.85 | 196.554 | <0.001 | 0.994 | -10182.335 | 23312.67 | 40519.74 | 20366.66 | 24789.67 | -28233.35 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 6 | 1 | 27315.58 | 27663.58 | 26212.95 | 136.546 | <0.001 | 0.987 | -12729.057 | 26154.12 | 30215.07 | 25460.09 | 26505.12 | -27319.62 |
| | 3 | 28306.02 | 29830.02 | 23477.25 | 192.392 | <0.001 | 0.995 | -10085.804 | 23219.61 | 41010.44 | 20173.60 | 24746.61 | -28307.87 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 7 | 1 | 27522.36 | 27920.36 | 26261.31 | 60.090 | <0.001 | 0.988 | -12699.012 | 26194.02 | 30838.73 | 25400.00 | 26595.02 | -27526.65 |
| | 3 | 28392.89 | 29966.89 | 23405.69 | 180.006 | <0.001 | 0.997 | -9995.801 | 23139.60 | 41514.18 | 19993.60 | 24716.60 | -28393.34 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 8 | 1 | 27654.58 | 28102.58 | 26235.10 | 134.660 | <0.001 | 0.989 | -12631.682 | 26159.36 | 31387.82 | 25265.34 | 26610.36 | -27658.64 |
| | 3 | 28554.53 | 30178.53 | 23408.91 | 105.232 | <0.001 | 0.997 | -9943.185 | 23134.37 | 42092.70 | 19888.36 | 24761.37 | -28554.97 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 9 | 1 | 27313.58 | 27811.58 | 25735.68 | 607.874 | <0.001 | 0.991 | -12327.745 | 25651.49 | 31463.70 | 24657.47 | 26152.49 | -27316.73 |
| | 3 | 28697.54 | 30371.54 | 23393.50 | 123.866 | <0.001 | 0.998 | -9881.252 | 23110.50 | 42652.59 | 19764.50 | 24787.50 | -28697.95 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 10 | 1 | 27489.61 | 28037.61 | 25753.28 | 90.850 | <0.001 | 0.991 | -12282.320 | 25660.64 | 32056.60 | 24566.62 | 26211.64 | -27492.81 |
| | 3 | 28835.93 | 30559.93 | 23373.46 | 128.494 | <0.001 | 0.998 | -9817.005 | 23082.01 | 43207.85 | 19636.01 | 24809.01 | -28836.34 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |

analyses and accompanying fit statistics can be found in Table 8. However, given the results of the previous attempts to fit the LSBQ alternative criteria were also considered, including minimum *n* per *k* profile identified, Mahalanobis' *D*, and overall parsimony of the model solution. Of the 30 models that were attempted to be fit, 21 successfully. As in the previous LPA investigations, attempts to fit a model using a Model 6 solution regularly failed to converge, although the present investigation failed above all $k > 1$ whereas previously a $k = 2$ profile was able to be fit using a Model 6 configuration. Furthermore, for all Model 3 configurations with $k > 3$ and Model 1 configurations with $k > 4$, solutions resulted in at least one *k* class with 1 or fewer participants identified to the class, suggesting these solutions are not suitable given the data. Following these initial criteria, 8 successfully converged models with sufficient *n* per *k* class were identified for further consideration.

The lowest BIC (27,247.25) and C-AIC (27,495.94) values were found in the $k = 4$ Model 1 solution. The SABIC favored a $k = 1$ Model 3 or Model 6 (23,612.88) solution, with $k = 2$, 3, and 4 (23,617.85; 23,646.20; 23,649.29) Model 3 solutions slightly less preferred than $k = 1$ model. The BLRT was not significant between a $k = 1$ and $k = 2$ Model 3 solution (103.48, $p = 0.485$), suggesting that Model 3 solutions may best be fit by a $k = 1$ enumerated model. The BLRT was significant in all successfully converged Model 1 solutions, providing further support for use of Model 1 over alternative configurations.

On further review of the $k = 4$ Model 1 solution, the BIC and C-AIC preferred option, it was found that while no profile had fewer than 1% of individuals assigned to membership, one *k* profile was comprised of only 9 of 208 possible individuals,

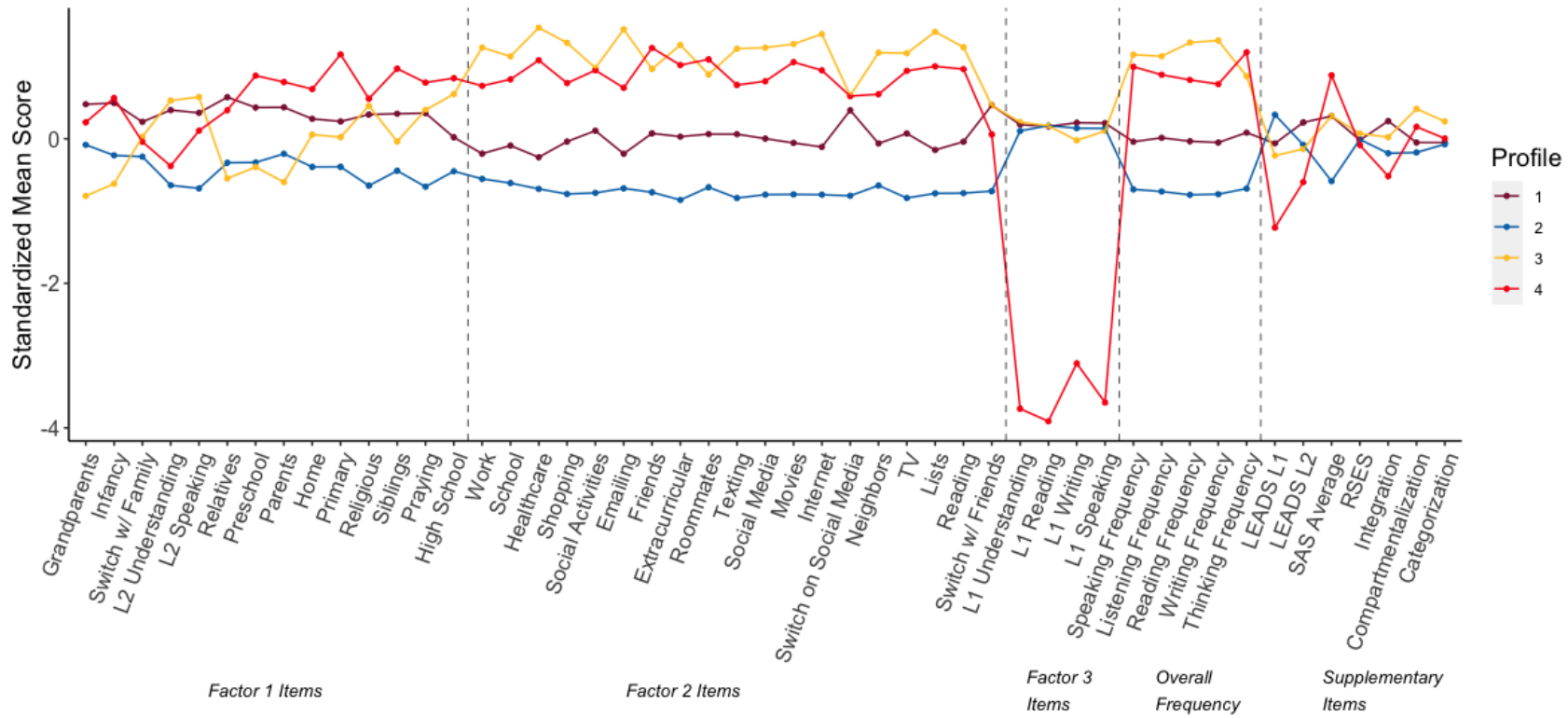


*Figure 5. Mean Standard Estimates for LSBQ Items and Supplementary Questionnaire for k = 4 Profiles.*

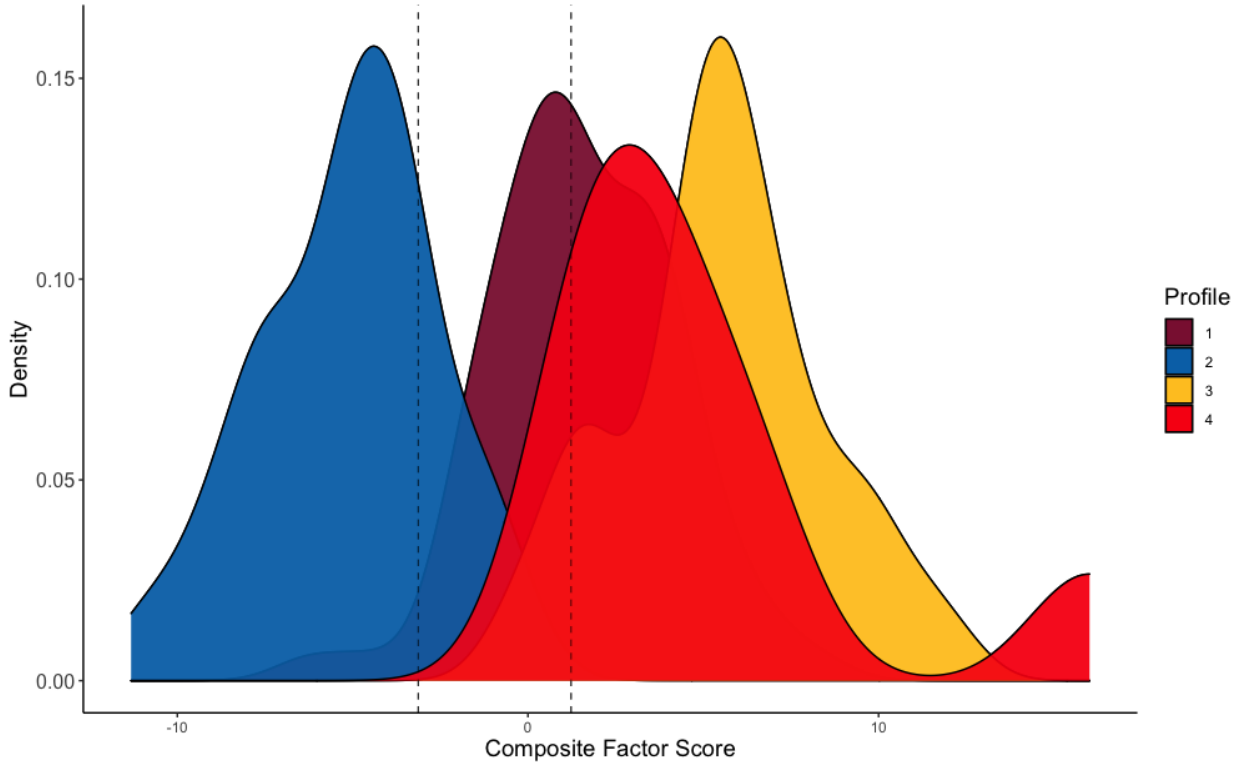


*Figure 6. Density Graph of LSBQ Composite Scores Grouped by Identified Latent Profiles for Model k = 4.*

representing less than 5% of the total sample. Furthermore, comparing the item mean standard estimates for each profile showed that this low *n* profile starkly diverged from the other profile estimates by nearly 4 standard deviations in their reported L1 abilities for speaking, understanding, reading, and writing, shown in Figure 5. While the estimates for the other 3 profiles was between 8 and 10 out of 10 for L1 proficiencies, this particular profile had estimates closer to 6 for the same items. However, the estimates for this profile may have been heavily influenced by just 2 individuals who reported low L1 abilities, between 4 and 6, while other members in this profile scored more similarly to the rest of the sample, between 7 and 9. Additionally, there was significant overlap in the LSBQ composite score estimates for these profiles (Figure 6), suggesting these profiles may be less clearly delineated when considering bilingualism through a composite score. Reviewing the $k = 3$ Model 1 profile assignments indicated that these 9 individuals from the profile in the alternative $k = 4$ solution were still grouped similarly but did not adversely impact the item estimates for any identified profile seen in Figure 7 and listed in Table 9, thus providing support for the $k = 3$ Model 1 solution over other *k* solutions. Furthermore, while there was still overlap in the LSBQ composite score for these profiles (Figure 8), there appears to be slightly better separation in the composite score estimates for each profile, suggesting these estimated profiles may be better characterized by the LSBQ composite scoring. The item estimates for this $k = 3$ Model 1 solution (Table 9) suggest the resulting profiles may be classified as another "balanced" bilingual profile, an "L2 learner" profile, and an "L1-L2 shift" profile, each of which have been previously observed in these data, providing further support for selecting these parameters for a final model.

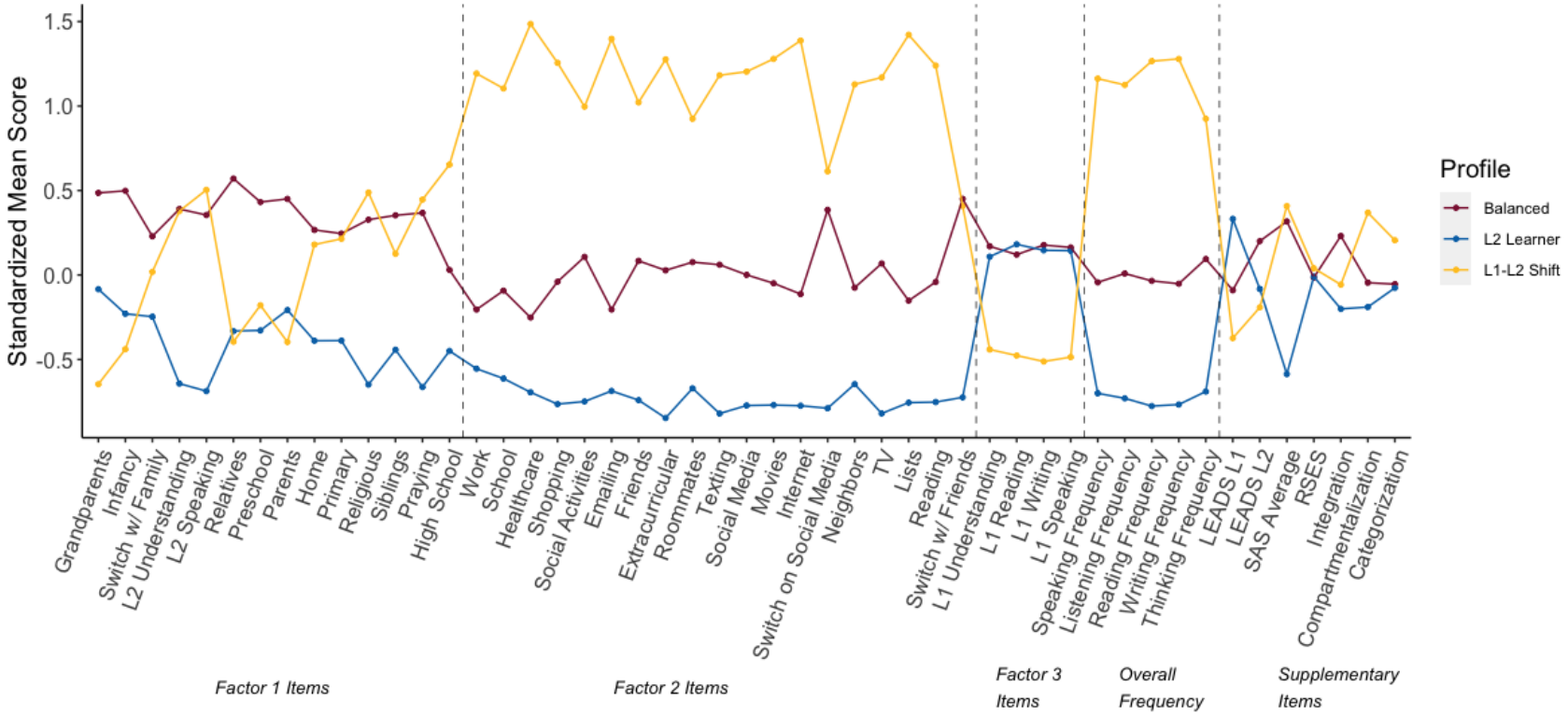


*Figure 7. Mean Standard Estimates for LSBQ Items and Supplementary Questionnaire for k = 3 Profiles.*

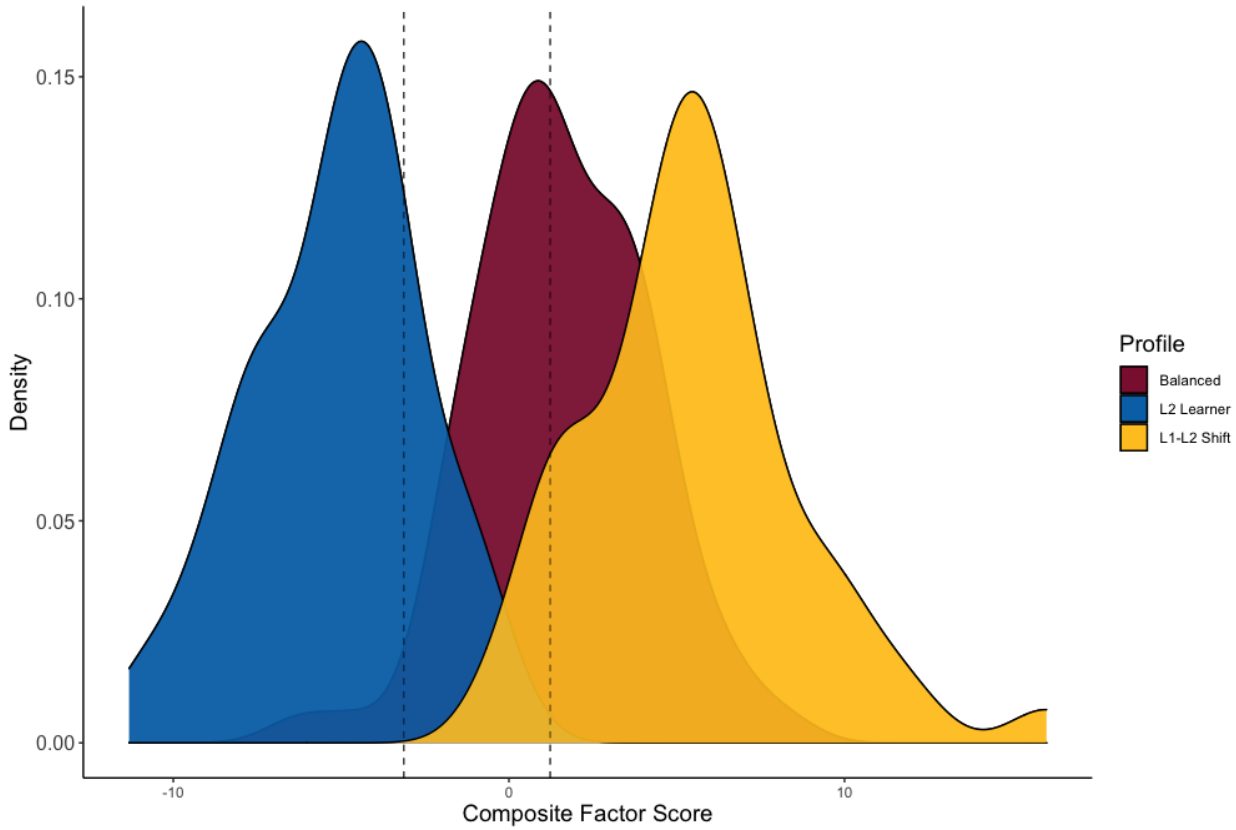


*Figure 8. Density Graph of LSBQ Composite Scores Grouped by Identified Latent Profile for Model k = 3.*

