Title

Are inconsistent bilingual-monolingual cognitive differences the result of population miscategorization?

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Abstract – Decades of psycholinguistic research have attempted to determine whether a “bilingual advantage” exists for cognitive abilities (e.g., Bialystok & Craik, 2010; Cummins, 1977; for a meta-analysis, see Grundy & Timmer, 2017). More recent work has shifted away from investigating the broader matter of cognition and working memory to focus on specific domains within those capacities (e.g., Linck, Osthus, Koeth, & Bunting, 2014). Despite countless studies, however, the existence of this phenomenon remains unconfirmed. This paper examines evidence for and against the presence of a “bilingual advantage” in multiple tasks of working memory and cognitive control, reviewing studies that compare monolingual and bilingual performance. It further looks at populations that are understudied in relation to these questions (i.e., L2 learners and heritage speakers). Finally, the topic of L2 attrition is discussed, alongside a novel perspective that may explain the inconsistencies in bilingual-monolingual comparisons of performance on cognitive tasks.

Keywords— working memory, cognitive control, bilingual advantage, L2 attrition

1. Introduction

It is estimated that more than half of the global population is fluent in at least two languages (Ansaldi, Marcotte, Scherer, & Raboyeau, 2008; Tucker, 1999); however, the extent to which language and mind interact remains unclear. Psychologists and Cognitive Scientists, among others, investigate whether cognitive advantages exist for bilinguals and multilinguals when compared to monolinguals, the existence of which may provide an additional reason for remaining monolinguals to prioritize learning foreign languages. Understanding the connection between cognition and language is crucial for language instruction and motivation, especially when creating policies regarding bilingualism and language learning. These questions, however, are not simple to answer due to shifting definitions, often-unclear methodology, and difficult reproducibility.

An underrepresented yet equally important area to consider during this research is the possibility for lasting cognitive effects present in individuals who have undergone second language (L2) attrition: individuals who previously studied and attained some level of proficiency in a foreign language but are currently only functionally-monolingual speakers of their native language. With these issues in mind, the current paper examines the state of psycholinguistic work comparing monolinguals and bilinguals on tasks of working memory and cognitive control. First, the categorization of some language-based populations (namely monolinguals, bilinguals, heritage speakers, L2 learners, and L2 attriters) in prior literature is explored. Next, a brief overview of how language and cognition has been investigated both between and within these populations is given. Finally, new avenues of psycholinguistic research are proposed in order to probe whether the current problems in this research may be attributed to discrepancies in the linguistic history and characteristics between the expected populations and the research participants themselves—specifically, whether heritage speakers or L2 attriters have been miscategorized as monolinguals, bilinguals, or both in previous work. In the case of the latter population, this perspective has not yet been examined in empirical work; consequently, pursuing this avenue of work will both invigorate the question of how language knowledge is related to cognitive performance and may account for decades of conflicting results in psycholinguistic literature.

2. Defining Populations

Despite researchers' use of common descriptions including “monolingual”, “bilingual”, and “heritage speaker”, it is unclear if psycholinguistic work actually targets the same populations when investigating them. This potential lack of uniformity poses a major problem for current research involving language-based populations, as no real consensus can be reached if different populations are being studied under the guise of “bilinguals,” “monolinguals,” or any related group.

2.1 Monolinguals

Monolinguals are widely defined as individuals who have no knowledge of a second language. In the current era, however, it is increasingly difficult to find participants with no L2 exposure, be it from family, friends, media, or mandatory school courses. Many more people are “functionally” monolingual, unable to produce or understand a second language despite some previous knowledge. A question remains

of how much exposure is significant, particularly for research purposes, as some “monolinguals” may be misclassified L2 learners or attriters.