Table 9

*Standard Mean Estimates for LSBQ and Supplementary Items Grouped by k = 3 Profile.*

| | *Profile* | | | | | |
|---|---|---|---|---|---|---|
| | 1 – "Balanced" | | 2 – "L2 Learner" | | 3 – "L1-L2 Shift" | |
| *Item* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* |
| Grandparents | 2.964 | 0.261 | 2.078 | 0.249 | 1.140 | 0.229 |
| Infancy | 2.446 | 0.228 | 1.470 | 0.223 | 1.140 | 0.189 |
| Switch w/ Family | 2.407 | 0.156 | 1.899 | 0.180 | 2.180 | 0.159 |
| L2 Understanding | 9.025 | 0.216 | 6.933 | 0.280 | 9.000 | 0.243 |
| L2 Speaking | 8.652 | 0.263 | 6.408 | 0.250 | 8.960 | 0.218 |
| Relatives | 2.449 | 0.207 | 1.302 | 0.173 | 1.200 | 0.167 |
| Preschool | 2.006 | 0.188 | 1.099 | 0.178 | 1.260 | 0.176 |
| Parents | 2.317 | 0.219 | 1.459 | 0.193 | 1.180 | 0.212 |
| Home | 1.683 | 0.138 | 1.041 | 0.121 | 1.600 | 0.161 |
| Primary | 1.546 | 0.131 | 0.950 | 0.117 | 1.520 | 0.157 |
| Religious | 1.736 | 0.160 | 0.548 | 0.125 | 1.920 | 0.137 |
| Siblings | 1.490 | 0.135 | 0.653 | 0.118 | 1.240 | 0.163 |
| Praying | 1.717 | 0.165 | 0.390 | 0.130 | 1.800 | 0.167 |
| High School | 1.287 | 0.093 | 0.904 | 0.084 | 1.840 | 0.132 |
| Work | 0.847 | 0.108 | 0.471 | 0.099 | 2.400 | 0.158 |
| School | 0.801 | 0.108 | 0.251 | 0.059 | 2.080 | 0.163 |
| Healthcare | 0.650 | 0.115 | 0.074 | 0.033 | 2.840 | 0.171 |
| Shopping | 1.108 | 0.105 | 0.301 | 0.072 | 2.540 | 0.156 |
| Social Activities | 1.278 | 0.098 | 0.435 | 0.096 | 2.160 | 0.132 |
| Emailing | 0.740 | 0.114 | 0.161 | 0.061 | 2.580 | 0.161 |
| Friends | 1.338 | 0.097 | 0.539 | 0.088 | 2.220 | 0.111 |
| Extracurricular | 1.158 | 0.113 | 0.213 | 0.076 | 2.500 | 0.125 |
| Roommates | 1.000 | 0.123 | 0.168 | 0.052 | 1.920 | 0.176 |
| Texting | 1.202 | 0.106 | 0.283 | 0.077 | 2.340 | 0.128 |
| Social Media | 1.104 | 0.114 | 0.304 | 0.080 | 2.300 | 0.134 |
| Movies | 1.259 | 0.083 | 0.478 | 0.096 | 2.680 | 0.141 |
| Internet | 0.947 | 0.103 | 0.208 | 0.057 | 2.600 | 0.135 |
| Switch on Social Media | 1.879 | 0.155 | 0.443 | 0.123 | 2.140 | 0.155 |
| Neighbors | 0.947 | 0.109 | 0.246 | 0.075 | 2.400 | 0.214 |
| TV | 1.406 | 0.073 | 0.459 | 0.090 | 2.580 | 0.134 |
| Lists | 0.749 | 0.118 | 0.077 | 0.038 | 2.460 | 0.131 |
| Reading | 1.068 | 0.086 | 0.328 | 0.074 | 2.400 | 0.165 |
| Switch w/ Friends | 2.242 | 0.118 | 0.865 | 0.153 | 2.200 | 0.140 |
| L1 Understanding | 9.847 | 0.094 | 9.798 | 0.061 | 9.300 | 0.228 |
| L1 Reading | 9.797 | 0.108 | 9.861 | 0.046 | 9.220 | 0.258 |
| L1 Writing | 9.706 | 0.127 | 9.686 | 0.075 | 8.980 | 0.254 |

| | | | | | | |
|---|---|---|---|---|---|---|
| L1 Speaking | 9.806 | 0.099 | 9.801 | 0.052 | 9.220 | 0.233 |
| Overall Speaking Frequency | 1.236 | 0.084 | 0.627 | 0.090 | 2.380 | 0.134 |
| Overall Listening Frequency | 1.350 | 0.095 | 0.628 | 0.095 | 2.460 | 0.129 |
| Overall Read Frequency | 1.072 | 0.109 | 0.248 | 0.061 | 2.500 | 0.154 |
| Overall Writing Frequency | 0.987 | 0.114 | 0.169 | 0.061 | 2.480 | 0.156 |
| Overall Thinking Frequency | 1.243 | 0.120 | 0.431 | 0.081 | 2.060 | 0.115 |
| LEADS L1 | 2.306 | 0.048 | 2.418 | 0.022 | 2.230 | 0.042 |
| LEADS L2 | 3.092 | 0.156 | 2.817 | 0.124 | 2.685 | 0.158 |
| SAS Average | 2.707 | 0.103 | 2.043 | 0.089 | 2.787 | 0.099 |
| RSES | 38.696 | 0.699 | 38.709 | 0.616 | 38.961 | 0.522 |
| MULTIIS Integration | 3.690 | 0.104 | 3.340 | 0.102 | 3.450 | 0.109 |
| MULTIIS Compartmentalization | 2.540 | 0.119 | 2.397 | 0.105 | 2.924 | 0.127 |
| MULTIIS Categorization | 2.876 | 0.146 | 2.814 | 0.131 | 3.125 | 0.124 |

**Fuzzy-Set Qualitative Comparative Analysis**

These analyses investigated the contribution of only the supplementary items towards the high-cut and low-cut composite score, as well as to the identification and characterization of profile membership in the $k = 3$ Model 1 from the earlier LSBQ and supplementary questionnaire LPA results. As the LSBQ Factor items had been investigated in the previous section, these analyses were only concerned with those sets comprised of the supplementary questionnaires, information from the $k = 3$ Model 1 LPA solution, and composite score identification in the LSBQ. In order to generate the necessary truth table, all supplementary item scores were scaled using a logit scale for fuzzy membership, with higher scores in each coded to a higher degree of membership. The results of all fsQCAs are found in Table 10.

A first fsQCA was performed, identifying two sets of conditions in the supplementary questionnaires that resulted in a high-cut composite score with relatively high overall solution consistency of .729, but low solution coverage of only .087. The first set necessitated membership for the LEADS L2, SAS, and RSES, and the exclusion from LEADS L1 as well as all three components of the MULTIIS, including categorization, compartmentalization, and integration. This set had a consistency score of .701, and a unique coverage score of only .036. The second set require the exclusion from both the LEADS L1 and L2 as well as the categorization and integration sections of the MULTIIS, but membership within the compartmentalization section as well as within the SAS and RSES, resulting in a consistency score of .745 with unique coverage of .015.

The second fsQCA identified the sets of conditions sufficient and necessary for a low-cut composite score, finding five sets in total with an overall solution consistency of

Table 10

*Fiss Configuration for Southwest U.S. Bilinguals Including Supplementary Questionnaire Data.*

| | *Composite score* | | | | | | | *Profile* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High cut* | | *Low cut* | | | | | *1 - Balanced* | *2 – L2 Learner* | *3 – L1-L2 Shift* | | |
| *LEADS L1* | ⊗ | ⊗ | ● | | ⊗ | ⊗ | ⊗ | ● | ● | ⊗ | ⊗ | ⊗ |
| *LEADS L2* | ● | ⊗ | ● | ● | ● | ● | ⊗ | ● | ⊗ | ● | ● | ⊗ |
| *SAS* | ● | ● | ● | ● | ● | ⊗ | ● | ● | ⊗ | ● | ● | ● |
| *RSES* | ● | ● | ● | ● | ● | ● | ● | ● | | | | |
| *Categorization* | ⊗ | ⊗ | ● | ● | | ⊗ | ⊗ | ⊗ | ● | ● | ⊗ | ⊗ |
| *Compartmentalization* | ⊗ | ● | | | ⊗ | ● | ● | ⊗ | ⊗ | ● | ⊗ | ● |
| *Integration* | ⊗ | ⊗ | ● | ⊗ | ⊗ | ⊗ | ⊗ | ● | | ⊗ | ⊗ | ⊗ |
| Consistency | .701 | .745 | .948 | .927 | .910 | .909 | .926 | .602 | .620 | .609 | .606 | .653 |
| Raw Coverage | .072 | .051 | .082 | .041 | .057 | .056 | .038 | .155 | .063 | .050 | .115 | .082 |
| Unique Coverage | .036 | .015 | .057 | .013 | .016 | .019 | .008 | - | - | .013 | .039 | .012 |
| Solution Consistency | .729 | | .936 | | | | | .602 | .620 | .606 | | |
| Solution Coverage | .087 | | .163 | | | | | .155 | .063 | .143 | | |

.936, with an overall sample coverage of .163. The first set required membership in the LEADS L1 and L2, SAS, RSES, as well as the integration and categorization components of the MULTIIS, with a set consistency of .948. The second set required individual membership of the LEADS L2, SAS, RSES, and the categorization subsection of the MULTIIS, as well as exclusion from the integration subsection, for a set consistency score of .927. A third configuration involved the exclusion from the LEADS L1 and the integration and compartmentalization components of the MULTIIS, with membership within the LEADS L2, SAS, and RSES items, for a set consistency of .910. The fourth configuration was comprised of membership for the LEADS L2, RSES, and compartmentalization subsets, as well as exclusion from the LEADS L1, SAS, categorization, and integration subsets, yielding a set consistency score of .909. The final fifth set was similar, but required exclusion from both the LEADS L1 and L2, exclusion from both the categorization and integration components, but membership within the compartmentalization section as well as within the SAS and RSES, resulting in a set consistency score of .926.

The fsQCAs for the contributions of the supplementary questionnaires to each of the identified $k = 3$ Model 1 profiles considered profile membership as the outcomes without additional composite score information. This outcome was selected to investigate the roles of cultural identity, biculturalism, and self-esteem in bilingual classification. The first of these fsQCAs investigated this relationship for profile 1 “balanced” bilingual membership and found only one set of conditions for a solution consistency of .602 and coverage of .155. This set required membership for all of LEADS L1 and L2, SAS, RSES, and the integration component of the MULTIIS, but exclusion from the

categorization and compartmentalization subsections. The second fsQCA found only one set of conditions for the solution to the "L2 learner" profile outcome, with an overall consistency score of .620 and coverage of only .063. This configuration included membership in the LEADS L1 and categorization subsections only, along with exclusion from the LEADS L2, SAS, and compartmentalization subsections. The final fsQCA for "L1-L2 shift" membership found three sets of conditions for its solution, with an overall consistency score of .606 and solution coverage of .143. The first of these sets required membership within the LEADS L2, SAS, and categorization and compartmentalization subsets, along with exclusion from the LEADS L1 and integration subset of the MULTIIS, for a set consistency score of .609. The second set similarly required membership within the LEADS L2 and SAS, but rather necessitated full exclusion from the LEADS L1 and all three components of the MULTIIS, with a set consistency score of .606. The third set required exclusion from both the LEADS L1 and L2, as well as exclusion from the categorization and integration components of the MULTIIS, and required membership in the SAS and compartmentalization component, and had a set consistency score of .653.

**Regression**

To test the hypothesis that identified latent profile membership can by predicted by attitudes about bilingualism, biculturalism, and other perceptions measured in the supplemental questionnaires, several regressions were calculated using the LPA profile membership results from Study Two as predicted by the LEADS L1 and L2, SAS average, RSES, and MULTIIS components. For each of the profile regressions, a Bonferroni-corrected p value was used due to the multiple comparisons being made. A

significant regression was found for "balanced" bilingual profile membership ($R^2$ = 0.169, $F(7,200) = 5.82$, Bonferroni-corrected $p < 0.001$), with only the LEADS L1 ($\beta$ = -0.367, $p < 0.01$), the SAS average ($\beta = 0.159$, $p < 0.001$) and the MULTIIS compartmentalization component ($\beta = 0.083$, $p < 0.05$) contributing to the model for "balanced" bilingual membership. Another significant regression was found for profile 2, "L2 learners" ($R^2 = 2.67$, $F(7,200) = 10.40$, Bonferroni-corrected $p < 0.001$). It was found that the LEADS L2 ($\beta = -0.104$, $p < 0.01$), the SAS score ($\beta = -0.220$, $p < 0.001$), the MULTIIS compartmentalization component ($\beta = -0.109$, $p < 0.01$), and the intercept for the model ($\beta = 1.102$, $p < 0.01$) all significantly predicted "L2 learner" profile membership. No significant regression was found for profile 3, "proficient" bilinguals ($F(7,200) = 2.40$, Bonferroni-correct $p = 0.090$. Finally, no significant regression was found for profile 4, "L1-L2 shift" bilinguals ($F(7,200) = 0.844$, Bonferroni-corrected $p$ = 1.00).

Due to the inclusion of the RSES in all set solutions for the fsQCA (Table 10), additional regressions were calculated to predict the LSBQ composite score based on the RSES, as well as L1 and L2 speaking and understanding scores as predicted by RSES. Previous research has suggested that self-esteem and self-confidence may be predictive of language proficiency self-evaluation, such that individuals with lower self-confidence also rate their language proficiencies lower than traditional testing would assess their abilities (Lee, 2008). No significant regression was found for the LSBQ composite score ($F(1, 206) = 0.378$, $p = 0.539$), for L1 speaking ($F(1, 206) < 0.00$, $p = 0.981$), for L1 understanding ($F(1, 206) = 0.377$, $p = 0.540$), for L2 speaking ($F(1, 206) = 3.33$, $p = 0.069$), nor for L2 understanding ($F(1, 206) = 1.03$, $p = 0.311$).

## Discussion

The LPA from this study resulted in an alternative *k* profile solution than in the previous two studies, but the resulting profiles remain interpretable within the extant bilingual literature. The addition of the supplementary questionnaires and alternative questions for the LSBQ were able to identify similar latent profiles within the data, and review of these profiles suggests the profile mean item estimates describe theoretical bilingual subtypes. These findings further support the utility of the LSBQ and latent modeling as additional tools for characterizing bilingual participants, but do not support the first hypothesis that the same bilingual profiles would be identified across datasets. The regression indicates that the subjective experiences measured in these data were not predictive of bilingual membership however, failing to support this aspect of the third hypothesis. However, several of these measures were significant in predicting specific membership after identification, suggesting there are associations between the subjective bilingual experiences of biculturalism and acculturation, and that these are unique to the latent profiles identified in these models.

The preferred model for these data was agreed to be the $k = 3$ Model 1, due to fit statistic indications as well as overall interpretability, parsimony, and minimum *n* per *k* class. Reviewing the LSBQ items as well as the rephrased questions, these profiles appear to reflect three different use-cases and developmental histories of bilingualism, providing support for the correct identification of these profiles. The "balanced" bilinguals in this study had estimates at or slightly above the mean for the sample, indicating these individuals had relatively more evenly distributed L1 and L2 use. The estimates for the adjusted frequency of language use questions were also closer to the

middle of the scale, indicating members used both of their languages more equally in all scenarios throughout their daily lives. The LEADS L1 and L2 scores reflected a slight bias towards a higher L2 score suggesting these "balanced" bilinguals identified more with their L2 than their L1. The SAS corroborated these findings, with a higher mean score indicating that these individuals tended to have more interactions associated with their L2 culture and speakers. Finally, the MULTIIS integration score was highest for "balanced" bilinguals out of all profiles in the sample, reflecting more feelings of cohesion and unity between the two L1 and L2 cultures these individuals identify with. The fsQCA analysis for "balanced" bilinguals found that members of this profile required the presence of both the LEADS L1 and L2, the SAS, and the integration component of the MULTIIS only, suggesting these may be defining features of this particular profile. All of this evidence together supports the title "balanced" bilinguals for this profile and adds information that these individuals have a high sense of cohesiveness between their two languages. These individuals may have a slight family-use preference towards an L2 but are likely simultaneous or early bilinguals who have had consistent support for both of their languages throughout their lifespan and in aspects of their daily lives. The SAS estimates may suggest there is more identification with their L2 culture, but the MULTIIS integration component indicates this L2 identification does not preclude their L1 identity. Contrary to the study hypotheses and earlier data, the RSES estimates for "balanced" bilinguals were not different from the other profiles, despite differences in other survey measures designed to tap into perceptions of cultural identification, which have been theorized to influence self-esteem and self-confidence (Nguyen & Benet-Martínez, 2013).

Profile 2 estimates appear to represent another "L2 learner" profile, or potentially bilinguals who no longer have significant exposure to or often use their L2. All the estimates for Factor 1 and Factor 2 items are below the mean score, indicating a stronger preference towards L1 use. Additionally, the estimates for these individuals' L2 understanding (6.93) and speaking (6.41) proficiencies are well below the other profiles' L2 estimates in the LPA, supporting the assumption that members of the profile are either learning an L2 or have suffered from L2 attrition. Of note, the estimates for their L1 understanding (9.80) and speaking (9.80) are quite high, suggesting that their L2 skills are significantly below their L1. The overall language use frequency items further support that this profile uses their L1 almost exclusively, with all five item estimates at the lower end of the scale. The LEADS L1 score for "L2 learners" is the highest estimate of all three LPA profiles, while the SAS is much lower than the other profiles, suggesting strong identification with and comfort using their L1 in context. Finally, "L2 learner" estimates for the MULTIIS components are the lowest in the group, particularly in integration and compartmentalization. Curiously, a low score in compartmentalization suggests that these individuals do not strongly separate their two language cultures and identities, while a low integration score contrastingly indicates that they do not feel the same two cultures form a single cohesive or united cultural identity. These conflicting attitudes towards cultural identity may reflect a confused interpretation of linguistic culture, or that "L2 learners" do not yet identify strongly enough with one linguistic culture, their L2. Particularly if "L2 learners" is comprised of late L2 learners or individuals who only briefly had an L2 speaker in their earlier development, this interpretation would make sense, as the LEADS L1 score suggests there is strong

identification with the L1, but the LEADS L2 does not reflect this same individual understanding. The low compartmentalization score could indicate "L2 learners" do not view the cultures of their two languages as "divergent" within themselves, possibly because there is only the identification with the single culture. (Yampolsky et al., 2016). Additionally, the MULTIIS instrument asks no question specifically about a single linguistic culture, as the LEADS and SAS both do, but rather asks individuals only to consider broad definitions of cultural context and bicultural identity outside of specific sociolinguistic contexts. Thus, the combined information from the MULTIIS, LEADS, and SAS suggests that bicultural identification or a lack of L2 identity within these individuals may be a defining subjective experience of "L2 learners."

The fsQCA provides further support to this second possibility, as the single set in the solution required the presence of the LEADS L1 and MULTIIS categorization, but required the absence of the LEADS L2, SAS, and MULTIIS compartmentalization, achieved only through lower scores on the measures due to the logit scaling of these items in the truth table. With this additional information, the low compartmentalization score on the MULTIIS, LEADS L2, and SAS all are key conditions for "L2 learners." However, given the low coverage of this solution (.063), it cannot be assumed that these are the only necessary conditions, as this coverage indicates only 13 individuals in the sample meet the full solution criteria, despite the *k* profile "L2 learners" having an *n* of 78. Given this, there are likely additional factors not included in the limited supplementary items fsQCA that further define these "L2 learners." However, using that fsQCA information along with the LSBQ LPA item estimates, researchers may be able to characterize and identify individuals who fit this "L2 learner" profile through their low

L2 proficiency and use, frequent and proficient L1 use, and lack of identification with a second L2 culture in the LEADS outside of their predominant L1 identity.

The LPA results for profile 3 appear to reflect the same "L1-L2 shift" bilingual previously identified in Study Two, and may also include heritage bilingual speakers. The estimates for this profile showed a preference towards L1 use with family members, particularly older family such as grandparents and parents, as well as strong early developmental L1 use. However, as early as primary school these individuals began trending towards L2 use and preference, and items from Factor 2 shows strong L2 use in every social setting for these individuals. L1 proficiency estimates for these individuals are the lowest of the entire sample, although these estimates are still proficient, while the adjusted overall frequency items are dominated by L2 use. The LEADS L1 and L2 estimates are the lowest of the sample, with the L1 score markedly lower than other profiles, suggesting that "L1-L2 shift" individuals do not identify as strongly with either of their language cultures. The SAS however shows a stronger identification with and comfort with L2 individuals and social situations, while the MULTIIS components for compartmentalization and categorization are highest for this group. This suggest that along with a relatively strong identification with their L2 culture, "L1-L2 shift" bilinguals are more prone to viewing their two linguistic cultures as separate or split, and may even prefer to hide one in favor of the other depending on the situation. Unlike "balanced" bilinguals, who seem to have a cohesive identity that includes both of their linguistic cultures, and unlike "L2 learners" who might lack strong identifications with a second culture entirely, "L1-L2 shift" members report stronger feelings of struggling to reconcile their two identities and may even only be able to feel connected to one at a time. Finally,

the fsQCA for this profile found three separate sets, with the only commonalities across all three being a low LEADS L1 score and a high SAS score, both of which indicate stronger identification with the L2 than L1, as well as a low integration score, further supporting this lack of cohesion and reconciliation between their L1 and L2 identities.

On further review of this profile, it was found that this "L1-L2 shift" is comprised almost entirely of individuals who indicated a non-English L1 and English as their L2, the same results as seen in the Study Two "L1-L2 shift" profile. For Study Two and Study Three, the LSBQ Likert scales were administered "language neutral," in that they reflected a participant-indicated L1 versus L2 scale, thereby not imposing a researcher-implied bias through English versus non-English scales. While Study One identified $k = 6$ profiles, several of these may have been influenced by such item phrasing and response scoring, as some appeared to be largely the same when considering L1 versus L2 order of acquisition rather than the explicit English versus non-English scaling. However, Studies Two and Three were able to identify profiles defined in part by this English as a second language component, suggesting these profile estimates may be one characterization of an "L1-L2 shift" bilingual or heritage language speaker.

The LSBQ composite score density graph (Figure 8) shows how the current calculation for the high-cut score may still be mischaracterizing some subtypes of bilinguals, both in underestimating and overestimating the contribution of individuals' languages. Profile 1, "balanced" bilinguals that indicate a relatively even distribution of both L1 and L2 use in Factors 1 and 2, along with proficient L1 and L2 abilities, and the overall frequency items showed no clear preference towards L1 or L2 as well. However, the LSBQ composite score density graph (Figure 8) for this profile showed that visually

half of these individuals failed to meet the high-cut score criteria (1.23) defined in Anderson et al. (2018). At the same time, the density curve for "L1-L2 shift" bilinguals in Figure 8 shows that none of these individuals scored below the low-cut, "not strongly differentiated" value (-3.13), and that the majority of these members scored above the high-cut score. While none of these individuals should be considered "monolingual" by falling below the low-cut score, the fact that so many "L1-L2 shift" bilinguals scored above the high-cut score in comparison to "balanced" bilinguals supports that this high-cut composite score alone should not be used as the sole determining factor in establishing bilingual status. Again, this administration of the LSBQ was "language neutral" for these data, and did not heavily favor non-English over English as contributing to a composite score, but it still appears to favor an L1 to L2 switch over relative balance towards achieving this high-cut score. This language dominance shift is often seen in the Southwest U.S. in ELL and heritage speaker populations (Kohnert & Bates, 2002), and has been suggested as one defining feature of heritage speakers in linguistic literature (Ortega, 2019). Given Figure 8, it appears the LSBQ composite score calculator may be valuable for identifying such "L1-L2 shift" bilinguals and heritage speakers, but less apt at the more nuanced "balanced" bilinguals found in profile 1. Additionally, the density curve for "L2 learners" supports the conclusion that these individuals are newly learning an L2 or have had substantial language attrition, as the majority of these members fall below even the low-cut score.

It appears that the addition of supplementary questions along with the adjustment of overall frequency of language use may further clarify the identification of bilingual subtypes through the LSBQ. Study One resulted in a $k = 6$ solution, wherein several

profiles appeared similar across the mean item estimates but varied by degree in these items, while Study Two found a $k = 4$ solution. The Study Two profiles were slightly more readily interpreted than those in Study One, although there did still appear to be some overlap between "proficient" and "L1-L2 shift" members, with both representing varying degrees of a shift toward the language of culture as discussed by Kohnert and Bates (2002). Study Three resulted in three defined subtypes of bilinguals that are also previously discussed in the extant literature, and the supplementary items appear to further corroborate these interpretations of these profiles. While the calculation of factor and composite scores from these adjusted items remains to be completed in order for researchers to readily classify individuals as broadly bilingual or to these more specific subtypes, the converging information from the current low-cut composite score, fsQCA, and latent profile estimates including the supplementary items could be used to characterize new samples of participants using these criteria.

With regard to the supplementary items, the LPA results suggest that there may be a relationship between current language use and history with attitudes towards cultural identification. The questionnaires that focused on sociolinguistic and cultural identities had differing estimates for each of the identified profiles and appear to reflect how individual's language use influences their cultural identification. Of note, "balanced" bilinguals had higher identification to both of their linguistic cultures as well as particularly high MULTIIS integration component scores, potentially related to this profiles ability to use their two languages interchangeably. In administering the supplemental questionnaires, participants were also provided space to give feedback or additional thoughts about bilingualism that may not have been asked about in the survey

measures. Many participants who were identified as “balanced” bilinguals generally reported positive experiences with their bilingualism, including having a “good feeling [helping] translate for older Hispanics” or being able to connect with non-English speaking elders through their bilingualism. These subjective comments paired with the high scores on the integration component support that many of the “balanced” bilinguals harbor positive attitudes towards their bilingualism. While these results do not allow a causal or directional statement about this association, it may be that the relationship between their use patterns and cultural attitudes contributes to defining this bilingual subtype. As seen in previous research, the cultural perceptions of languages influences bilinguals’ identification with and use of their languages (Turner & Reynolds, 2010; Vega, 2018), and these “balanced” bilingual estimates support previous findings that individuals who have more balanced and frequent use between both of their languages also tend to have an overall positive attitude towards and outlook of both of their languages in addition to a stronger sense of a bicultural identity (Nguyen & Benet-Martínez, 2013).

On the other hand, “L1-L2 shift” bilinguals showed the lowest identification with their L1 in the LEADS and the highest compartmentalization and categorization scores on the MULTIIS. These individuals are theorized to have experienced an L1 to L2 dominance shift as described by Kohnert & Bates (2002) and evidenced by their profile estimates. There does appear to be a relationship between the shift towards L2 dominance and a sense of separate cultural identity in these data, as has also been discussed with regard to a feeling of “differentness” and even discriminative attitudes towards minority languages (Hurtado & Vega, 2004; Ramírez-Esparza & García-Sierra, 2014). As

Ramírez-Esparza and García-Sierra (2014) note however, the language of administration of a survey can influence personality outcomes as suggested by the Cultural Frame Switching (CFS) theory. While the present study attempted to keep this administration of the LSBQ as linguistically neutral as possible including changing the Likert values towards an L1 versus L2 scale, the entirety of the test was still administered in English only. Again, the "L1-L2 shift" profile was comprised almost entirely of individuals who stated English was their L2, so it is possible that administration in their L1 could produce alternative outcomes for the supplementary cultural and linguistic identification measures. However, these participants also indicated they spent the majority of their daily lives reading and writing in their L2. If the language of administration does greatly impact their identification with their languages, then these differences would be pervasive throughout their daily life as well. While CFS has been shown to have a strong effect when the language the instrument is presented in changes, the effect has also been elicited through displaying cultural iconography, the culture of an interviewer asking participants questions, and priming participants to book covers associated with specific cultures (Chen, Benet-Martínez, & Bond, 2008; Chen & Bond, 2010; Ramírez-Esparza et al., 2006). It is possible that by mentioning their two languages by name participants experienced awareness of their two cultures more than they might have with a direct "English" and "non-English" comparison. Particularly for "L1-L2 shift" bilinguals who scored highest on compartmentalization and categorization items, this awareness of their two separate cultures may be reflected in their response patterns. If the assumption holds that these individuals view their two languages and associated cultures as separate, divergent, or solely isolated to their unique contexts, activating awareness of their two

cultures could be result in different responses to items that better fit their perceptions of what that culture's responses should be, rather than their own uninfluenced identifications with the responses to the item. For instance, one of the LEADS items asks participants if they feel "proud" speaking their languages. It may be that an individual feels equally proud to be able to speak both of their languages, but their perception of one language's culture is to not be prideful, and thus they could score lower on that LEADS item for that specific language, while the same LEADS item for their other language scores higher if their perception of that culture allows them to be prideful. If the "L1-L2 shift" profile consists primarily of individuals who compartmentalize their languages and experience this CFS effect more strongly, the results to the supplemental items or even the language proficiency items could be influenced strongly by this effect.

The regression analyses suggested that profile membership and classification in the latent model in Study Two was only somewhat predicted by the supplemental questionnaire items, but that these regressions depended on the individual profiles and their association with specific questionnaires. Overall, this suggests that the supplementary questions alone are not enough to classify bilinguals into the previously identified latent profiles. It may be that many of these profiles share similar attitudes towards their languages, biculturalism, or their efficacy in using their languages, even if the ways they are able to use their languages differ. Given that bilingualism is a known heterogenic construct, this result supports the need for alternative methods of identifying and characterizing subtypes of bilingualism through a variety of measures, including items such as overall proficiency and individual use patterns. It was found that individual membership within these previously identified profiles was somewhat predicted by

several of the supplementary measures. From Study Two, “balanced” bilingual membership was negatively correlated with the LEADS L1 score and positively correlated with the SAS and MULTIIS compartmentalization scores, although the compartmentalization score was more weakly involved than the other two items. These findings may suggest that “balanced” bilinguals tend to have lower identification with their L1 and higher identification with their L2, as both the SAS and LEADS L1 would suggest this trend. Additionally, while the compartmentalization component was only weakly associated with the profile, it may be that there is still some internal separation between their language in these bilinguals. This finding is counterintuitive to some ideas of the “balanced” bilingual, which often considers the label appropriate if the bilinguals are able to use their two languages frequently and in multiple situations as well as having sufficient proficiency in each (Yow & Li, 2015). This particular identification pattern may fit a “unidimensional” model of biculturalism, in which an bicultural individual can “separate” membership with their heritage culture as they assimilate with the mainstream culture or vice versa (Ryder et al., 2000). Importantly, this unidimensional model necessitates that an individual must identify along a single spectrum of biculturalism, losing membership within one culture to assimilate towards the other. It may be that for these bilinguals, this division between the two cultures persists within their own identity, despite frequently switching between their languages in many different contexts, as the estimates in Study Two (Table 6) suggest these subtypes do.

Additionally, results indicated that classification to the “L2 learners” profile from Study Two was negatively associated with the LEADS L2, SAS, and MULTIIS compartmentalization scores. In context, the LEADS L2 and SAS associations support

the earlier conclusion that the "L2 learner" profile has yet to strongly establish an L2 cultural identity. These individuals are only beginning to gain early proficiency in their L2, and still largely use their L1 in most daily situations as well as having a strong developmental history of L1-only use. As such, their concept of an L2 cultural identity may not be strongly formed, and their scores in the LEADS and SAS reflect this. Additionally, the negative association with the MULTIIS compartmentalization score could support that these individuals have yet to develop a strong L2 cultural identity. The MULTIIS compartmentalization items ask participants about their attitude towards using their languages in one another's contexts, that is, whether they feel comfortable using their L1 in an L2 context and vice versa, as well as whether they feel separately defined as a person by their two cultural identities. The LPA estimates for "L2 learners" in Table 6 suggest that these individuals use their L1 in every context, and suggest they are likely learning their L2 outside of a familial or societal context, possibly through a post-secondary course. For these individuals, they may not yet have strong attitudes towards using their L2 in L1 contexts, and do not feel a cultural identity towards their L2 yet. This particular context would fit into a "bidimensional" model of biculturalism and acculturation, which posits that members can disassociate or assimilate to their two cultural groups, one with the heritage culture and the other the mainstream culture (West et al., 2017). In a bidimensional model, individuals can maintain their cultural identity in either culture while simultaneously shifting or disidentifying with the other. It appears that these "L2 learners" are maintaining their mainstream cultural identities, while not yet identifying or possibly even disidentifying with the heritage L2.

The RSES was also included to measure participants' general feelings of self-esteem and self-confidence, both of which have been theorized to be related to bilingualism through their own perceived language ability (Lee, 2008). However, the estimates for this score did not differ between the three identified profiles (Table 9), despite the differences in self-reported language ability and proficiency in both L1 and L2. Additionally, regression analyses found no significant interaction between RSES scores and the LSBQ composite score, or L1 and L2 understanding or speaking ratings. These findings suggest that general self-esteem is not a strong predictor of profile membership in these data. The fsQCA solutions for both high-cut and low-cut bilingual composite scores does include the presence of the RSES score in all sets (Table 10), reflecting stronger self-esteem and self-confidence. This could reflect two alternative findings. The first is that the majority of participants did not have low self-esteem and thus the inclusion of this value in the fsQCA reflects the presence of a higher RSES score throughout the sample. The second possibility is that individuals with low RSES scores, having low self-esteem and self-confidence, similarly rated their language proficiency abilities lower, even if traditional language proficiency testing would rate them higher than their own perceptions. Regressions did not find the RSES scores to predict any L1 or L2 speaking or understanding score however, so it is unlikely the second possibility was the reason for RSES being present in both the low-cut and high-cut fsQCA solutions.

## Study Four

Study Four combined all available LSBQ responses in an attempt to develop a final latent model of bilingualism within these data. Using both the Anderson et al. (2018) and Southwest U.S. datasets combined, Study Four repeated the LPA process as in

the previous studies using the original LSBQ responses only. After selecting a model, the estimates for each profile were used to again characterize and describe each using a bilingual subtype that is supported in previous research and within these studies. The prevalence of each profile was also compared across the LSBQ composite score using the same density graphs in previous studies, along with a comparison of the mean standard estimate of each LSBQ item for the identified *k* profiles. Finally, the fsQCA was performed again with these data to further characterize the conditions contributing towards bilingual classification, as well as the profile-specific conditions that lead to a bilingual outcome. These results are then compared to those from Study One and Study Two in an attempt to develop a final model of bilingualism present in the LSBQ including its identified subtypes. Additional transformations to the calculation of the LSBQ composite score are considered in an attempt to address previous bias in this measure. These results are demonstrated in relation to the present LPA findings, and specific recommendations are discussed for using these measures in a bilingual population.

## Methods

### Participants

For Study Four, the 42 original LSBQ item responses from Study One participants identified as having bilingual experience ($n$ = 257) was combined with all Study Two and Three participants ($n$ = 208) to create one dataset of $n$ = 465 bilingual responses to the LSBQ.

## Measures

Only the LSBQ items available in Study One were used for these analyses, including the Factor and Composite scores as defined by Anderson et al. (2018). However, Study Two did not use language-specific Likert scales as was the case in Study One, where item responses ranged from "English Only" to "non-English Only" or similarly worded but language-specific scales. Instead, in Study Two participants reported their L1 and L2, and all LSBQ Likert scales reflected an "L1 Only" to "L2 Only" response option with their unique responses used in place of "L1" and "L2." For Study Four, individuals in Study Two who did not report English as their L1 had the applicable scales and responses reversed, while all other responses were confirmed to have used English as the individual's L1. In adjusting these scores this way, the responses between Study One and Study Two are considered on the same scale and thus can be properly combined.

# Results

## Latent Profile Analysis

The LPA procedures were repeated as in the previous studies, attempting to fit $k$ = 1 through 10 profiles to Models 1, 3, and 6 configurations for 30 total models. While the sample from Study Two only had complete data, the Study One data had missing responses and therefore needed to be imputed. As in Study One, the non-parametric missing forest function available in mclust was used to impute these data, and these imputed responses were bound within the range of possible responses to the LSBQ items, to create one complete dataset of the 42 indices with which to fit all 30 LPA models to.

The resulting solutions listed in Table 11 were then compared using the BIC, C-AIC, saBIC, BLRT, entropy, and other fit statistic information criteria including minimum *n* per *k* class and profile estimates where appropriate. Of the attempts to fit the 30 models to these data, 21 successfully converged. As seen in the previous studies, Model 6 solutions with $k > 1$ failed to converge, likely due to the number of parameters being estimated for such models. Of the 21 models that did converge, configurations with $k > 9$ resulted in a solution that assigned fewer than 1% of participants to any one *k* profile, suggesting these solutions should not be considered as accurate. Further review of these $k = 10$ configurations found that at least one *k* profile had at most 1 participant identified to that profile, supporting the decision to reject these solutions. The BIC (46,255.93) supported a $k = 2$ Model 3 solution, however the BIC values for both $k = 3$ (46,259.52) and $k = 4$ (42,263.08) Model 3 solutions showed that all three models had similar values. The C-AIC supported a $k = 1$ Model 3 or Model 6 solution (47,229.03), followed by $k = 2$ (47,243.93), $k = 3$ (47,290.52), and $k = 4$ (47,337.08) Model 3 solutions. The saBIC was lowest for $k = 8$ (42,562.94) and $k = 9$ (42,617.11) Model 3 solutions. Finally, the BLRT found that a $k = 5$ Model 3 solution was not significantly different over the $k = 4$ Model 3 solution (46.49, $p = 0.94$), while all other BLRT values were significant comparing *k* to $k - 1$ solutions. Entropy was highest for the $k = 6$ Model 1 solution at 0.98, but was above 0.95 in all converged models, suggesting that there was high profile separation and low uncertainty in these models.

Other factors were then used to consider final *k* profile enumeration, including minimum *n* per *k* class and the profile item mean standard estimates. The fit statistics evaluated tended to prefer Model 3 over Model 1 configurations, but due to earlier

Table 11

*Fit Statistics of Latent Profile Analyses for All Available LSBQ Bilingual Responses.*

| *Classes* | *Model* | *BIC* | *CAIC* | *SABIC* | *BLRT* | *BLRT p* | *Entropy* | *-2LL* | *AIC* | *AWE* | *CLC* | *KIC* | *ICL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 56818.68 | 56902.68 | 56552.08 | - | - | 1.0000 | -28151.372 | 56470.74 | 57584.61 | 56304.74 | 56557.74 | -56818.68 |
| | 3 | 46284.03 | 47229.03 | 43284.83 | - | - | 1.0000 | -20239.904 | 42369.81 | 54921.26 | 40481.81 | 43317.81 | -46284.03 |
| | 6 | 46284.03 | 47229.03 | 43284.83 | - | - | 1.0000 | -20239.904 | 42369.81 | 54921.26 | 40481.81 | 43317.81 | -46284.03 |
| 2 | 1 | 51986.49 | 52113.49 | 51583.42 | 5096.293 | <0.001 | 0.9742 | -25603.226 | 51460.45 | 53145.58 | 51208.40 | 51590.45 | -51995.43 |
| | 3 | 46255.93 | 47243.93 | 43120.25 | 292.212 | <0.001 | 0.9752 | -20093.798 | 42163.60 | 55286.31 | 40189.55 | 43154.60 | -46262.04 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 3 | 1 | 49584.88 | 49754.88 | 49045.34 | 2665.717 | <0.001 | 0.9755 | -24270.367 | 48880.73 | 51137.08 | 48542.69 | 49053.73 | -49594.87 |
| | 3 | 46259.52 | 47290.52 | 42987.37 | 260.516 | <0.001 | 0.9669 | -19963.541 | 41989.08 | 55683.03 | 39929.01 | 43023.08 | -46271.02 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 4 | 1 | 48985.84 | 49198.84 | 48309.83 | 863.144 | <0.001 | 0.9655 | -23838.795 | 48103.59 | 50931.17 | 47679.52 | 48319.59 | -49005.70 |
| | 3 | 46263.08 | 47337.08 | 42854.46 | 260.550 | <0.001 | 0.9609 | -19833.265 | 41814.53 | 56079.71 | 39668.45 | 42891.53 | -46281.67 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 5 | 1 | 48101.18 | 48357.18 | 47288.69 | 1148.774 | <0.001 | 0.9729 | -23264.408 | 47040.82 | 50439.59 | 46530.76 | 47299.82 | -48119.77 |
| | 3 | 46480.70 | 47597.70 | 42935.60 | 46.491 | 0.941 | 0.9559 | -19810.020 | 41854.04 | 56690.44 | 39621.95 | 42974.04 | -46506.39 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 6 | 1 | 47632.76 | 47931.76 | 46683.80 | 732.529 | <0.001 | 0.9767 | -22898.143 | 46394.29 | 50364.27 | 45798.24 | 46696.29 | -47649.44 |
| | 3 | 46501.51 | 47661.51 | 42819.95 | 243.292 | <0.001 | 0.9669 | -19688.374 | 41696.75 | 57104.34 | 39378.68 | 42859.75 | -46520.45 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 7 | 1 | 47417.55 | 47759.55 | 46332.12 | 479.319 | <0.001 | 0.9664 | -22658.484 | 46000.97 | 50542.19 | 45318.90 | 46345.97 | -47445.42 |
| | 3 | 46652.79 | 47855.79 | 42834.75 | 112.829 | <0.001 | 0.9657 | -19631.959 | 41669.92 | 57648.73 | 39265.85 | 42875.92 | -46675.02 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 8 | 1 | 47068.58 | 47453.58 | 45846.69 | 613.068 | <0.001 | 0.9693 | -22351.950 | 45473.90 | 50586.33 | 44705.84 | 45861.90 | -47094.92 |
| | 3 | 46517.44 | 47763.44 | 42562.94 | 399.453 | <0.001 | 0.9700 | -19432.233 | 41356.47 | 57906.48 | 38866.41 | 42605.47 | -46539.12 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 9 | 1 | 46978.53 | 47406.53 | 45620.16 | 354.158 | <0.001 | 0.9654 | -22174.871 | 45205.74 | 50889.40 | 44351.67 | 45636.74 | -47010.82 |
| | 3 | 46708.09 | 47997.09 | 42617.11 | 73.463 | <0.001 | 0.9694 | -19395.501 | 41369.00 | 58490.24 | 38792.94 | 42661.00 | -46731.81 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| 10 | 1 | 47069.78 | 47540.78 | 45574.94 | 172.864 | <0.001 | 0.9680 | -22088.439 | 45118.88 | 51373.74 | 44178.81 | 45592.88 | -47101.98 |
| | 3 | 46795.45 | 48127.45 | 42568.00 | 176.747 | <0.001 | 0.9742 | -19307.128 | 41278.26 | 58970.69 | 38616.20 | 42613.26 | -46817.77 |
| | 6 | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |

discussed assumptions for variance and covariance in latent models, $k = 2$, $k = 3$, and $k = 4$ solutions for both Model 1 and Model 3 were all compared for final model selection. Each model had a sufficient minimum *n* per *k* profile, but some had more even distribution among groups (Table 12). An even distribution does not necessarily imply a given model is better than another, but given Study One found relatively even latent profile distribution, one might expect similar behavior from these data. Of these six potential models, the Model 3 and Model 1 estimates were largely the same and had similar interpretations, thus following the homogeneity and local independence assumptions, a Model 1 configuration was pursued for parsimony (Lubke & Neale, 2006).