2.2 Bilinguals

Bilinguals “know and use [two or more] languages and interact with different cultures” (Grosjean, 2010, p. xvi). There are many potential linguistic backgrounds that fit this descriptor, however; these differences may prove crucial when examining “bilingual speaker” performance. Some bilinguals are exposed to two languages from birth, resulting in either balanced bilingualism or dominance in one of the languages. Other bilinguals learn a second language in childhood (i.e., sequentially) or later (i.e., second language acquisition). Though various measures of language knowledge exist, there is currently no standard or widely accepted measure to “confirm” the extent of a bilingual’s language knowledge, nor is there any formal threshold that definitively separates a bilingual from a language learner. This is problematic as a tested bilingual population may contain individuals with multiple acquisitional backgrounds, differences that may be crucial to the outcomes the linguistic or psycholinguistic research. Heritage language speakers or language learners may also inadvertently be recruited and tested as “bilingual”.

2.3 Heritage Speakers

Heritage speakers are classified as individuals proficient in the majority language of their area, who grew up in contact with a minority language spoken at home or by family (Polinsky, 2011). Many heritage speakers consider themselves bilingual, and indeed some researchers may decline to distinguish between the groups as well (e.g., Valdés, 2005). However, heritage speakers often perform poorly on written language competency measures due to little-to-no formal instruction in the heritage language, leading some researchers to erroneously classify members of this population as monolinguals.

2.4 L2 Learners

Second language acquisition occurs when a language is learned by an individual who is no longer a child. This division varies based at the discretion of each researcher, though later learners are typically thought to have difficulty with complete acquisition of the L2 (Hartshorne, Tenenbaum, and Pinker, 2018; Johnson and Newport, 1989; cf. Bongaerts, 1999; Ioup et al., 1994). Some researchers may study L2 learners separately from bilinguals; others may not make distinctions between advanced learners and bilinguals for the purposes of their research.

2.5 L2 Attriters

Language attrition is understood to be “the non-pathological decrease in a language that had previously been acquired by an individual” (Köpke and Schmid, 2004). The manifestation of language attrition varies by person, and the majority of studies on L2 attrition probe potential factors influencing the language loss (see Weltens and Grendel, 1993). However, language attrition may not represent total loss of a language, as some studies support the idea of attrition being lack of conscious access to the linguistic information rather than total loss of the language (see Oh et al., 2003, 2010). Furthermore, though it has been argued that L2 attrition may be the result of incomplete L2 acquisition (see Montrul, 2002), “peak

language proficiency in the attrited language” is more often considered to be one factor of many that contribute to the loss of language knowledge (Bardovi-Harlig and Stringer, 2010; Weltens and Grendel, 1993).

3. Language and Cognition

3.1 Memory and Cognitive Function

The term “cognition” refers to the many functions performed by the mind while managing information. The majority of this data is processed with the mechanisms present in executive function, (which encompasses a range of separate operations that collectively determine “purposeful, goal-directed, problem-solving behavior” (Gioia, Isquith, and Guy, 2001). Different aspects of executive function are responsible for a myriad of tasks including planning, attention, and feedback incorporation, which allows for learning new information and acting accordingly. Cognitive control and working memory are capacities associated with executive function, used to manage information that is immediately present. Cognitive control is largely thought to be a component of executive function that modulates the various aspects a person may “control” as they determine both their intake from and responses to a stimulus (Mackie, Van Dam, & Fan, 2013), as well as interacting with multiple stimuli at once (i.e., multitasking). It is further believed that bilinguals have a “language control” involved with regulating which of their two languages must be accessed and utilized at any given time (Emmorey, Luk, Pyers, & Bialystok, 2008). Working memory (WM) is “a temporary storage system under attentional control that underpins our [ability] for complex thought” (Baddeley, 2007) which is used to immediately process information. The exact structure of WM remains contested, as some researchers argue for a domain-specific multiple resource capacity (see Baddeley, 2000; Baddeley and Hitch, 1974) while others believe that it has a single resource (see Just and Carpenter, 1992) or even that WM is domain general (Cowan, 2005). Models often include components for storage and processing, though some models specify separate mechanisms for different types of information (e.g., audio or visual intake).