These $k = 2$, 3, and 4 models were then examined for overall interpretability in tandem with the fit statistics and model interpretations from the previous analyses in these studies to determine final model selection. The estimates for $k = 2$ Model 1 (Figure 9) show that the two profiles are somewhat reversed around the LSBQ item means, indicating one profile as having stronger "L1 dominant" use, while the other has stronger "L2 dominant" use. The $k = 3$ Model 1 (Figure 10) shows that the profiles may identify non-English language learners, English language learners, and balanced bilinguals. Finally, the $k = 4$ Model 1 estimates (Figure 11 and Table 13) shows that the solution identifies a "balanced" profile, "L1-L2 shift" bilinguals, "proficient" bilinguals, and an "n-ELL" profile, similar to what was observed in the previous studies. Composite scores grouped by $k = 4$ profiles are also shown in Figure 12, suggesting similar distribution to these profiles as seen in previous studies. As results previously established the presence of several of these profiles in these data, as well as the BLRT supporting that a higher *k*

Table 12

*n per k Profile for Study Four Solutions.*

| *k* | *Profile* | *Model 1* | *Model 3* |
|---|---|---|---|
| 2 | 1 | 175 | 391 |
| | 2 | 290 | 74 |
| 3 | 1 | 108 | 145 |
| | 2 | 229 | 246 |
| | 3 | 128 | 74 |
| 4 | 1 | 103 | 142 |
| | 2 | 176 | 198 |
| | 3 | 78 | 55 |
| | 4 | 108 | 70 |

profile solution was not statistically different from this solution, a preferred BIC and C-AIC for this solutions over a *k* - 1 solution, and additional interpretability, the final selected model was the *k* = 4 Model 1 solution.

**Fuzzy-Set Qualitative Comparative Analysis**

As in Study One and Study Two, the fsQCA was repeated for this combined dataset, again investigating the role of Factors 1, 2, and 3 in the high-cut (1.23) and low-cut (-3.13) composite scores. Additionally, the fsQCAs were performed with the additional *k* = 4 Model 1 profile information to investigate the contribution of latent classes towards the low-cut composite score, as in Study Two where the low-cut composite score was used as the outcome. All fsQCA results are shown in Table 14. As in previous analyses, Factor 1 and 2 responses were first scaled using a bell-shaped distribution of membership, with scores in the middle representing more balanced bilingual use and proficiency. Factor 3, representing only English use and proficiency, was instead scaled using a logistic distribution, with higher scores representing higher degrees of English use and proficiency. Latent profile membership was still calibrated using a crisp definition to represent individual profile membership or exclusion.

The fsQCA for the high-cut composite score yielded a two set solution, with high overall solution consistency (.802) and relatively high coverage (.471). The first set required membership in both Factors 1 and 2, with a set consistency of .790 and unique coverage of .274. The second set required the presence of Factor 2 and the absence of Factor 3, with a consistency score of .831 and unique coverage of .077. The fsQCA was repeated but for the low-cut composite score, and found the same two set solution, albeit with different overall solution consistency (.988) and coverage (.471). For the low-cut

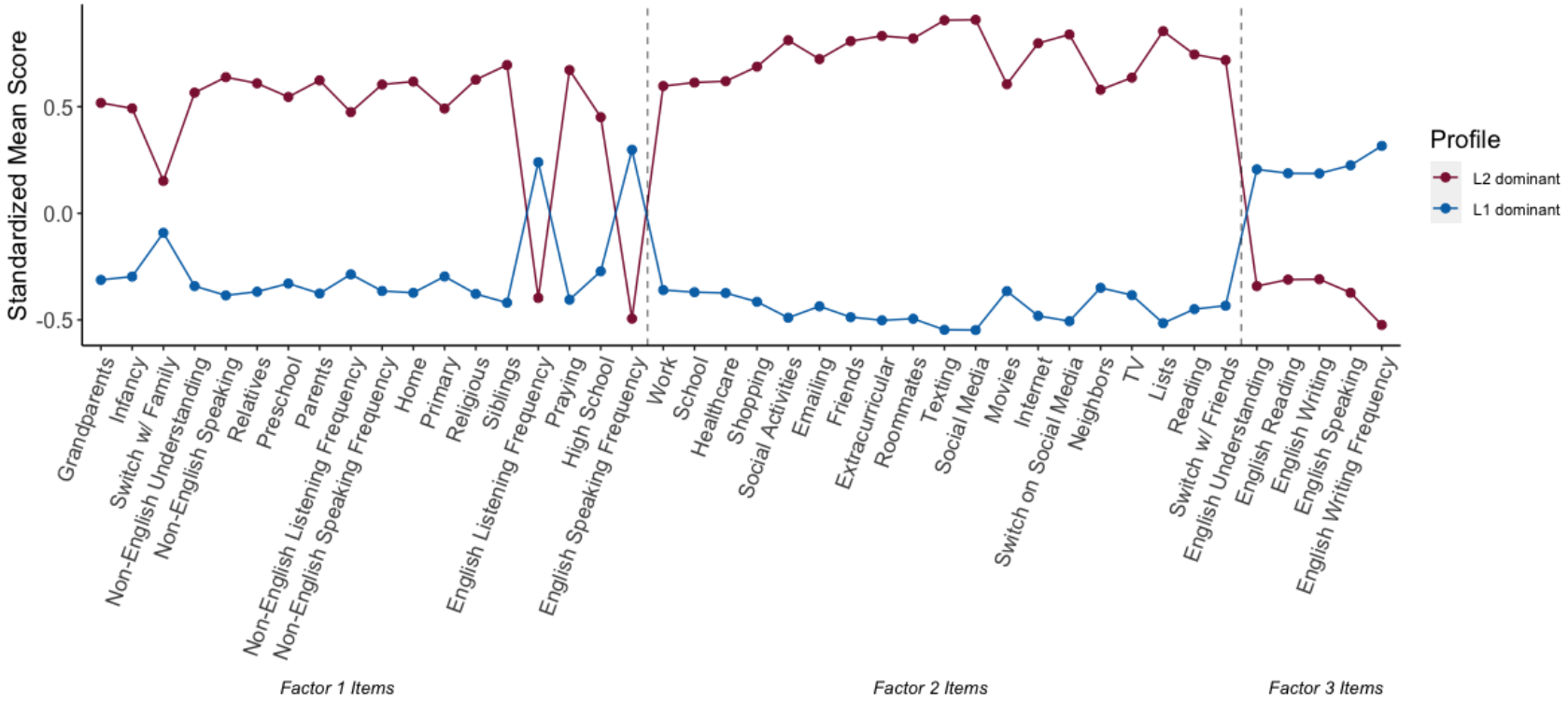


*Figure 9. Mean Standard Estimates for LSBQ Items for k = 2 Profiles.*

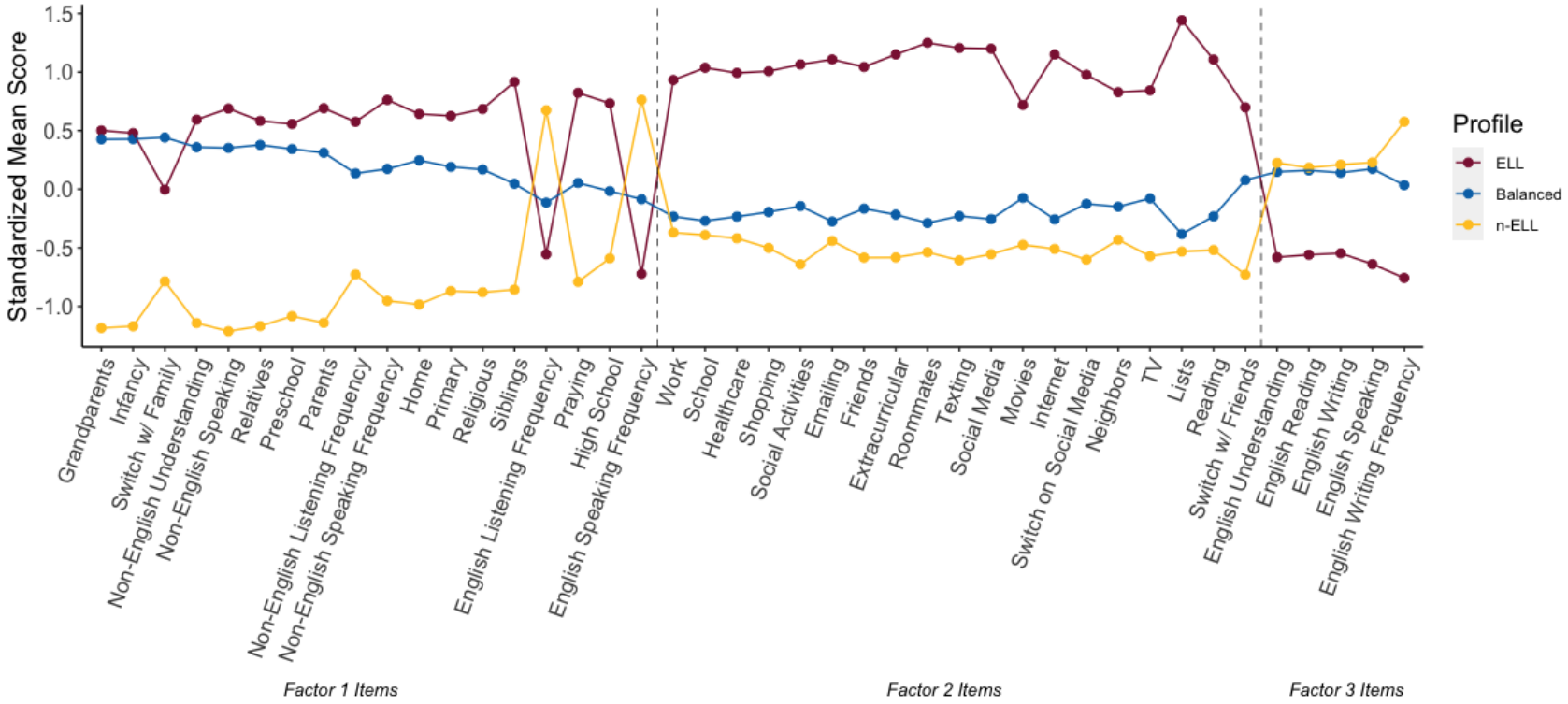


*Figure 10. Mean Standard Estimates for LSBQ Items for k = 3 Profiles.*

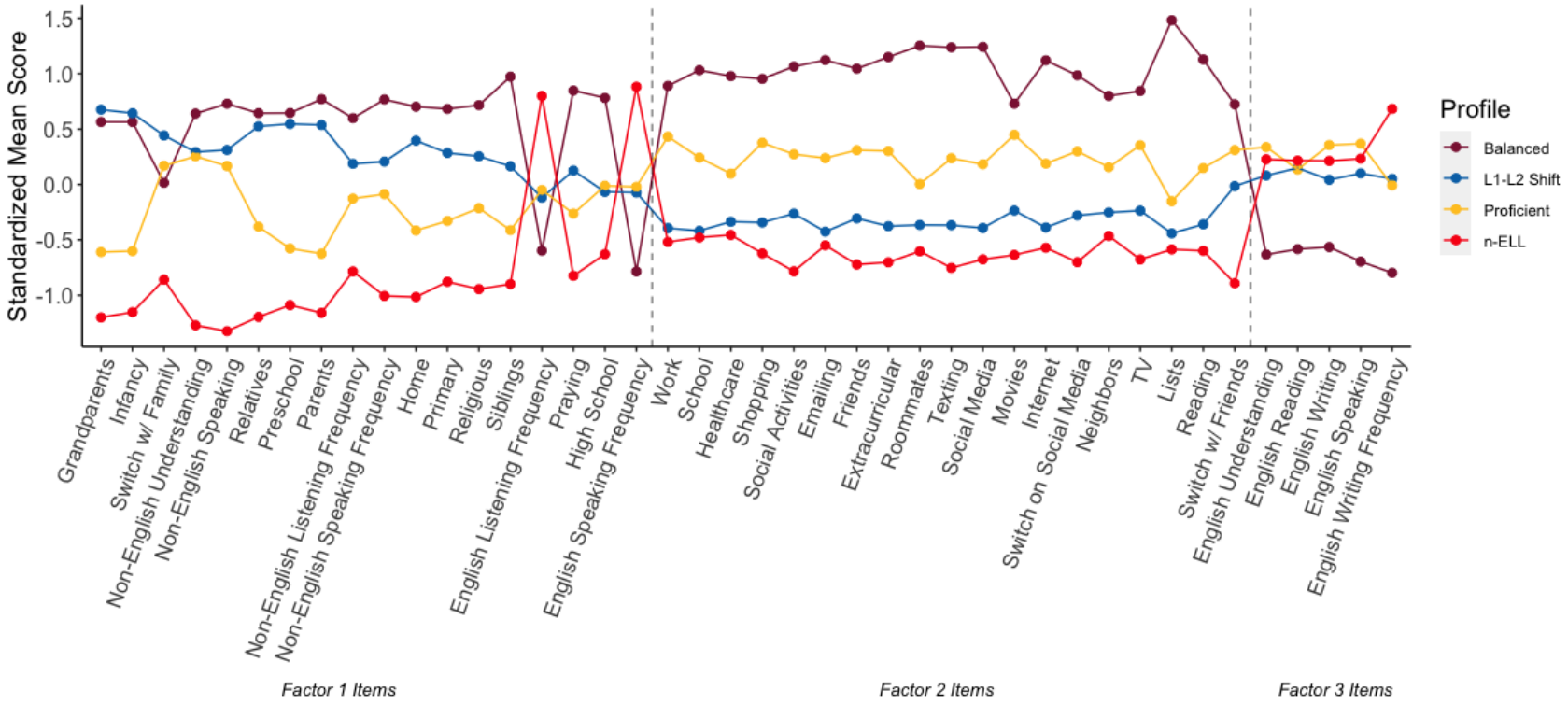


*Figure 11. Mean Standard Estimates for LSBQ Items for k = 4 Profiles.*

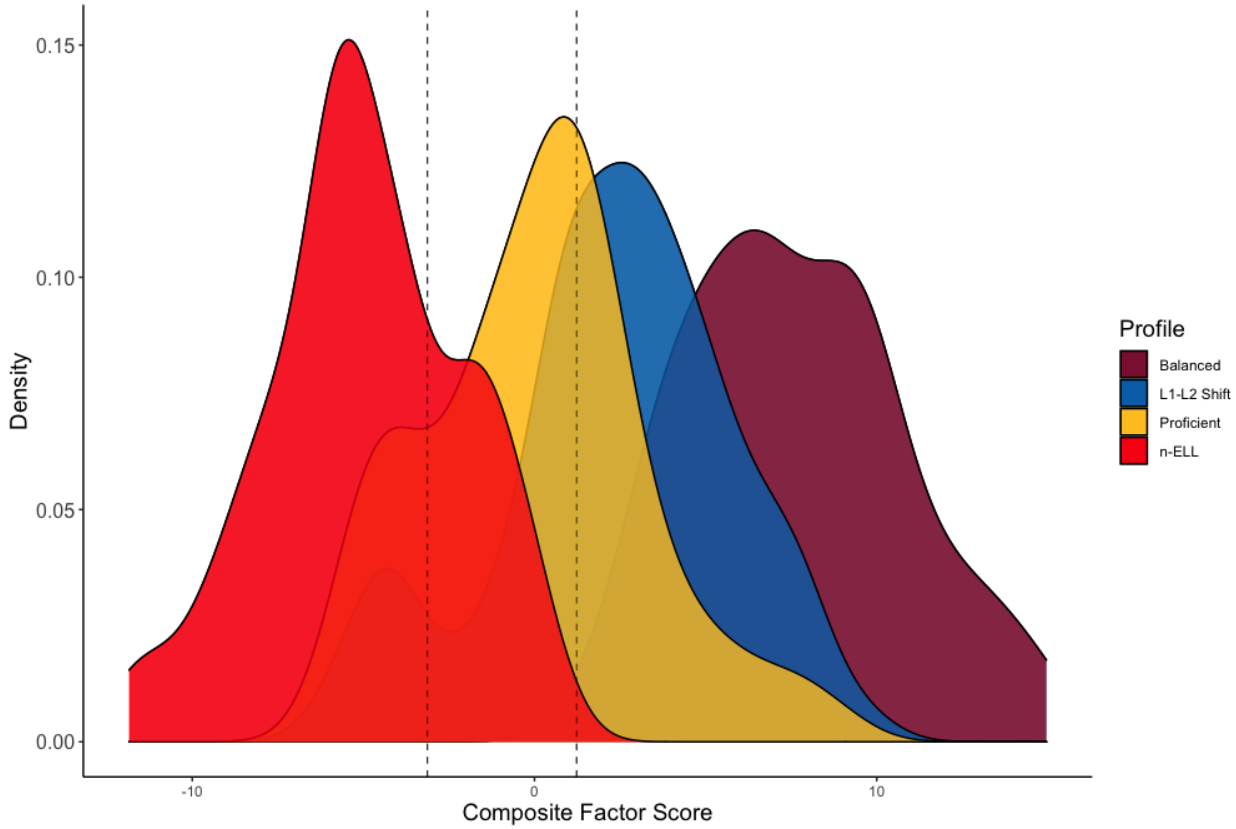


*Figure 12. Density Graph of LSBQ Composite Scores Grouped by Identified Latent Profile for Model k = 4.*