3.2 L2-Related Cognitive Differences

WM and cognitive control are tested using various tasks, which are often used to compare monolingual and bilingual participant performance. Varied results are found even using the same tasks, casting doubt on what mechanisms they are actually targeting; however, this may also be explained by the lack of field-wide standardization in these tests. Therefore, it remains unclear whether second language knowledge has a positive, negative, or null effect on these cognitive measures. The minimization of diverse linguistic situations, including heritage speakers and L2 attriters, may also contribute to these results, as these non-traditional members of a “bilingual” or “monolingual” group may in fact be better represented if considered as separate from the group. In sum, standardization of both population-inclusion criteria and methodology is critical for understanding the results of work related to language-based groups.

3.2.1 Bilinguals

Various studies have shown significant differences between bilinguals and monolinguals in performance on cognitive tasks, though these effects do not uniformly demonstrate a bilingual or monolingual

advantage. In a 2017 meta-analysis of studies involving children, young adults, and older adults, Grundy and Timmer found an overall positive effect of bilingualism for WM when tasks were administered in participants' L1. However, this advantage did not hold for the L2; in fact, monolinguals outperformed bilinguals for WM tasks administered in their L2. The paper further suggests that language knowledge directly and positively affects WM capacity, though this finding varies with the age of the participants (further discussed in 3.3.2., *Age*).

Likewise, studies employing the same tasks have found conflicting results. For instance, Kaushanskaya et al. (2011) and Kaushanskaya (2012) found a bilingual advantage whilst employing both forward and backward digit span. Conversely, Cole and Pickering (2010) used a separate measure of forward digit span and found no group effect, and Ratiu and Azuma (2015) similarly found no bilingual advantage over monolinguals in forward or backward digit span tasks. These results are unsurprising from a miscategorization perspective, as differing levels and domains of linguistic competency may have varied (and yet ill-understood) effects on psycholinguistic task performance.

3.2.2 Heritage Speakers

The cognitive effects of heritage language knowledge have been sparsely studied and highly speculative, leading to questions about the nature of heritage language knowledge and its connection with cognition in a solely auditory domain. Bolger and Zapata (2011) refer to the components of WM that are present during processing as “language mode” and assert that an experimental design involving both visual and aural dimensions is necessary to test the capacities of these speakers. In short, they believe that heritage speakers with higher auditory comprehension capabilities in their heritage language may perform better than monolinguals on WM tasks using auditory stimuli due to their experience with both languages, whereas the same effects may not be found in tests involving reading comprehension or written production. In an empirical investigation of processing and inhibitory control, Torres (2013) finds that heritage speakers displayed a slight advantage over L2 learners in inhibitory tasks. In the case of these speakers, the only differences in performance may be linked to the specific domain in which they have knowledge of the heritage language (e.g., aural competence or literacy), in which case further subcategorization may be necessary to accurately represent their language knowledge.

3.2.3 L2 Learners

Multiple studies have investigated the relationship between cognition and language knowledge in those who are currently attempting to become bilingual at a later stage in life: L2 learners. Studies of WM during L2 acquisition (see a review in Sagarra, 2012) support WM as a predictor for language comprehension and production. Some work has incorporated cognitive tasks in both the L1 and the L2 (including studies in the aforementioned meta-analysis by Grundy & Timmer, 2017; see also Alptekin & Erçetin, 2010), finding some language-specific effects that support the view that cognitive changes and language acquisition occur simultaneously. Classifying these learners can be difficult, leading some studies to differentiate between beginner and advanced L2 learners; however, due to a lack of standardization despite widely used measures of language proficiency (i.e., CEFL, ACTFL), the former may also be classed as monolinguals and the latter as bilinguals.

3.2.4 Language Loss

Language attrition is not simply forgetting language knowledge. Ecker (2004) identifies factors that may affect attrition, specifically: repression and suppression, distortion, decay, retrieval failure or slowing, interference, cue-dependent retrieval, and loss of access to a self-contained cognitive system for language. Language attrition has only begun to be studied in conjunction with cognition, almost exclusively in the context of attrited L1, to decipher the cognitive mechanisms underlying the process. Köpcke (2007) posits that memory may be at the core of language attrition. In the case of WM, specifically as a capacity for processing but not necessarily producing language, she (drawing on the ideas of Anderson, 2003) suggests that the central executive (which, as proposed by Baddeley and Hitch, 1974, manages cognitive functioning across the facets of WM) may be overriding the inhibitory response honed by bilinguals in an attempt to better function in the non-attrited language. The vast majority of psycholinguistic work in this domain seek to explain the reasons for L2 attrition, rather than exploring task performance of L2 attriters in comparison with other language-based populations. L2 attriters, much like less-proficient L2 learners, are often classified as monolinguals due to this lack of understanding of their linguistic history (as previously discussed in 2.5, *L2 Attriters*); the presence of these individuals in non-representative groups may be detrimental to our understanding of language-based changes in cognition.

3.3 Other Potential Factors

Linguistic knowledge is not the only reason for cognitive differences among individuals. Socioeconomic status and age are thought to affect language-associated performance on these tasks. In order to more clearly observe group differences for individuals with differing L2 knowledge, these additional factors must be measured and, to the extent possible, controlled; at the moment, however, they continue to complicate investigations in the field.

3.3.1 Socioeconomic Status

In a study of bilingualism and executive functioning (including WM and cognitive control), Calvo and Bialystok (2014) found significant effects of children's socioeconomic status (SES) on language skills and cognitive performance. SES was positively correlated with performance on the verbal and executive function tasks, effects which were found in both bilingual and monolingual children of the same race and ethnicity.

3.3.2 Age

Performance on WM tasks has been linked to age. The “bilingual difference” showing significant disparities in WM between bilinguals and monolinguals has most consistently been found in children and older adults. Bilingual children often demonstrate cognitive advantages (for a meta-analysis of comparative cognitive performance in bilinguals and monolinguals, see Adesope, Lavin, Thompson, & Ungerleider, 2010) when compared to their monolingual peers.

This view is supported by research conducted on children looking at cognitive performance. Bialystok, Martin, & Viswanathan (2005) found significant differences in reaction time on a conflict task, with the

bilingual participants responding much more quickly than their monolingual counterparts. Similarly, Bialystok (1999) found higher levels of cognitive and attentional control in bilingual children when compared to their monolingual counterparts. Diaz (1985) saw a positive correlation between degree of L2 knowledge in bilingual children and their performance on cognitive tasks of verbal and nonverbal ability; this finding is supported in the previously mentioned L2 learners.

Differences in cognitive task performance are rarely found in young adult bilingual and monolingual groups. Bialystok et al. (2005) hypothesize that WM differences in bilinguals and monolinguals are not salient in this population due to “peak” cognitive function in young adults. Grundy and Timmer (2017) further add to Bialystok’s view, positing that either a linear increase in WM performance would occur across an individual’s lifespan as (L2) language knowledge is acquired, or that bilingual and monolingual children would show the largest difference in performance on WM tasks due to the heavy cognitive load imposed by early language acquisition. After reviewing studies that controlled for potential confounds including socioeconomic status and performance on measures of intelligence, they conclude that the latter is more likely, and the results presented indicate that these expansion effects may positively correlate with L2 knowledge (and, potentially, use).

The processing benefits enjoyed by younger adults appear to plateau between the ages of 20 and 30, later gradually declining until the age of 60 (Bialystok et al., 2005). WM then likely remains stagnant for a majority of the lifespan: Dobbs and Rule (1989) discovered two declines in WM performance in aging adults: one occurring between the ages of 60 and 69, and the other occurring after the age of 70. Though these age effects often appear more consistently in studies of WM than language-based effects, population miscategorization may factor into these results as discussed in the next section.