Table 13

*Mean Standard Estimates for LSBQ Items Grouped by k = 4 Profile.*

| | *Profile* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 – "Balanced" | | 2 – "L1-L2 Shift" | | 3 – "Proficient" | | 4 – "n-ELL" | |
| *Item* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* | *Mean* | *SE* |
| Grandparents | 3.562 | 0.129 | 3.716 | 0.107 | 1.738 | 0.614 | 0.816 | 0.182 |
| Infancy | 3.225 | 0.171 | 3.349 | 0.143 | 1.400 | 0.546 | 0.581 | 0.106 |
| Switch w/ Family | 2.119 | 0.162 | 2.648 | 0.077 | 2.307 | 0.183 | 1.028 | 0.145 |
| Non-English Understanding | 9.484 | 0.114 | 8.563 | 0.184 | 8.441 | 0.439 | 4.338 | 0.395 |
| Non-English Speaking | 9.380 | 0.134 | 8.152 | 0.258 | 7.716 | 0.559 | 3.237 | 0.357 |
| Relatives | 3.086 | 0.135 | 2.909 | 0.153 | 1.616 | 0.457 | 0.462 | 0.115 |
| Preschool | 2.975 | 0.176 | 2.825 | 0.172 | 1.181 | 0.440 | 0.458 | 0.073 |
| Parents | 3.290 | 0.146 | 2.935 | 0.147 | 1.270 | 0.505 | 0.498 | 0.112 |
| Non-English Listening Frequency | 2.695 | 0.106 | 2.296 | 0.089 | 1.996 | 0.207 | 1.344 | 0.094 |
| Non-English Speaking Frequency | 2.707 | 0.095 | 2.166 | 0.091 | 1.870 | 0.204 | 0.968 | 0.085 |
| Home | 2.630 | 0.137 | 2.239 | 0.156 | 1.210 | 0.342 | 0.436 | 0.089 |
| Primary | 2.324 | 0.175 | 1.904 | 0.105 | 1.215 | 0.204 | 0.636 | 0.078 |
| Religious | 2.496 | 0.109 | 1.891 | 0.174 | 1.252 | 0.327 | 0.318 | 0.102 |
| Siblings | 2.534 | 0.174 | 1.512 | 0.146 | 0.787 | 0.307 | 0.172 | 0.059 |
| English Listening Frequency | 2.796 | 0.105 | 3.114 | 0.048 | 3.173 | 0.065 | 3.744 | 0.073 |
| Praying | 2.547 | 0.139 | 1.563 | 0.182 | 1.017 | 0.326 | 0.261 | 0.102 |
| High School | 1.894 | 0.141 | 1.182 | 0.067 | 1.207 | 0.108 | 0.684 | 0.061 |
| English Speaking Frequency | 2.688 | 0.122 | 3.168 | 0.045 | 3.204 | 0.059 | 3.819 | 0.067 |
| Work | 1.261 | 0.128 | 0.242 | 0.056 | 0.883 | 0.113 | 0.139 | 0.056 |
| School | 1.294 | 0.150 | 0.167 | 0.044 | 0.664 | 0.119 | 0.111 | 0.038 |
| Healthcare | 0.986 | 0.137 | 0.126 | 0.036 | 0.413 | 0.134 | 0.045 | 0.023 |
| Shopping | 1.315 | 0.104 | 0.318 | 0.059 | 0.878 | 0.138 | 0.106 | 0.052 |
| Social Activities | 1.786 | 0.115 | 0.593 | 0.120 | 1.069 | 0.149 | 0.136 | 0.061 |
| Emailing | 1.224 | 0.144 | 0.167 | 0.043 | 0.589 | 0.118 | 0.075 | 0.035 |
| Friends | 1.832 | 0.106 | 0.628 | 0.122 | 1.181 | 0.154 | 0.259 | 0.075 |
| Extracurricular | 1.587 | 0.098 | 0.344 | 0.099 | 0.896 | 0.195 | 0.070 | 0.045 |
| Roommates | 1.856 | 0.157 | 0.281 | 0.082 | 0.645 | 0.176 | 0.046 | 0.035 |
| Texting | 1.787 | 0.073 | 0.443 | 0.108 | 0.938 | 0.172 | 0.124 | 0.054 |
| Social Media | 1.781 | 0.105 | 0.384 | 0.105 | 0.865 | 0.185 | 0.130 | 0.060 |
| Movies | 1.371 | 0.111 | 0.580 | 0.090 | 1.151 | 0.090 | 0.253 | 0.079 |
| Internet | 1.484 | 0.148 | 0.286 | 0.064 | 0.741 | 0.136 | 0.135 | 0.047 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Switch on Social Media | 2.398 | 0.106 | 0.841 | 0.181 | 1.530 | 0.320 | 0.314 | 0.077 |
| Neighbors | 1.246 | 0.163 | 0.302 | 0.081 | 0.658 | 0.134 | 0.110 | 0.044 |
| TV | 1.598 | 0.115 | 0.643 | 0.098 | 1.170 | 0.130 | 0.244 | 0.073 |
| Lists | 1.700 | 0.154 | 0.134 | 0.044 | 0.374 | 0.138 | 0.018 | 0.023 |
| Reading | 1.580 | 0.158 | 0.391 | 0.067 | 0.790 | 0.105 | 0.190 | 0.054 |
| Switch w/ Friends | 2.448 | 0.113 | 1.558 | 0.202 | 1.928 | 0.254 | 0.508 | 0.121 |
| English Understanding | 8.957 | 0.250 | 9.632 | 0.079 | 9.874 | 0.067 | 9.765 | 0.058 |
| English Reading | 9.482 | 0.174 | 9.935 | 0.024 | 9.923 | 0.034 | 9.969 | 0.019 |
| English Writing | 8.495 | 0.312 | 9.296 | 0.106 | 9.707 | 0.134 | 9.538 | 0.095 |
| English Speaking | 8.662 | 0.264 | 9.541 | 0.086 | 9.830 | 0.092 | 9.688 | 0.072 |
| English Writing Frequency | 2.740 | 0.151 | 3.386 | 0.056 | 3.355 | 0.081 | 3.881 | 0.051 |

composite solution, the first set with both Factors 1 and 2 present had a set consistency of .997 and unique coverage of .247. The second set, Factor 2 membership and the exclusion of Factor 3, had a consistency score of .974 and unique coverage of .059.

Finally, the fsQCAs for low-cut composite score membership were repeated, including the latent profile information from the $k = 4$ Model 1 solution. For the profile 1 "balanced" bilingual fsQCAs, the solution was comprised of three sets, with an overall consistency score of .992 and coverage of .581. The first set only required the presence of profile 1 and had perfect consistency (1.00). The second set required both Factors 1 and 2 present and had a high set consistency score (.997). The third set required Factor 2 membership with the absence of Factor 3, and also had a high consistency score (.974). For profile 2 "L1-L2 shift" bilinguals, the fsQCA found a similarly configured three set solution, with an overall solution consistency score of .990 and coverage of .469. The first set required profile 2 membership and the presence of Factor 2 and had perfect consistency (1.00). The second set required the presence of both Factors 1 and 2, with a set consistency score of .997. The third set required only the presence of Factor 2 but the absence of Factor 3, with a consistency score of .974. The fsQCA for profile 3 "proficient" bilinguals found a three set solution, with an overall solution consistency score of .987 and coverage of .518. However, the first set required the absence of profile 3 membership, suggesting this solution should be more carefully interpreted, as well as the presence of Factor 2, with a set consistency of .994. The second set required both Factors 1 and 2 membership, with a set consistency of .997. The third set required profile 3 membership and Factor 3 presence, and had a set consistency score of .967 but had a unique coverage value of only .027. Finally, the fsQCA for profile 4 "n-ELLs" also had a

Table 14

*Fiss Configuration Chart for All Available LSBQ Data.*

| | *Profile* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High Cut* | | *Low Cut* | | *1 – Balanced* | | | *2 – L1-L2 Shift* | | | *3 – Proficient* | | | *4 – n-ELL* | | |
| *Profile* | - | - | - | - | ● | | | ● | | | ⊗ | | ● | | ⊗ | ● |
| *Factor 1* | ● | | ● | | | ● | | | ● | | | ● | ● | ● | | |
| *Factor 2* | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● |
| *Factor 3* | | ⊗ | | ⊗ | | | ⊗ | | | ⊗ | | | ● | | ⊗ | ● |
| Consistency | .790 | .831 | .997 | .974 | 1.00 | .997 | .974 | 1.00 | .997 | .974 | .994 | .997 | .967 | .997 | .984 | .947 |
| Raw Coverage | .394 | .197 | .352 | .164 | .295 | .352 | .164 | .213 | .352 | .164 | .379 | .352 | .129 | .352 | .158 | .023 |
| Unique Coverage | .274 | .077 | .247 | .059 | .170 | .189 | .029 | .058 | .161 | .035 | .139 | .010 | .027 | .239 | .058 | .009 |
| Solution Consistency | .802 | | .988 | | .992 | | | .990 | | | .987 | | | .990 | | |
| Solution Coverage | .471 | | .411 | | .581 | | | .469 | | | .518 | | | .419 | | |

three set solution, with an overall consistency score of .990, with solution coverage of .419. The first set only required Factor 1 and 2 membership, with a set consistency score of .997. The second set required the absence of profile 4 membership, again requiring careful interpretation, along with the presence of Factor 2 and the absence of Factor 3, with set consistency of .984. The third set required the presence of profile 4, Factor 2, and Factor 3, and had a set consistency score of .947 but a low unique coverage of .009 for the entire sample.

## Discussion

The combined dataset for all available LSBQ responses further supports the utility of LPA and fsQCA for identifying and characterizing bilingual subtypes using these data. The LPA for Study Four resulted in a $k = 4$ model, similar to the LPA from Study Two. The present model also found four profiles previously identified, including a set of "balanced" bilinguals, "L1-L2 shift" bilinguals, "proficient" bilinguals, and "n-ELLs," supporting the hypothesis that a combined dataset will reidentify previous subtypes of bilinguals. While this final model does differ in parameters and identified profiles from Study One and Study Three, there appears to be stronger support for this particular configuration over the alternatives with these combined data. The "receptive" profile members from Study One seem to be reidentified into the "L1-L2 shift" or "proficient" profiles, while the earlier identified "ELL" group from Study One appears to be merged into the "L1-L2 shift" group. Finally, the fsQCA showed several configurations involving these profiles that contribute towards bilingual status for researchers to consider. These configurations suggest that the particular sets of conditions in each profile differ from the earlier studies, which does not support the hypothesis that the combined dataset will have

the same profiles with the same sets of conditions contributing to bilingualism as previously observed.

The profile 1 “balanced” bilingual group was again found in these combined data and had similar estimates as in the previous three studies. On Figure 9, it at first appears that these individuals are heavily using non-English over the other profiles in the sample, but the estimates in Table 13 show that while there does again appear to be a slight preference towards non-English in Factor 1, non-English home use and proficiency, while the estimates for Factor 2, non-English social use, are more centered around the middle ranges of the Likert scale. The appearance of a non-English preference for this profile in Figure 9 suggests that across the sample there is a slight bias toward English use, as Figure 9 is scaled around the mean of the sample. This is made more apparent by profile 4 “n-ELLs” estimates only being 0.5 to 1.0 standard deviation below the sample mean on the same graph. One striking feature about this “balanced” group of bilinguals is the relatively “low” English understanding and speaking proficiency, relative to the other profile estimates. Table 13 shows that the profile estimate for English understanding is 8.96 (*SE* = 0.25) and is 8.66 (*SE* = 0.26) for English speaking, while the other three profiles identified have estimates above 9.6 for English understanding and above 9.5 for English speaking.

The fsQCA for “balanced” bilinguals found high overall solution consistency (.992) for these profile members meeting the LSBQ low-cut composite score criteria. In the Fiss chart (Table 14), the first set solution involving this profile required only the presence of “balanced” bilingual membership and actually had perfect consistency (1.00), indicating that all members of this profile achieved the low-cut composite score. The

remaining two sets were identical to the solutions seen for the high-cut and low-cut composite scores and did not include additional profile membership information. These results indicate that for this LPA, simply being classified as a "balanced" bilingual was the only necessary condition to meet the low-cut criteria of bilingualism, or at least to no longer meet "monolingual" classification. Furthermore, this provides good support for the identification of the latent "balanced" bilingual profile, as the theoretical definitions of this subtype of bilingualism require active use of an L1 and L2.

This LPA also identified profile 2 as the same "L1-L2 shift" bilinguals previously seen in these samples. The estimates for this profile (Table 13) clearly show an early developmental preference towards non-English use, particularly with individuals' grandparents, parents, and other relatives. However, by primary and high school, the estimates show a preference towards English use, and all Factor 2 items, non-English social use, clearely trend towards English use having the second lowest scores of any profile, with only "n-ELLs" having stronger English use estimates here. However, unlike results from Study One where a "receptive" bilingual profile was identified that had a similar shift towards English dominated use, the estimates for non-English understanding (8.56, *SE* = 0.18 ) and non-English speaking (8.15, *SE* = 0.26) proficiencies are still quite high, and these individuals are likely still reasonably proficient in their non-English language.

These individuals, having a more dominant shift towards English in their social language use, are still readily classified as bilingual, supported by the results of the fsQCA. Like the fsQCA for "balanced" bilinguals, the overall solution consistency for "L1-L2 shift" bilinguals was very high (.990), and included two sets that were identical to

the solutions for low-cut and high-cut composite score outcome without additional profile membership information. In a further similarity to the "balanced" bilingual fsQCA, the only set that included "L1-L2 shift" membership also had perfect consistency (1.00) and required profile membership as well as the presence of Factor 2, non-English social use. This configuration suggests that in order for "L1-L2 shift" bilinguals to meet the LSBQ low-cut composite score, members needed to have more balanced English and non-English social use, remembering again that the composite score favors non-English values as contributing to higher composite scores. Reviewing Figure 8 however, the majority of "L1-L2 shift" bilinguals meet at least the low-cut criteria, with visually a little more than half above even the high-cut criteria. Thus, while Factor 2 presence with "L1-L2 shift" membership results in perfect consistency, it would appear that a number of other combinations occur with profile membership that do not have as high of a consistency score for resulting in the low-cut composite outcome. This may be reflective of the variety of conditions that "L1-L2 shift" bilinguals experience as a feature of this language classification. Kohnert and Bates (2002) discuss their findings in sequential Spanish-English bilinguals who would likely fit the present definition for "L1-L2 shift" bilinguals, describing their sample as having consistent non-English use at home with strong English social use and eventual dominance in English over time. While Kohnert and Bates' (2002) study found relatively consistent English exposure after age 4 outside of the home with solely Spanish at home for the bilinguals in their sample, they discuss a comparison sample of German-Swedish sequential bilinguals who were found to have more "balanced" exposure at home. While this second sample drew from the U.S. Southwest where data similar to Kohnert and Bates' (2002) would be expected, the first

sample was not drawn from this same geographic area, and the at home language exposure for "L1-L2 shift" individuals in that sample may vary, accounting for the omission of Factor 1 membership information in the fsQCA.

Profile 3 "proficient" bilinguals were also identified in the LPA, as in studies One and Two previously. This profile is characterized here as having early exposure to both English and non-English, with a slight trend towards English including during infancy and with older family members. This differs from the previous estimates for "proficient" bilinguals, and the responses for this portion of the entire LSBQ itemset appear to fit in between the Study One identified "proficient" and "moderate" bilinguals. Given that the present LPA did not identify a "moderate" profile, it may be that many of these previously "moderate" individuals are classified as "proficient" and the lowered estimates reflect these differences. The items reflecting later development and current day-to-day use, such as primary, work, social activities, and texting all are more in-line with slightly skewed "proficient" bilingual estimates, which are near the middle of the scale but with a mild preference towards English. Finally, estimates are high for this profile's English understanding (9.87) and speaking (9.83), with their non-English understanding (8.44) and speaking (7.72) still reasonably high but not nearly as proficient as their stated English proficiencies. As discussed earlier, the LPA did not identify a "receptive" group of bilinguals in the final model and it may be that those previously identified individuals were reclassified in either the "L1-L2 shift" or "proficient" profiles. Both profile's non-English speaking estimates would support this conclusion, including both proficiency and frequency which are somewhat lower than previous estimates for these groups have been.

The fsQCA for “proficient” bilinguals resulted in three sets for an overall solution consistency of .987, but the first set required the absence of profile membership while the second did not include profile status and actually matched one of the earlier described sets for composite score. The first set required absence from “proficient” bilingual membership as well as the presence of Factor 2, non-English social use. This configuration suggests that for individuals who did not meet this “proficient” profile criteria, using both English and non-English frequently in social situations was often sufficient for bilingual identification. This provides further support that non-English social use is likely very important in bilingual status as measured by the LSBQ, but the requirement for the absence of “proficient” bilingual membership is counterintuitive. One explanation could be that for “proficient” bilinguals, a higher non-English social use score is necessary to compensate for the earlier discussed English home use preference in order to achieve the requisite LSBQ bilingual composite score. This set could explain that by finding “proficient” bilingual members who have more evenly distributed non-English and English social use do not regularly meet the composite score criteria, thus, the exclusion from “proficient” membership would be necessary for this configuration. Figure 8 shows that many “proficient” bilinguals do not meet either the high-cut or low-cut bilingual composite score criteria, likely through a number of causes including lower Factor 1 and Factor 2 scores.

The third set in the “proficient” bilingual fsQCA found that the presence of “proficient” bilingual membership, Factor 1, non-English home use and proficiency, and Factor 3, English proficiency and use, had a set consistency score of .967, although a low unique coverage score of just .027. This suggests that “proficient” bilinguals with high

English use and proficiency nearly always met the LSBQ bilingual classification, but that this specific configuration without additional Factor 1 or Factor 2 information only occurred in the sample 2.7% of the time. It is unclear why this occurred so infrequently but is likely related to the fsQCA process itself. As in the observed "L1-L2 shift" profile, it is likely that there is variation or unidentified heterogeneity in the items within the "proficient" profile, such that the fsQCA could only consistently identify this set configuration as regularly contributing to the desired LSBQ composite score outcome. These differences could exist in non-English home or social use, hence why neither is included in the resulting set solution for this profile. The item estimates for each profile suggest that each subtype of bilingual had different use cases for their languages as identified in the LSBQ, but the estimates themselves do not guarantee that all members assigned to a given profile will closely follow all of the estimates for the profile. There could be individuals that best fit this "proficient" profile out of the four potential classes in the model, but who differently use their languages than other members of the same profile, such as with specific family members or in particular social situations. As such, they may share similarities across many items, enough to be identified as a "proficient" bilingual but have different factor scores and ultimately a different composite score.

The LPA for these combined data also identified the "n-ELL" profile as seen in Study One and Study Two, although Study Two was a grouped "L2 learner" profile rather than a language-specific profile. These combined data made a direct English versus non-English comparison, thus the reidentification of the "n-ELL" individuals. The estimates for this group were the most clearly English preferring of the sample, with all items reflecting their English proficiency and use. Additionally, the estimates for non-

English understanding (4.34) and speaking (3.24) were the lowest estimates of any language for all profiles and would suggest either low-proficiency or a lack of proficiency in non-English speaking and understanding. As suggested with previous "n-ELLs," these are likely individuals who only recently began learning a non-English L2, or only briefly used one for a period of their life after early childhood language development. The estimates for English use frequency as well as familial language use both support high levels of English-only use in their early life, supporting that "n-ELLs" grew up in a monolingual English household. Additionally, it is unlikely that these members have the opportunity to learn their non-English L2 in their community, as all estimates for social use items are heavily skewed towards English preference as well. It is likely that the limited non-English L2 proficiency this profile has is either being acquired through post-secondary education or was only briefly present during another period of their lives.

The fsQCA results support this conclusion, as the only set that involved "n-ELL" profile membership also required sufficient Factor 2 and Factor 3 proficiency in order to achieve a sufficient LSBQ composite score. However, this set also only had a unique coverage of .009 indicating this configuration occurred extremely infrequently, likely reflecting the fact that the "n-ELL" profile estimates do not support that a member would have sufficient non-English social use. Figure 8 also supports that the majority of "n-ELL" individuals do not meet the LSBQ composite score criteria and should not yet be considered bilingual. The low coverage associated with the "n-ELL" profile membership in the fsQCA is then reflective of this, given that the outcome of the analysis was bilingual identification through the LSBQ.

The composite score values were also investigated directly using only the factor score information and found two identical solution configurations for both the low-cut and high-cut LSBQ composite scores. The first set necessitated the presence of both Factor 1 and Factor 2, while the second required Factor 2 with the absence of Factor 3. Importantly, the second set had low unique coverage for both the high-cut (.077) and low-cut (.059) solutions, indicating this exact configuration did not occur frequently in these data. The common factor in both sets, non-English social use, suggests that this feature crucial in qualifying as bilingual. While it is not the only necessary condition for bilingualism, its presence in both sets indicates that the contribution of non-English social use is critical for the LSBQ composite score and bilingual classification. However, as discussed in Study One, the current version of the LSBQ directly compares English versus non-English and does not consider bilingualism from the "neutral" perspective that studies Two and Three did, and therefore "non-English" social use specifically may be less accurate in other bilingual contexts than "L2 social use" would be. For these data, all answers were converted to reflect the same "English versus non-English" Likert scale as in the data from Study One. Given this, if it were possible to convert the original Anderson et al. (2019) dataset to reflect an "L1 versus L2" scale, it might be expected to observe the same importance of "L2 social use" contributing to bilingual classification, as this component was considered critical in the fsQCA for the composite score classification.

It is also possible that by making the LSBQ administration "language neutral" in Study Two, the response patterns obscured the ability of the LPA to identify the same "receptive" and "ELL" profiles previously seen. Ramirez-Esparza et al. (2006) found that

Spanish-English bilinguals responded differently on a personality index depending on which language that index was delivered in. The differing results for the LPA in these three studies that looked only at the LSBQ items could be in part related to individual perceptions of their languages, and as seen in Ramirez-Esparza et al.'s (2006) study, responses may be unconsciously affected by the presentation of the participants' languages in the questionnaire. As discussed earlier, Study One explicitly stated "English" and "non-English," while Study Two used an autofill option to present the participant's stated L1 and L2 and by doing so, may have made individual perceptions of culture more salient. It was suggested that the CFS effect may be present in Study Three, particularly as it relates to supplementary items, and it cannot be ruled out that it may also be present in the general LSBQ items in this study. Furthermore, the supplementary questionnaires provided support for the reidentification of several of these profiles, although the inclusion of these measures did not support an LPA that identified an "n-ELL" or "ELL" group. Because these items were only administered to the second Southwest U.S. sample, the present study is unable to include these measures in Study Four to attempt to better classify individuals to profiles using information regarding their bicultural identity, perceptions of culture, and other cultural practices. Finally, all recruitment measures for collecting the second sample were only presented in English and all materials were only made available in English. It may be that the present study was unable to recruit an "ELL" group in this second sample, and the subsequent LPAs from this combined dataset were unable to effectively characterize a relatively smaller group compared to the larger identified groups in the final model. As such, the previously

identified “ELLs” from Study One were reclassified into other profiles in this model that may not describe them as accurately as the “ELL” profile in Study One does.

## General Discussion

Each of these studies provided support for using latent modeling to identify and describe bilingual subtypes through a language background questionnaire. These studies were able to use two separate samples of bilinguals who completed the LSBQ and apply LPA to identify several latent profiles in each sample, as well as reidentify several of the previously identified profiles with similar estimates. The Anderson et al. (2018) data was found to best fit a $k = 6$ profile solution, while a second Southwest U.S. sample best fit a $k = 4$ profile. After combining these data, a $k = 4$ profile solution was found to best describe these data, and the estimates suggested that the same profile names used for the Southwest U.S. sample were able to describe these combined data as well. Latent models were able to consistently identify a “balanced” bilingual profile, a “proficient” bilingual profile, an “L1-L2 shift” profile, and a low-proficiency L2 learner group or more specifically, an “n-ELL” group. Each of these profiles was named such according to the profile estimates that best described their language histories, proficiencies, and use-patterns and each matched somewhat with previously discussed subtypes of bilinguals in the extant literature.

Across all studies, analyses identified a profile best described as a “balanced” bilingual, due to the relatively even proficiencies in their L1 and L2, as well as reporting using both languages in many situations both at home and in their social lives, along with more frequent language switching practices. While the term “balanced” should not be taken literally, and researchers have sometimes used “nearly balanced” to convey this

nuance, the concept of a "balanced" bilingual is one who has high levels of proficiency in their L1 and L2, including having frequent early developmental use of both languages, and maintains frequent use of both during their current life practices (Surrain & Luk, 2019; Yow & Li, 2015). These identified "balanced" profiles fit this definition well, having high proficiencies for their L1 and L2 in all four models, as well trending most towards the mean of the LSBQ Likert scales for language use frequency. While the Southwest U.S. sample geographically is from a region that does not officially require bilingual language support in non-English languages, a "balanced" group was still identified here, suggesting that these individuals are able to practice both their heritage language and mainstream language in daily contexts.

A "proficient" bilingual profile was also consistently identified, which had similarly high levels of proficiency in their L1 and L2 as the "bilingual" group did. However, this group differed in that they still showed some preference towards using their L1, or in the case of Study One, English, throughout their social lives. It appears that this profile largely consists of individuals who grew up speaking two languages including English at home, and whose family may have had a slight preference towards using a non-English L2, but who generally prefer to use their English L1 in daily social contexts. Additionally, the estimates for these "proficient" bilinguals suggested relatively frequent switching habits with their family, these individuals reported language switching less frequently with their friends or on social media compared to the "balanced" profile. It is likely that these "proficient" bilinguals speak a language combination that is not common where they live or spend their social time, or alternatively, these individuals may feel

more comfortable speaking their English L1 in these contexts even if they have the opportunity to choose either their L1 or non-English L2.

While the "L1-L2 shift" profile did not directly appear in Anderson et al.'s (2018) data, it was identified in the Southwest U.S. bilingual sample and the identification of this class persisted after combining the two datasets. This profile, when identified, matched some descriptions of a heritage bilingual or sequential Spanish-English bilinguals who shift from Spanish proficiency towards English proficiency dominance (Kohnert & Bates, 2002; Kohnert, Bates, & Hernandez, 1999; Ortega, 2019). This profile is characterized by strong early exposure to and development of an L1, most frequently non-English in these data, followed by the onset of L2 development usually coinciding with preschool or primary school ages. While the home language practices continue to support L1 development and use, the estimates found in these models suggest that these "L1-L2 shift" bilinguals began developing stronger L2 proficiencies and using their L2 more exclusively in all contexts outside of the home. Finally, current proficiency estimates suggest that these individuals have high L2 understanding and speaking skills, but are often only moderately proficient in L1 understanding and slightly lower L1 speaking abilities. As Kohnert and Bates (2002) found in their research, these individuals generally appear to "shift" language dominance from their L1 towards their L2 around young adolescence, in part due to the language of instruction and mainstream language practices, and these estimates support the relationship between the identified "L1-L2 shift" profile members and bilinguals with this language shift.

Finally, latent analyses consistently identified an "L2 learner" or "n-ELL" group of individuals in several of the resulting models. These profile members all had strong

developmental histories of L1 use as well as dominant L1 social use and a high proficiency in all areas of their L1. Their L2 ratings were significantly lower, often below what may be considered proficient, and there were no items on the LSBQ that indicated a preference towards using their L2 over their L1. As such, these individuals are likely "approaching" bilingualism, or may have only had a brief period of L2 exposure and proficiency that has since atrophied. While these individuals may not meet stringent definitions of bilingualism, their identification in these data provided some support for the utility of the LSBQ composite score for assessing bilingualism. When comparing observed composite scores for the classified members of each profile, "n-ELLs" and "L2 learners" seldom met Anderson et al.'s (2018) high-cut composite score criteria to be considered sufficiently bilingual. Often, members of this profile fell below the monolingual low-cut composite score or between this low-cut score and the high-cut score, reflecting their L2 and bilingual development.

The present studies also provided evidence for various sets of conditions that differently contribute towards the identification of these profiles and their bilingual status through iterative fsQCAs. The repeated fsQCA resulted in different configurations involving some of the key factors of bilingualism, both on a macro scale for whether or not an individual may be considered bilingual, as well as on a meso scale characterizing the factors that define the latent profiles identified in the LPAs. However, the majority of these configurations did not directly match between samples, requiring further consideration. It had been theorized that the conditions that contribute towards bilingualism and the subtypes of bilingualism identified in the LPAs would share similar necessary and sufficient conditions, but these data did not support this conclusion. In the

high-cut composite score fsQCAs, only one matching configuration was found between Anderson et al.'s (2018) sample and the Southwest U.S. sample, which required the absence of factors 1, 2, and 3. As discussed, due to the calibrations for factors 1 and 2, this configuration indicates that individuals who predominantly use their non-English language in the Anderson et al. (2018) sample or their L2 in the Southwest U.S. sample, but also has low proficiency English or L1 abilities. This configuration appearing twice supports the conclusion that the current application of the LSBQ composite score overweighs the use of L2 in the classification of bilingualism. Furthermore, as demonstrated in Study One, an individual who solely used a non-English language would have a higher calculated composite score than one who reported an even split between their English and non-English languages. Study Two attempted to remove some of this bias by removing the explicit "English versus non-English" Likert scale comparison, but these fsQCA results suggest that the composite score still retains some of these biases. Figure 3 visualizes this bias, as the L1-L2 shift profile is almost entirely classified as above the low-cut composite score, with the majority above the high-cut as well.

The continued presence of this bias in the current calculation of the composite score supports the need to rethink how the composite score should be treated, particularly if the "L1 versus L2" Likert scale is adopted as suggested. The LSBQ composite score calculator overvalues non-English in Study One and overvalues L2 in Study Two, due to the way the factor loadings are applied to the items and summed into the composite score as Anderson et al. (2018) suggest. These biases are apparent first in Figure 1, where the identified "ELL" profile consistently has a higher composite score than the "n-ELL" profile, even though these profiles should have similar bilingual classifications when

considering bilingualism on a spectrum of language use. In fact, generating a test case with Anderson et al.'s (2018) composite score calculator demonstrates that an individual who reports no English proficiency and uses solely a non-English language would yield a composite score of 28.50, well above the 1.23 cut score, while an English-only monolingual would score a -6.58. Even after applying an "L1 versus L2" scale to these data to address this non-English bias, Figure 3 suggests this change may continue to overvalue L2 use and proficiency, by counting most of the "L1-L2 shift" profile members as sufficiently bilingual. Some of these individuals report speaking almost solely their L2 however, with only limited L1 use since their early developmental years, which may no longer meet more stringent definitions of bilingualism. In reviewing these "L1-L2 shift" scores and generating test cases of language use and histories in Anderson et al.'s (2019) composite score calculator, an individual with early L1 exposure through infancy, who then began using solely their L2 beginning in preschool and reports no current L1 daily use or proficiency would have a composite score of 24.66, classifying them as bilingual. Additionally, the specific language acquisition order may be important to the researchers, as might be the case when comparing the "n-ELLs" and "ELLs" in these samples if the study investigates outcomes related to participants' heritage language and the language they are learning. For instance, in a study investigating subjective experiences of language discrimination, where participants are asked how they feel using both of their languages in public as is done in the LEADS and SAS, the bilinguals whose heritage language matches the mainstream language may have very different subjective experiences to those whose heritage language does not. Alternatively, if a study is interested in biological outcomes of bilingualism, the language acquisition order may be

less important than the overall language use and history, requiring researchers to consider both of these applications carefully. Given both of these approaches have their uses and drawbacks, researchers may also consider another method for recalculating the composite scores entirely.

When the LSBQ is administered, participant responses to these questions be rescaled prior to calculating factor and composite scores. The current Likert scale reflects a continuum of bilingualism, with only the middle values being considered "split" or "balanced" bilingualism. As such, a response of "2" should be considered the highest possible score used in calculating the factor scores. Responses of "1" or "3," representing "mostly English / L1" or "mostly non-English / L2" respectively, should both be considered a value of 1 in the composite score calculator, while responses of "0" and "4" indicating "only English" or "only non-English" respectively should be scored as 0. In this way, the use of either English or non-English is valued the same in the composite score calculator, and the highest valued score on the Likert scale is those responses that indicate a "balanced" use of bilingualism. Using this suggestion, the highest possible composite score should be 16.00, which would represent an individual who indicated using both English and a non-English language evenly throughout their entire development and in all of their daily and social use cases, while also having perfect English and non-English proficiency in understanding and speaking.

To demonstrate the effect of this transformation on the composite score and the identified $k = 4$ bilingual subtypes from Study Four, Figure 13 uses the same latent profile identification for each participant, reflecting their actual responses to the LSBQ, but has rescaled the calculation of the factor scores and composite scores with the above

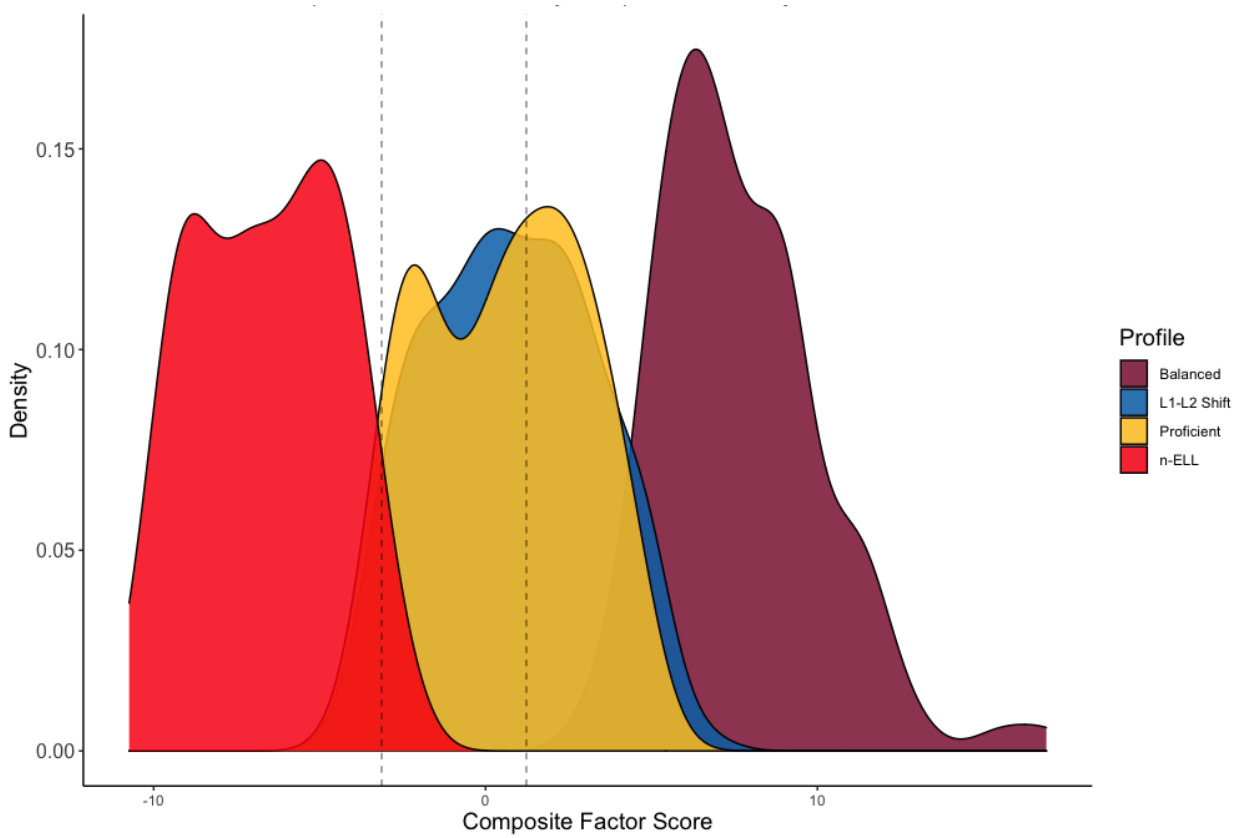


*Figure 13. Density Graph of Recalculated LSBQ Composite Scores Grouped by Identified Latent Profile for Model k = 4.*

recommendations. The figure illustrates how "balanced" bilinguals are considered on this composite score, with the entire profile classified above Anderson et al.'s (2018) high-cut value. At the same time, both "proficient" and "L1-L2 shift" bilinguals have their composite score distributions shifted to the left, a result of lower composite score values from the recalculation. Many members of these profiles are still classified as "sufficiently bilingual," but the L2 bias in weighting the composite score appears somewhat more mitigated, as both groups have similar ranges in this measure. Finally, the "n-ELL" group is entirely classified below the high-cut score, and many might still be considered "monolingual" using the composite scoring alone. The results of this transformation thus more heavily weight current daily and more frequent bilingual use, where individuals use both of their languages in more situations, rather than more heavily weighting L2 dominance, as in the case of the "L1-L2 shift" bilinguals, or non-English language use specifically. These findings suggest that by using this rescoring method, Anderson et al.'s (2018) high-cut composite score of 1.23 for bilingualism may remain a valid cut-score for researchers to apply when considering bilingual classification for a given sample, but additional measures beyond the LSBQ should be investigated to find converging support for this method and reapplication of the cut score values, including standardized measures and additional contextual measures of language use as recommended by previous studies (de Bruin, 2019).

These results may also prove useful for clinical consideration of language assessment tools currently in use. The present findings indicate that single measures such as the LSBQ may only correctly classify certain subtypes of bilinguals, while mischaracterizing others. In particular, the "ELL" group in Study One, and the "L1-L2

shift" groups in studies Two, Three, and Four were overidentified as bilingual due to the previously discussed weighting system used by the composite score, while the fsQCA identified specific ways that these subtypes tended to use their language that often were not indicative of mixed bilingual language use. With clinical research, bilingual language impairment has been found to be both underidentified and overidentified and is related to current assessments used to diagnose language impairment (Bedore & Peña, 2008). In their review, Bedore and Peña (2008) discuss two reasons for this in issues with the translation of assessments and the difficulty in developing norms for bilingual language development specifically. However, these studies demonstrate that different bilingual subtypes could be expected to have varying language development, and that a single set of bilingual language development norms may not applicable for all subtypes. In light of this, clinicians should consider developing multiple sets of norms relative to expected language development of the bilingual subtype being assessed. As was the case for the LSBQ, a single measure of bilingualism in the composite score was not able to be accurately applied to each subtype of bilingualism, and it may be that single measures of language impairment do not correspond to all bilingual subtypes as well. Developers of language assessments could benefit from approaching bilingual norms for their tests by identifying the expected language development patterns for different bilingual subtypes and consider including information for clinicians to identify the subtypes they are working with. Using language surveys in tandem with this LPA and fsQCA approach would be useful to identify these language development characteristics and provide guidelines for clinicians in practice, while at the same time allowing assessment developers to create different sets of norms for the many varying patterns of bilingual

language development. Clinicians would then be able to clearly identify and differentiate between typical language development within these bilingual subtypes from atypical development and provide treatment for these individuals.

The addition of the supplemental questionnaires provided further insight to the LPA identification in these samples, and supported the hypothesis that profiles identified as having different bilingual experiences and use cases would differ in their responses to cultural identification and perceptions of biculturalism. However, the hypothesis that bilingual subtype membership could be predicted by these supplemental questionnaires was not supported, with regression analyses not identifying a clear, but latent models demonstrated that individual experiences with language use as reported on the LSBQ were able to be classified with associated qualitative feelings regarding bicultural identification. Results support earlier findings that "balanced" bilinguals or those who report using their two languages more frequently and in more contexts also have higher reported feelings of bicultural integration and lower compartmentalization and categorization, all of which suggests a more cohesive bicultural identity (West et al., 2017; Yampolsky et al., 2016). At the same time, results indicated that the identified "L1-L2 shift" bilinguals tended to report higher feelings of compartmentalization, likely reflecting their language practice of using their L1 and L2 in more exclusive contexts, as well as overall lower levels of L1 and L2 identification relative to the rest of the sample. Lower integration, higher compartmentalization, and higher acculturation have all been previously predictive of lower well-being, but the present findings do not support those conclusions (Chen & Bond, 2010; Lee, 2008). It may be that the RSES used in this study

to measure well-being, self-esteem, and self-worth did not tap into the same perceptions of self-worth as in previous literature.

**Limitations**

The LSBQ asks for participants to report their language proficiencies in both of their languages, and results were recorded on a Likert scale ranging from 0 to 10. It is possible that participants with different perceptions of their fluency and proficiency may have responded differently, even if formal language testing would score them to be equally proficient, as subjective measures of language proficiency can be unreliable even in adults (Sheng, Lu, & Gollan, 2014). There is also evidence supporting the accuracy of self-ratings for language proficiency adults, as it has been found to correlate with objective measures, but the measures nonetheless remain open to bias not associated with actual proficiency (Marian et al., 2007). Future studies could corroborate the accuracy of proficiency ratings in the LSBQ by also administering formal or objective language proficiency measures.

Additionally, while fsQCA was used to characterize the conditions that contribute to bilingualism and latent profile membership, alternative methods could be used to assess predictive value of the variables towards profile membership, such as a latent regression mixture model (Pastor, Barron, Miller, & Davis, 2007). Using a latent regression mixture model would use the individual entropy for profile membership probability and allow researchers to characterize the predictive validity of each LSBQ item to latent profile membership. However, the LSBQ includes 42 items used in the composite score calculation, and the resulting analyses may be underpowered without a larger sample size given the number of predictors and depending on the identified *k*

profiles, and these results may difficult to interpret for researchers. Furthermore, using the factor scores as these studies did in the fsQCAs for a latent regression mixture model would also be prone to earlier the identified issues with the Likert scales used in the LSBQ, as both lower and higher scores on these factors are reflective of stronger monolingual use, with only the middle range of scores indicative of more evenly distributed bilingual language use. Higher factor scores in factors 1 and 2 would represent stronger L2 use, and the latent regression model may be influenced by this scaling, potentially weighting items that are more indicative of L2 use as contributing towards bilingual status. As such, the application of the fsQCA allows the present LSBQ responses and factor scores to be calibrated to reflect a more accurate interpretation of the Likert scales relationship to bilingualism, allowing researchers to understand the resulting sets that contribute to both bilingual classification and profile membership.

**Conclusion**

The present study demonstrated the validity of using latent modeling to characterize subtypes of bilinguals who respond to a language survey questionnaire. The resulting latent profiles identified were able to be classified according to previously hypothesized groups of bilinguals, and included estimates associated with each subtype that relate to the language uses and proficiencies of these bilingual subtypes. Results from the fsQCA support the hypothesis that the sets of conditions that contribute to individual profile membership can be used to further characterize these profiles and their classification as bilingual. While the supplementary questionnaires cannot be used to directly predict bilingual status, the inclusion of these data support earlier research that finds positive associations between higher degrees of bilingual language use and more

integrated bicultural identity. Furthermore, the supplementary information was related to previously identified latent profiles of bilingualism, supporting the hypothesis that bilinguals with similar experiences using their languages share some similarities in their subjective experiences of biculturalism and their individual language identities. Additional recommendations were made regarding the administration and scoring of the LSBQ in order to more accurately identify bilingualism in responses. Finally, the combined dataset did not result in the same latent model of bilingual subtypes but did reidentify several of the previously observed subtypes. These results provide only partial support for the hypothesis that a combined dataset would result in the reidentification of the bilingual subtypes from the previous studies. On the whole, these findings do support that the LSBQ and latent modeling techniques can be used to classify individuals to specific subtypes of bilinguals, with which researchers studying bilingualism may use to model the heterogeneity in a bilingual sample and better characterize the various subtypes of bilinguals within.