4. A New Perspective

Working memory and cognitive control have been studied in several populations with varying amounts of language knowledge, including monolinguals, bilinguals, heritage speakers, L2 learners, and language attriters. The majority of work comparing populations has occurred between bilingual and monolingual speakers, while heritage speakers and L2 learners have been sparsely studied. The results of these investigations are often contradictory from one study to the next, as variations in methodology can cause minute differences in the cognitive functions being studied. Further complicating these matters is the unpleasant truth that language-based cognitive differences between bilinguals and heritage speakers are understudied; therefore, it is not yet known how bilinguals and heritage speakers may perform differently on cognitive tasks. Likewise, L2 attriters are severely underrepresented in the psycholinguistic literature, with few studies examining the cognitive implications of the L2 attrition rather than its cognitive bases. Thus, it is likely that at least some “bilinguals” or “monolinguals” have a more storied linguistic history than their labels suggest.

As previously discussed, there is much variation between researchers as they study populations grouped by language knowledge. If and when an inadvertent comparison of different populations occurs, the data (and results) may be muddled— and these disparities may be the root of the “bilingual advantage problem.” In short, researchers are aware of these rich (and drastically diverse) linguistic backgrounds yet continue to refer to speakers as members of a “bilingual” or “monolingual” group without justifying

their inclusion. Coupled with scant literature exploring these speakers, it is likely that miscategorization is at the root of much of the variation in “bilingual” research; the data collection may be intrinsically flawed rather than the results themselves. If bilinguals and heritage speakers show group differences on cognitive and linguistic assessments, yet are undifferentiated in the published report, muted bilingual effects may be found when they are compared to monolinguals. Similarly, if L2 attriters are tested alongside monolinguals, they may not show a stark (or significant) difference when compared to a “bilingual” population. The majority of students who have graduated from secondary education have been exposed to a foreign language in some capacity. It is furthermore easier than ever to connect with speakers of different languages via the internet, as well as consumption of media and entertainment that is hosted in a language that is not the user’s L1. In short, there are many functional monolinguals who have some latent L2 knowledge, to a non-insignificant degree (Ramage, 1990). Inability to access language knowledge and facilitate meaningful production in an L2 does not imply that an individual has no L2 knowledge (Oh et al., 2003).

Finding a “bilingual advantage” is often inconsistent, even in studies using similar measures. There is no widely accepted standard measure of bilingual proficiency. It is not unlikely that some heritage speakers may be miscategorized as bilinguals, nor that some L2 attriters may be misclassified as monolinguals. If this is the case, it may explain the difficulties in bilingual psycholinguistic research regarding the “bilingual advantage”. With so-called ceiling effects being identified for young adults regardless of L2 knowledge (yet rarely in other age groups), this hypothesis is compelling: young children may be “true” monolinguals, as they have not yet been exposed to a second language through schooling or technology-related interactions. Conversely, older adults may not have ever formally studied an L2 in the absence of a foreign language requirement in their schooling; they also may not seek out interactions that are not based in their native language.

4.1. Other explanations

This perspective is likely to be scrutinized on many fronts. First, some in the field believe that the supposed process of L2 attrition is, in fact, a problem of incomplete attainment of the L2 rather than a phenomenon to be studied separately. As discussed in section 2.5, multiple researchers cite peak proficiency in a language as a major factor in whether L2 attrition will occur (Bardovi-Harlig & Stringer, 2010; de Bot & Weltens, 1991; Weltens & Grendel, 1993). However, the idea that the problem of attrition lies in acquisition is not consistent with studies of L1 attrition; barring rare and extreme cases, all humans have a first language. As studies by Oh et al. (2003, 2010) demonstrate, some language knowledge remains in cases where very young children undergo a process of L1 loss. Thus, it is unlikely that L2 attrition can be explained in this way.