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# APPENDIX A

# LANGUAGE AND SOCIAL BACKGROUND QUESTIONNAIRE

Appendix A

Language and Social Background Questionnaire

**Lifespan Cognition and Development Laboratory**
**Ellen Bialystok, Ph.D., Principal Investigator**
Department of Psychology, York University

## Language and Social Background Questionnaire

Today's Date: _____ (Day / Month / Year) 1. Sex: Male ☐ Female ☐

2. Occupation/Student Status (i.e. FT/PT, current year of study): _____

3. Handedness: Left ☐ Right ☐ 4. Date of Birth: _____ (Day / Month / Year)

5. Do you play first-person shooting (FPS)/action video games? **Yes** ☐ **No** ☐
   If **yes**, on average how many hours do you play per week? _____

6. Do you have hearing problems? **Yes** ☐ **No** ☐
   If **yes**, do you wear a hearing aid? **Yes** ☐ **No** ☐

7. Do you have vision problems? **Yes** ☐ **No** ☐
   If **yes**, do you wear glasses or contacts? **Yes** ☐ **No** ☐
   Is your vision corrected to normal with glasses or contacts? **Yes** ☐ **No** ☐

8. Are you colour blind? **Yes** ☐ **No** ☐
   If **yes**, what type? _____

9. Have you ever had a head injury **Yes** ☐ **No** ☐
   If **yes**, please explain: _____

10. Do you have any known neurological impairments? (e.g., epilepsy etc) **Yes** ☐ **No** ☐
    If **yes**, please indicate: _____

11. Are you currently taking any psychoactive medications? **Yes** ☐ **No** ☐
    If **yes**, please indicate: _____

12. Please indicate the highest level of education and occupation for each parent:

| Mother | Father |
|---|---|
| 1. _____ No high school diploma | 1. _____ No high school diploma |
| 2. _____ High school diploma | 2. _____ High school diploma |
| 3. _____ Some post-secondary education | 3. _____ Some post-secondary education |
| Post-secondary degree or | Post-secondary degree or |
| 4. _____ diploma | 4. _____ diploma |
| 5. _____ Graduate or professional degree | 5. _____ Graduate or professional degree |
| Occupation: _____ | Occupation: _____ |
| First Language: _____ | First Language: _____ |
| Second Language: _____ | Second Language: _____ |
| Other Language: _____ | Other Language: _____ |

13. Were you born in Canada? **Yes** ☐ **No** ☐

If **no**, where were you born? _____

When did you move to Canada _____

**Year**

14. Have you ever lived in a place where English is not the dominant communicating language? **Yes** ☐ **No** ☐

| | | **From** | **To** |
|---|---|---|---|
| If **yes**, where and for how long? | 1. _____ | _____ | _____ |
| | 2. _____ | _____ | _____ |
| | 3. _____ | _____ | _____ |
| | | **Year** | **Year** |

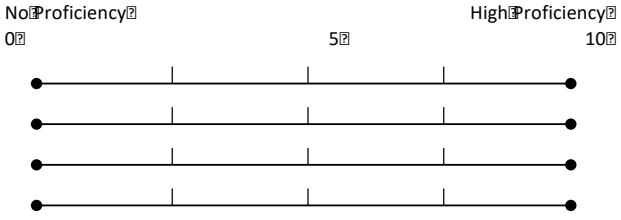
## Language Background

15. List all the language and dialects you can speak and understand including English, ***in order of fluency***:

| Language | Where did you learn it? | At what age did you learn it? (If learned from birth, write age "0") | Were there any periods in your life when you did not use this language? Indicate duration in months/years. |
|---|---|---|---|
| 1. _____ | ☐ Home ☐ School<br>☐ Community ☐ Other: _____ | | |
| 2. _____ | ☐ Home ☐ School<br>☐ Community ☐ Other: _____ | | |
| 3. _____ | ☐ Home ☐ School<br>☐ Community ☐ Other: _____ | | |
| 4. _____ | ☐ Home ☐ School<br>☐ Community ☐ Other: _____ | | |
| 5. _____ | ☐ Home ☐ School<br>☐ Community ☐ Other: _____ | | |

Relative to a highly proficient speaker's performance, rate your proficiency level on a scale of 0-10 for the following activities conducted in English and your other language(s).

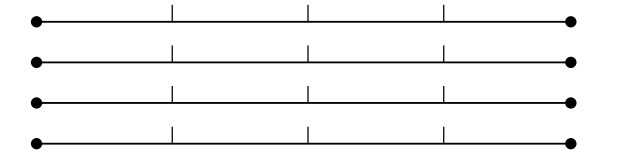
16.1 **English**




16.2 Of the time you spend engaged in each of the following activities, how much of that time is carried out in English?

| | None | Little | Some | Most | All |
|---|---|---|---|---|---|
| Speaking | ☐ | ☐ | ☐ | ☐ | ☐ |
| Listening | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reading | ☐ | ☐ | ☐ | ☐ | ☐ |
| Writing | ☐ | ☐ | ☐ | ☐ | ☐ |

17.1 **Other Language:** _____




17.2 Of the time you spend engaged in each of the following activities, how much of that time is carried out in this language?

| | None | Little | Some | Most | All |
|---|---|---|---|---|---|
| Speaking | ☐ | ☐ | ☐ | ☐ | ☐ |
| Listening | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reading | ☐ | ☐ | ☐ | ☐ | ☐ |
| Writing | ☐ | ☐ | ☐ | ☐ | ☐ |

## Community Language Use Behavior

18. Please indicate which language(s) you most frequently heard or used in the following life stages, both inside and outside home.

| | | All English | Mostly English | Half English half other language | Mostly the other language | Only the other language |
|---|---|---|---|---|---|---|
| 18.1 | Infancy | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18.2 | Preschool age | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18.3 | Primary School age | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18.4 | High school age | ☐ | ☐ | ☐ | ☐ | ☐ |

19. Please indicate which language(s) you generally use when speaking to the following people.

| | | All English | Mostly English | Half English half other language | Mostly the other language | Only the other language |
|---|---|---|---|---|---|---|
| 19.1 | Parents | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.2 | Siblings | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.3 | Grandparents | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.4 | Other Relatives | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.5 | Partner | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.6 | Roommates | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.7 | Neighbours | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19.8 | Friends | ☐ | ☐ | ☐ | ☐ | ☐ |

20. Please indicate which language(s) you generally use in the following situations.

| | | All English | Mostly English | Half English half other language | Mostly the other language | Only the other language |
|---|---|---|---|---|---|---|
| 20.1 | Home | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.2 | School | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.3 | Work | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.4 | Social activities (e.g. hanging out with friends, movies) | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.5 | Religious activities | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.6 | Extracurricular activities (e.g. hobbies, sports, volunteering, gaming) | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.7 | Shopping / Restaurants / Other commercial services | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20.8 | Healthcare services / Government / Public offices / Banks | ☐ | ☐ | ☐ | ☐ | ☐ |

21. Please indicate which language(s) you generally use for the following activities.

| | | All English | Mostly English | Half English half other language | Mostly the other language | Only the other language |
|---|---|---|---|---|---|---|
| 21.1 | Reading | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.2 | Emailing | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.3 | Texting | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.4 | Social media (e.g. Facebook, Twitter etc.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.5 | Writing shopping lists, notes, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.6 | Watching TV / listening to radio | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.7 | Watching movies | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.8 | Browsing on the Internet | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21.9 | Praying | ☐ | ☐ | ☐ | ☐ | ☐ |

22. Some people switch between the languages they know within a single conversation (i.e. while speaking in one language they may use sentences or words from the other language). This is known as "language-switching". Please indicate how often you engage in language-switching. If you do not know any language(s) other than English, fill in all the questions with 0, as appropriate.

| | | Never | Rarely | Sometimes | Frequently | Always |
|---|---|---|---|---|---|---|
| 22.1 | With parents and family | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22.2 | With friends | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22.3 | On social media (e.g. Facebook, Twitter) | ☐ | ☐ | ☐ | ☐ | ☐ |

**Thank you for participating!**

Appendix B

**Language and Social Background Questionnaire Administration and Scoring Manual**

**Administering the Language and Social Background Questionnaire**

It is possible for participants to complete the LSBQ on their own, but it is recommended that researchers administer the LSBQ in an interview format so that questions can be clarified and responses discussed. If the instrument is administered as a self-completion questionnaire, responses should be checked with the participant to clarify any ambiguous or contradictory responses. Language backgrounds are inherently complex, so discussion between the researcher and the participant is essential.

**Administering the LSBQ in interview format**

The first section contains demographic questions. Some items are specific to neuroimaging studies and may not be applicable to other research (e.g., **Items 9, 10, 11**). These questions should be tailored to the needs of the specific study and are not relevant to determining the participant's language status.

**Item 12** asks for parents' education, occupation, and language(s) they can speak. Parents' education is used as an estimated measure of the participants' socioeconomic. Parents' language knowledge is not included in the final factor structure, but it is important to ask to get a better picture of the participant's language background, particularly if other factors are ambiguous.
To help participants remember all of the answer options, turn the questionnaire so the participant can see the question page upright.

**Item 13** asks if the participant was born in Canada (or insert your home country). If their response is "no", then proceed to ask which country they were born in and when they moved to Canada.

**Item 14** asks if the participant ever lived in a country or region where English was not the dominant communicating language. While this question was not included in the final factor structure, it is useful for determining if the participant was in a community or society where they would be routinely exposed to or likely to practice a Non-English language. This question does not include vacations; it refers specifically to long term residence at least one year or longer. Participants who were not born in Canada, or another country where English is the dominant communicating language, should indicate their country of birth, year of birth and year they moved from that country in addition to any other countries in which they lived.

**Item 15** is the beginning of the Language Background section. The question contains a table on which the participants list all the languages and dialects they know in descending order of fluency. This refers to all the languages and dialects that they can speak and

understand, or just understand. The first column lists the languages the participant knows, the second asks where they learned the language, the third asks at what age they learned it and the last asks if there were any periods in their life that they did not use that language. The participant is asked to rank the languages in order from the language they can speak/understand the best to the poorest, irrespective of order of acquisition. Literacy is not relevant to these judgments, and dialects (e.g. Jamaican Patois, French Creole) are considered to be different languages.

If the participant indicates that they learned a language "from birth", record a "0", otherwise record the age the participant indicates. If the participant indicates a school grade, estimate the age and confirm with the participant.

The last column asks if there were any periods in which the participant did not use English. A response of "yes" requires specifying that period and stating that they did not use other languages. If the participant moved to another country and used another language but called their parents once a month and spoke with them in English, this does not count towards non-use of English, and the answer would be "no". If the participant says they "only use it a little bit", this also does not count because technically they are still using the language, although the frequency of use is low. If the participant did indeed stop using (hearing, speaking, reading, and writing) the language completely for a period of time then record the number of years that they did not use the language.

If the participant indicated knowing any other languages, proceed to ask the same questions for all of the languages on the list, in the same manner. If the research is being conducted in a country where the regular school curriculum requires students to take a foreign language course, researchers should inquire about the participants' knowledge of that language even if they do not mention it themselves.

**Items 16 and 17** ask participants to rate their proficiency and language use for English and a second language for speaking, understanding, reading and writing on a scale from 0 to 10, where 0 indicates no proficiency and 10 indicates high proficiency. Researchers should instruct participants to indicate how they would rate their proficiency by drawing a vertical line that intersects the scale. Sometimes participants indicate with circles or X shapes on the scale, to avoid difficulties with interpretation, we recommend the researcher demonstrate by drawing a vertical line through the first scale in item 16.1 as an example and then handing the pen to the participant to fill out the remaining scales. The scale is formatted to be 10 cm long. To calculate the participant's score, use a ruler to measure where their vertical line intersects the scale.

Item 16.2 asks how much time is carried out in English for speaking, understanding, reading and writing. The participant should check off one answer option for each activity in this language. Make sure that the participant does not check off more than one box.

If the participant has indicated knowledge of a second language, ask the same questions again for the other language. Replace the word "English" for the name of their other language when phrasing the questions verbally.

**Items 18 to 21** constitute the Community Language Use Behavior (CLUB) section of the questionnaire. Item 18 asks about language use throughout different life stages. Item 19 asks about language use with different people. Item 20 asks about language use in different situations. Item 21 asks about language use for different activities. Lastly, item

21 asks about language-switching. Items 18 to 20 are on a 5 point scale of All English, mostly English, half English half other language, mostly the other language, or only the other language. Item 21 is also on a 5 point scale of never, rarely, sometimes, frequently, or always. Monolinguals, who do not know a second language, should indicate "All English". The participant may indicate "not applicable" for some items; the researcher should make a note of this beside that item. The option of "not applicable" is not included in the questionnaire to avoid participants from choosing "not applicable" inappropriately or excessively (e.g., monolinguals choosing "not applicable" instead of "All English"). Item 22 inquires about language switching, something that participants may not be aware of doing. The researcher should clearly explain **"Some people switch between the languages they know within a single conversation, for example, speaking in one language but then using a sentence or word from another language. This is known as "language-switching."** At this point it is always useful to confirm that the participants understand the explanation. If they do not understand, it is be useful to illustrate with an example using the participants' own languages. For instance, if the participant knows English and French, explain: **"It would be like speaking in French to someone and then saying one sentence in English. Or speaking all French but using one English word."** Confirm that the participant understand what language-switching is before they answer the questions. Monolinguals, who do not know a second language, should indicate "Never" as they do not have a second language to switch between.

Sometimes inconsistencies or ambiguities appear in participants' responses. Researchers should always clarify any conflicting responses.

**Language and Social Background Data Entry and Factor Score Calculator**

**The Spreadsheet**

Data entry is done in the excel document titled, "LSBQ Factor Score Calculator". Some cells are locked to prevent changes from being made to constant values and formulas. These include:

- The second row which contains variables' weights, as derived from the factor analysis. This value refers to the variables weight on the factor on which it loads.
- The third and fourth row which contain the variables' means and standard deviations, which are used to calculate standard score.
- Columns AS- CM which contains formulas to calculate the factor score.

The factor score is calculated by multiplying the standard score ((Observed Score-Mean)/Standard Deviation) by the variable's weight and then summing all the variables that load onto that factor. The Factor Scores appear in columns CJ-CL.
The composite factor score is calculated by multiplying the individual factor scores by the variance they explain and then summing the three weighted factors. The Composite Factor Score appears in column CM.

Data entry is completed in columns A-AR. These cells area not locked.

**Data Entry**

Enter the data from your collected LSBQs in columns A-AR. Listed below is a table with all the variable names in the spreadsheet, the item they correspond to, and the value to enter.

Value Legend:
A = number ranging from 0 to 10
B = None=0 Little=1 Some=2 Most=3 All=4
C = All English= 0 Mostly English=1 Half English half other language=2 Mostly the other language= 3 Only the other language= 4
D = Never=0 Rarely=1 Sometimes=2 Frequently= 3 Always=4

| Variable Name in Spreadsheet | Item number on LSBQ | Value |
|---|---|---|
| ID | Subject ID | Subject ID |
| Grandparents | CLUB Q 19 | C |
| Infancy | CLUB Q 18 | C |
| Switching_with_Family | CLUB Q 22 | D |
| Non-Eng_Understanding | Language Background 17.1 | A |
| Non-Eng_Speaking | Language Background 17.1 | A |
| Relatives | CLUB Q 19 | C |

| | | |
|---|---|---|
| Preschool | CLUB Q 18 | C |
| Parents | CLUB Q 19 | C |
| Non-Eng_Listening_Frequency | Language Background 17.2 | B |
| Non-Eng_Speaking_Frequency | Language Background 17.2 | B |
| Home | CLUB Q 20 | C |
| Primary | CLUB Q 18 | C |
| Religious | CLUB Q 20 | C |
| Siblings | CLUB Q 19 | C |
| English_Listening_Frequency | Language Background 16.2 | B |
| Praying | CLUB Q 21 | C |
| HighSchool | CLUB Q 18 | C |
| English_Speaking_Frequency | Language Background 16.2 | B |
| Work | CLUB Q 20 | C |
| School | CLUB Q 20 | C |
| Health_Care | CLUB Q 20 | C |
| Shopping | CLUB Q 20 | C |
| Social_Activities | CLUB Q 20 | C |
| Email | CLUB Q 21 | C |
| Friends | CLUB Q 19 | C |
| Extra_Curricular | CLUB Q 20 | C |
| Roommates | CLUB Q 19 | C |
| Text | CLUB Q 21 | C |
| Social_Media | CLUB Q 21 | C |
| Movies | CLUB Q 21 | C |
| Internet | CLUB Q 21 | C |
| Switching_on_Social_Media | CLUB Q 22 | D |
| Neighbours | CLUB Q 19 | C |
| TV | CLUB Q 21 | C |
| Lists | CLUB Q 21 | C |
| Reading | CLUB Q 21 | C |
| Partner | CLUB Q 19 | C |
| Switching_With_Friends | CLUB Q 22 | D |
| English_Understanding | Language Background 16.1 | A |
| English_Reading | Language Background 16.1 | A |
| English_Writing | Language Background | A |

| | | |
|---|---|---|
| | 16.1 | |
| English_Speaking | Language Background 16.1 | A |
| English_Writing_Frequency | Language Background 16.2 | B |

**The Individual and Composite Factor Scores**

The individual and composite factor scores are automatically calculated in the spreadsheet.

- Column CJ, labelled "Non-English_Home_Use_And_Proficiency", is the factor score for Factor 1. A higher score on this factor indicates greater second language proficiency and greater second language use in more private life, home, and with family members. Lower score on this factor indicates poor or no second language ability and more English use in these contexts.
- Column CK, labelled "Non-English_Social_Use", is the factor score for Factor 2. A higher score indicates more second language use in societal and community contexts and a lower score indicates more English use.
- Column CL, labelled "English_Proficiency", is the factor score for Factor 3. A Higher score indicates High English proficiency and a lower score indicates low English proficiency.
- Column CM, labelled "Composite_Factor_Score" is the Composite Factor score and represents the overall Bilingualism Score. A higher score indicates bilingualism and a lower score indicates monolingualism.

**Interpreting the Composite Factor Score**

The composite factor score can be used both as a continuous variable and as a criterion to define groups categorically.

To classify participants in discrete groups, we recommend that only participants with composite factor scores below -3.13 be classified as monolingual and only participants with composite factor scores above 1.23 be classified as bilingual. Participants who lie between -3.12 and 1.22 may have ambiguous language backgrounds that cannot be classified as monolingual or bilingual, for example, receptive bilinguals. Receptive bilinguals have very different language profiles from both monolinguals and balanced bilinguals. Receptive bilinguals can understand a second language, however does not speak that language. It would not be appropriate for studies that aim to make comparisons between monolinguals and bilinguals to include these participants in either group because they are neither monolingual nor bilingual.

# APPENDIX B

# REVISED LANGUAGE AND SOCIAL BACKGROUND QUESTIONNAIRE INCLUDING REVISED ITEMS AND ADAPTED SUPPLEMENTARY QUESTIONNAIRES


## Consent & Captcha

I am a graduate student under the direction of Professor Tamiko Azuma in the College of Health Solutions at Arizona State University. I am conducting a research study to investigate individual experiences with bilingualism, and use survey information to better characterize how different people with bilingual backgrounds use and experience their languages, cultures, and self-identity.

I am inviting your participation, which will involve a 10- to 20-minute survey, asking you about various aspects of your language history and knowledge, language background, current language use, as well as your subjective feelings about aspects

of your cultural identity and self-esteem. You have the right not to answer any question, and to stop participation at any time.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. Upon completion of the survey, you will be entered into a raffle for one of five $25 gift cards, but compensation is not guaranteed for survey completion. You must be 18 or older to participate in the study and currently live in one of the following states; Arizona, California, Colorado, Nevada, New Mexico, Texas, or Utah.

Although there is no direct benefit to you, possible benefits of your participation are advancing scientific understanding of the bilingual phenomenon. There are no foreseeable risks or discomforts to your participation.

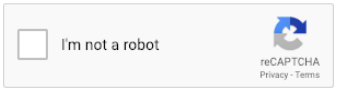
Your responses will be anonymous; we will only collect contact information necessary to reach you via email, should you win the raffle after we have completed data collection. Your email will not

be tied to your responses and will be collected through a separate form following survey completion. The results of this study may be used in research reports, presentations, or future publications but your name and identifying information will not be used. Results and data will only be shared in the aggregate form, meaning your data will be included with others' survey responses and will include no identifying information.

If you have any questions concerning the research study, please contact the research team at: Sam McGee, scmcgee@asu.edu, or Tamiko Azuma, tamiko.azuma@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

By continuing, you are agreeing to be part of the study.

Please complete the Captcha to continue to the survey.




## Background

Please list all of the languages and dialects you can speak and understand including English, ***in the order you are most fluent.***

Language 1 (*most* fluent)

Language 2

Other languages

Do you currently live in the Southwest United States? (Arizona, California, Colorado, Nevada, New Mexico, Texas, or Utah)

- ○ Yes
- ○ No

Please list all of the languages and dialects you can speak and understand including English ***in the order that you learned them***

***in.*** (1 = learned first, 2 = learned second)

*If you learned one or more languages from the same age, list them in the order that you are most fluent.*

${q://QID18/ChoiceTextEntryValue/1}

${q://QID18/ChoiceTextEntryValue/2}

${q://QID18/ChoiceTextEntryValue/3}

Please indicate your *Mother's* languages in the order she learned them. Leave blank any that do not apply.

| | |
|---|---|
| Mother's First Language | |
| Mother's Second Language | |
| Mother's Other Languages | |

Please indicate your *Father's* languages in the order he learned them. Leave blank any that do not apply.

Father's First Language

Father's Second Language

Father's Other Languages

Were you born in the United States?

- ○ Yes
- ○ No (Please report the age in years you moved to the U.S.)

Have you *ever* lived in a place where English is not the dominant communicating language?

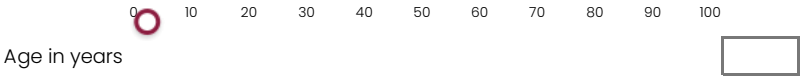
- ○ No
- ○ _____ Yes (If Yes, where?)

**Block 1**

Where did you learn ${q://QID18/ChoiceTextEntryValue/1}?

- ☐ Home
- ☐ Community
- ☐ School
- ☐ _____ Other (please describe)

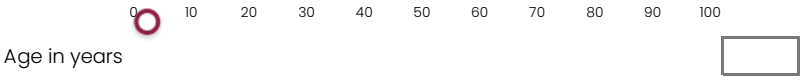
What age in years did you start learning ${q://QID18/ChoiceTextEntryValue/1}? (If learned from birth, select "0")




Where did you learn ${q://QID18/ChoiceTextEntryValue/2}?

- ☐ Home
- ☐ Community
- ☐ School
- ☐ Other (please describe)

What age in years did you start learning ${q://QID18/ChoiceTextEntryValue/2}? (If learned from birth, select "0")




Age in years

Relative to a highly proficient speaker's performance, *rate your proficiency* level on a scale of 0-10 for the following activities for ${q://QID18/ChoiceTextEntryValue/1}.

| | 0 = Not proficient, 10 = Highly proficient<br>0 1 2 3 4 5 6 7 8 9 10 |
|---|---|
| ${q://QID18/ChoiceTextEntryValue/1} Speaking | |
| ${q://QID18/ChoiceTextEntryValue/1} Understanding | |
| ${q://QID18/ChoiceTextEntryValue/1} Reading | |
| ${q://QID18/ChoiceTextEntryValue/1} Writing | |

Relative to a highly proficient speaker's performance, *rate your proficiency* level on a scale of 0-10 for the following activities ${q://QID18/ChoiceTextEntryValue/2}.

| | 0 = Not proficient, 10 = Highly proficient<br>0 1 2 3 4 5 6 7 8 9 10 |
|---|---|
| ${q://QID18/ChoiceTextEntryValue/2} Speaking | |
| ${q://QID18/ChoiceTextEntryValue/2} Understanding | |
| ${q://QID18/ChoiceTextEntryValue/2} Reading | |
| ${q://QID18/ChoiceTextEntryValue/2} Writing | |

Of the time you spend in each of the following activities, *how much of that time* is carried out in ${q://QID18/ChoiceTextEntryValue/1}?

| | None | Little | Some | Most | All |
|---|---|---|---|---|---|
| Speaking | ○ | ○ | ○ | ○ | ○ |
| Listening | ○ | ○ | ○ | ○ | ○ |
| Reading | ○ | ○ | ○ | ○ | ○ |
| Writing | ○ | ○ | ○ | ○ | ○ |

Of the time you spend in each of the following activities, *how much of that time* is carried out in ${q://QID18/ChoiceTextEntryValue/2}?

| | None | Little | Some | Most | All |
|---|---|---|---|---|---|
| Speaking | ○ | ○ | ○ | ○ | ○ |
| Listening | ○ | ○ | ○ | ○ | ○ |
| Reading | ○ | ○ | ○ | ○ | ○ |
| Writing | ○ | ○ | ○ | ○ | ○ |

**Block 2**

Please indicate which language(s) you *most frequently* heard or used in the following life stages, both inside and outside the home.

| | Only ${q://QID18/ChoiceTextEntryValue/1} | Mostly ${q://QID18/ChoiceTextEntryValue/1} | Both ${q://QID18/ChoiceTextEntryValue/1} and ${q://QID18/ChoiceTextEntryValue/2} equally | Mostl ${q://QID18/ChoiceT |
|---|---|---|---|---|
| Infancy | ○ | ○ | ○ | |
| Preschool | ○ | ○ | ○ | |
| Primary school age | ○ | ○ | ○ | |
| High school age | ○ | ○ | ○ | |

Please indicate which language(s) you generally use when speaking with the following people.

| | Only ${q://QID18/ChoiceTextEntryValue/1} | Mostly ${q://QID18/ChoiceTextEntryValue/1} | Half ${q://QID18/ChoiceTextEntryValue/1}, half ${q://QID18/ChoiceTextEntryValue/2} | M /Cho |
|---|---|---|---|---|
| Parents | ○ | ○ | ○ | |
| Siblings | ○ | ○ | ○ | |
| Grandparents | ○ | ○ | ○ | |
| Other relatives | ○ | ○ | ○ | |
| Partner | ○ | ○ | ○ | |
| Roommates | ○ | ○ | ○ | |
| Neighbors | ○ | ○ | ○ | |
| Friends | ○ | ○ | ○ | |

Please indicate which of your two primary language(s) you generally use in each of the following situations;

| | Only ${q://QID18/ChoiceTextEntryValue/1} | Mostly ${q://QID18/ChoiceTextEntryValue/1} | Half ${q://QID18/ChoiceTextEntryValue/1}, half ${q://QID18/ChoiceTextEntryValue/2} | M /Cho |
|---|---|---|---|---|
| Home | ○ | ○ | ○ | |
| School | ○ | ○ | ○ | |
| Work | ○ | ○ | ○ | |
| Social Activities (e.g. hanging out with friends, movies, etc.) | ○ | ○ | ○ | |
| Religious Activities | ○ | ○ | ○ | |
| Extracurricular Activities (e.g. hobbies, sports, volunteering, gaming, etc.) | ○ | ○ | ○ | |
| Shopping / Restaurants / | | | | |

| | | | |
|---|---|---|---|
| services / Government / Public offices / Banks | ○ | ○ | ○ |

Please indicate which of your two primary language(s) you generally use for the following activities.

| | Only ${q://QID18/ChoiceTextEntryValue/1} | Mostly ${q://QID18/ChoiceTextEntryValue/1} | Half ${q://QID18/ChoiceTextEntryValue/1}, half ${q://QID18/ChoiceTextEntryValue/2} | Mostl /Choice |
|---|---|---|---|---|
| Reading | ○ | ○ | ○ | |
| Emailing | ○ | ○ | ○ | |
| Texting | ○ | ○ | ○ | |
| Social Media (e.g. Facebook | ○ | ○ | ○ | |

| | | | |
|---|---|---|---|
| lists, notes, etc. | ○ | ○ | ○ |
| Watching TV / listening to radio | ○ | ○ | ○ |
| Watching movies | ○ | ○ | ○ |
| Browsing the internet | ○ | ○ | ○ |
| Praying | ○ | ○ | ○ |

Some people switch between the languages they know within a single conversation (i.e. while speaking in one language they may use sentences or words from the other language). This is known as “language-switching”. Please indicate how often you engage in language-switching.

| | Never | Rarely | Sometimes | Frequently | Always |
|---|---|---|---|---|---|
| Switching with parents and family | ○ | ○ | ○ | ○ | ○ |
| Switching with friends | ○ | ○ | ○ | ○ | ○ |
| Switching on social media (e.g. Facebook, Twitter, etc.) | ○ | ○ | ○ | ○ | ○ |

On a typical day, approximately how much time do you spend in each of your languages for the following activities?

| | Only ${q://QID18/ChoiceTextEntryValue/1} | Mostly ${q://QID18/ChoiceTextEntryValue/1} | Both ${q://QID18/ChoiceTextEntryValue/1} and ${q://QID18/ChoiceTextEntryValue/2} equally | Mostly ${q://QID18/ChoiceT |
|---|---|---|---|---|
| Speaking with other people | ○ | ○ | ○ | |
| Listening to other people | ○ | ○ | ○ | |
| Reading | ○ | ○ | ○ | |
| Writing | ○ | ○ | ○ | |
| Thinking to myself | ○ | ○ | ○ | |

Please rate your agreement with the following statements about speaking ${q://QID18/ChoiceTextEntryValue/1}.

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| "I enjoy speaking ${q://QID18/ChoiceTextEntryValue/1}." | ○ | ○ | ○ | ○ | ○ |
| "I feel comfortable when I speak ${q://QID18/ChoiceTextEntryValue/1} at school / work." | ○ | ○ | ○ | ○ | ○ |
| "I feel proud when speaking ${q://QID18/ChoiceTextEntryValue/1}." | ○ | ○ | ○ | ○ | ○ |
| "I feel uncomfortable in a community that speaks a lot of ${q://QID18/ChoiceTextEntryValue/1}." | ○ | ○ | ○ | ○ | ○ |
| "I feel useful when I speak ${q://QID18/ChoiceTextEntryValue/1}." | ○ | ○ | ○ | ○ | ○ |
| "I feel close to my community when I speak ${q://QID18 | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| "I feel helpless when I speak ${q://QID18/ChoiceTextEntryValue/1}." | ○ | ○ | ○ | ○ | ○ |

Please rate your agreement with the following statements about speaking your ${q://QID18/ChoiceTextEntryValue/2}.

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| "I enjoy speaking ${q://QID18/ChoiceTextEntryValue/2}." | ○ | ○ | ○ | ○ | ○ |
| "I feel comfortable when I speak ${q://QID18/ChoiceTextEntryValue/2} at school / work." | ○ | ○ | ○ | ○ | ○ |
| "I feel proud when speaking ${q://QID18/ChoiceTextEntryValue/2}." | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| "I feel useful when I speak ${q://QID18/ChoiceTextEntryValue/2}." | ○ | ○ | ○ | ○ | ○ |
| "I feel close to my community when I speak ${q://QID18/ChoiceTextEntryValue/2}." | ○ | ○ | ○ | ○ | ○ |
| "I feel confused when I speak ${q://QID18/ChoiceTextEntryValue/2}." | ○ | ○ | ○ | ○ | ○ |
| "I feel helpless when I speak ${q://QID18/ChoiceTextEntryValue/2}." | ○ | ○ | ○ | ○ | ○ |

Please select the choice that *most* applies to you.

| | All ${q://QID18/ChoiceTextEntryValue/1} | Mostly ${q://QID18/ChoiceTextEntryValue/1} | ${q://QID18/ChoiceTextEntryValue/1} and ${q://QID18/ChoiceTextEntryValue/2} equally |
|---|---|---|---|
| Your closest friends' cultures / ethnicities are; | ○ | ○ | ○ |
| You prefer going to social gatherings / parties where people are or speak; | ○ | ○ | ○ |

Please select the choice that best describes your agreement.

| | Strongly disagree | Mostly disagree | Somewhat disagree | Neutral | Somewhat agree | Mostly agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| I feel that I'm a person of worth, at least on an equal basis with others. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I feel I have a number of good qualities. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| All in all, I am inclined to feel that I am a failure. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am able to do things as well as most other people. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I feel I do not have much to be proud of. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I take a positive attitude towards myself. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| On the whole, I am satisfied with myself. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| useless at times. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| At times I think I am no good at all. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

While completing this questionnaire, please keep the following information in mind;

*Cultural identity* refers to (1) the feeling of being a member of a particular cultural group, and (2) the experience of aligning with the values, beliefs, behaviors, etc. of a particular culture.

*Cultural context* refers to an environment that contains the values, beliefs, and practices specific to a particular culture, and involves the company of members from that particular cultural group.

identities.

| | Not at all | A little | Moderately | Quite a bit | Exactly |
|---|---|---|---|---|---|
| "I only really experience my different cultures if I identify with them one at a time." | ○ | ○ | ○ | ○ | ○ |
| "My cultural identities are connected." | ○ | ○ | ○ | ○ | ○ |
| "I draw similarities between my cultural identities." | ○ | ○ | ○ | ○ | ○ |
| "I identify with one culture more than any other." | ○ | ○ | ○ | ○ | ○ |
| "When I am in a particular cultural context, I feel that I should not show my other cultural identities." | ○ | ○ | ○ | ○ | ○ |
| "I have an identity that includes all my different | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| "The differences between my cultural identities cannot be reconciled." | ○ | ○ | ○ | ○ | ○ |
| "While I have different cultures, only one culture defines me." | ○ | ○ | ○ | ○ | ○ |
| "Each of my cultural identities is a separate part of who I am." | ○ | ○ | ○ | ○ | ○ |
| "One cultural identity predominates in how I define myself." | ○ | ○ | ○ | ○ | ○ |
| "One of my cultures is more relevant in defining who I am than the others." | ○ | ○ | ○ | ○ | ○ |

## Optional Feedback

All of the following questions are *optional*, but we would appreciate your feedback regarding your bilingual experience. If you do not wish to provide any feedback, you may skip to the bottom of this page to finish the survey.

Were there any ways you use each of your languages that this survey did *NOT* ask about that you feel are important to your bilingualism? Please describe.

Were there any questions that did not describe how *you* feel you use your languages? Please describe.

Do you have any additional feedback regarding the survey items, your experience as a bilingual, or your experience regarding

culture?

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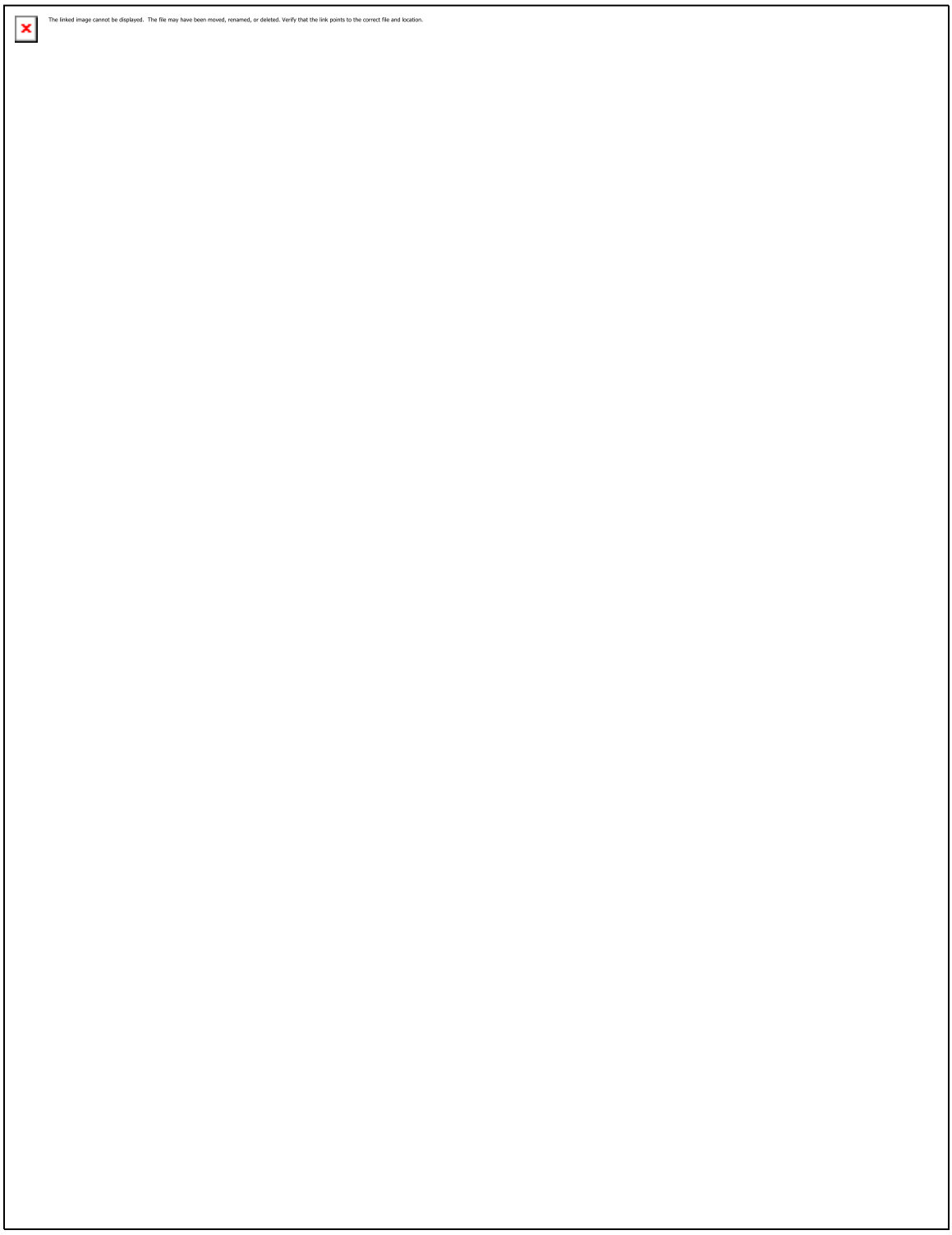
# APPENDIX C

# HUMAN SUBJECTS DOCUMENTATION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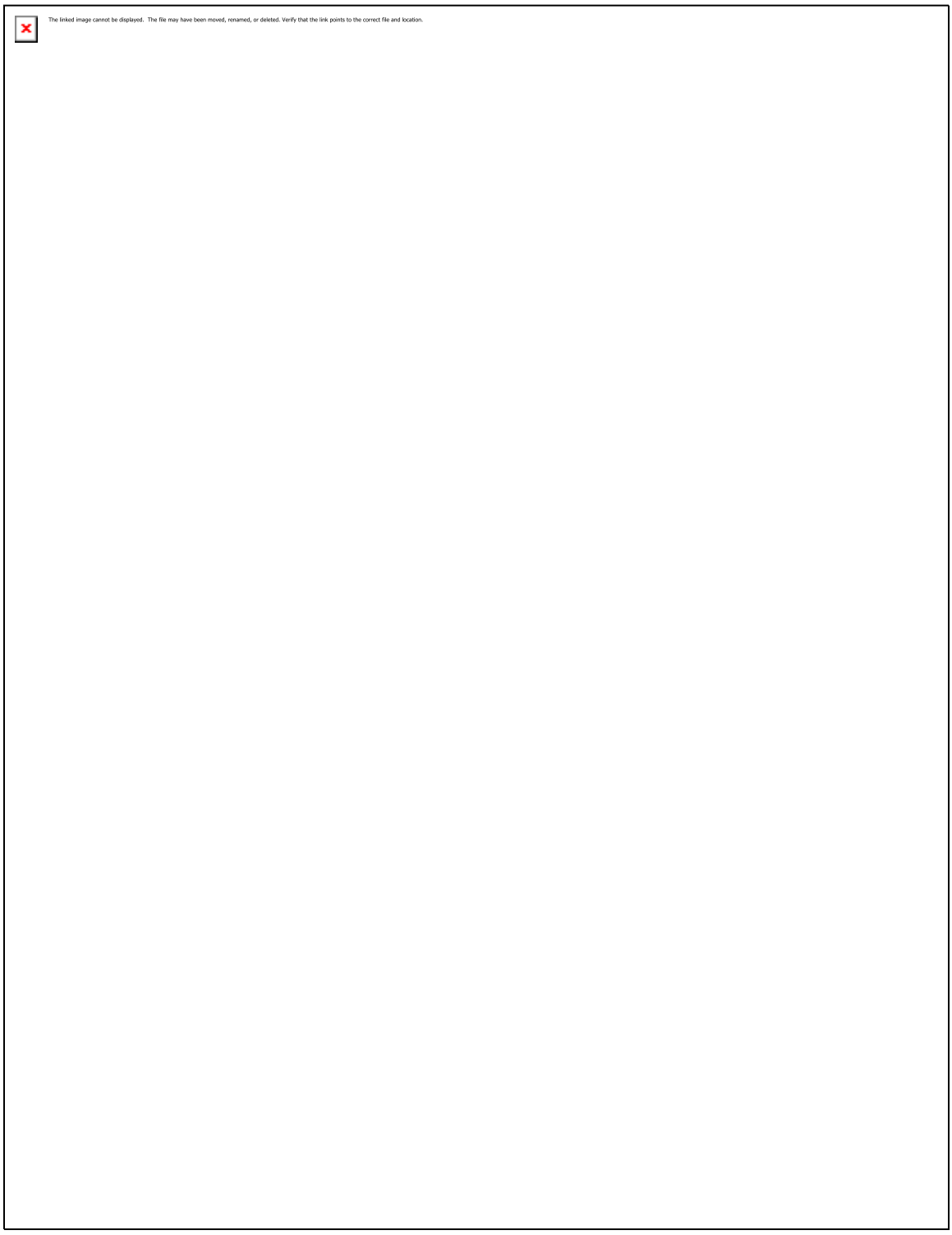
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