Next, some may posit that the issue lies in how members of these populations are recruited and selected rather than their defining traits. This issue is underscored by the difficulty in distinguishing between bilinguals and heritage speakers. As previously discussed in section 3.2.2., it is not uncommon for heritage speakers to consider themselves bilingual, regardless of level of proficiency. This is likely due to the sociocultural and linguistic factors that shape a heritage speaker’s identity, both as an individual and as a member of a community that is linked to the heritage language (see Cho, 2000; Cho et al., 1997; Hornberger & Wang, 2008; Van Deusen-Scholl, 2003). That heritage speakers may not be fully proficient

in the heritage language is a topic that must be broached with the utmost sensitivity and respect for each speaker. An explanation for inconsistencies involving errors in self-reported language group might be remedied by administering a language history questionnaire rather than asking participants to choose the population to which they most belong. Still, this answer has roots in miscategorization and is therefore not incompatible with the current perspective.

Alternatively, discrepancies between results seeking to test whether the “bilingual advantage” exists might be attributed to the absence of standardized tests for measures of executive function. As previously mentioned, there is often doubt about which processes are being engaged during cognitive tasks, highlighted in the history of the digit span task. Despite initial reports that the task targeted the same working memory mechanisms (see Baddeley and Hitch, 1974), the forward and backward iterations were later found to be less correlated than originally thought, leading some researchers to posit that backward digit span may utilize the visuospatial elements as well as phonological aspects of working memory (Li and Lewandowsky, 1995; St. Clair-Thompson & Allen, 2013). This is a systematic issue that infects any research performed in this area; how can one study’s results be compared to another when the stimuli is completely different? Some standardized measures have been developed (see Murray, Salis, Martin, & Dralle, 2018), though there has not yet been a field-wide shift to using easily replicable methods for testing such sensitive cognitive properties. It seems unlikely, however, that these non-uniform results could be wholly attributed to non-standardized measures of executive function. In the case of digit spans, both orders are still understood to target the same phonological properties of working memory; backward digit span simply targets an additional component. Likewise, Stroop tasks test inhibitory control as an integral function of the task itself (Stroop, 1935); regardless of whether altering the task allows other cognitive mechanisms to be tested alongside this aspect of cognitive control, it is intuitive that the performance of the groups would continue to reflect these similarities. For this reason, the issue appears to lie within the groups themselves rather than solely with the tasks utilized across studies.

Finally, second language knowledge simply may have no effect on executive functioning (see a review by Hilchey & Klein, 2011). Whether this is the final resolution to the conundrum of the “bilingual” advantage remains to be seen; however, it cannot be accepted until researchers have exhausted all other avenues of exploring the factors that contribute to the current inconsistent results. Utilizing diverse and accurately-labeled populations studying cognitive performance can only further this discussion and move closer to a more definitive answer.

5. Conclusion

The existence of a “bilingual advantage” (or perhaps more accurately, a bilingual difference) has plagued its proponents and critics for decades. Despite the myriad of potential reasons for inconsistent by-group performance on cognitive tasks, no definitive answer has been found for the cause of this variance. Discussions of group miscategorization thus far have centered on defining monolinguals and bilinguals rather than exploring the subgroups that may exist within the participants recruited for each. Critically, psycholinguistic investigations into heritage learner and L2 attriter performance is a near-barren field, though it may hold the key to explaining the wild variance in previous literature.

Ultimately, there may be no language-based difference in cognitive function. Equally likely, the “peak” cognitive performance effects described by Bialystok et al. (2005) may hold across all young adults regardless of L2 knowledge. Nonetheless, future exploratory work using this perspective will doubtlessly answer critical questions about the relationship between language knowledge and give new clarity to the intersection of language and cognition, namely how the acquisition process itself (rather than the current state of accessible L2 knowledge) affects the mind.

Are there significant differences between L2 attriters and monolinguals, or heritage speakers and bilinguals? Only time will tell. Future studies must include extensive surveys of language background to correctly determine what language knowledge an individual possesses and the manner in which that language knowledge was acquired. With correct categorization and standardization of each speaker population, these questions can begin to be answered and the mysteries of the mind will be further and more wholly understood.

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