BILINGUAL APHASIA AND THE THEORY OF COGNITIVE ADVANTAGE

By

ANNA NATHALIE LANGEROVA

_____

A Thesis Submitted to The W.A. Franke Honors College

In Partial Fulfillment of the Bachelor's degree
With Honors in

Linguistics

THE UNIVERSITY OF ARIZONA

M A Y 2 0 2 2

Approved by:

_____

Dr. Janet Nicol

Department of Linguistics

Abstract

The theory of a bilingual "cognitive advantage" posits that bilingualism can improve an individual's executive control. It is believed to provide a protective effect against neurological or degenerative brain disorders, and perhaps even help improve the rate or manner of recovery following a brain injury. In this literature review, I looked at various studies and reviews to see if there was any data pertaining to the question of if bilinguals are affected differently by aphasia than monolinguals, due to the theorized effect of a cognitive advantage. Such data would be in support of the cognitive advantage hypothesis. From what could be gathered from the research, there does not appear to be any conclusive evidence to support whether bilinguals do or do not have a general neurological advantage over monolinguals. There is also not enough evidence to support or deny a potential effect in regard to recovery after a serious brain injury. It appears that more research is needed to produce a more conclusive answer.

Bilingual Aphasia and the Theory of Cognitive Advantage

Bilingualism has fascinated researchers for decades. One aspect of bilingualism that has received a great deal of attention in recent years is the idea that the use of more than one language may result in an advantage in specific cognitive processes. Due to a bilingual's ability to communicate in two languages, it is believed that the "executive control" networks of the brain are strengthened (Pavlenko, 2014). This idea of enhanced executive function stems from studies that show that experience, or "learning" changes the structure of our brains (Bialystok, 2011, p. 229). This effect has been observed to happen after both long-term experiences (such as a career) and short-term experiences (such as learning how to juggle) (Bialystok, 2011, p. 229). This evidence suggests a possibility that bilingualism may work in a similar way and influence cognitive performance due to accumulating experience that results in cognitive network and ability modification (Bialystok, 2011, p. 233).

If this is true, then one could assume certain injuries or brain disorders may be less likely to occur in those who speak more than one language, or the effects may be less severe. If being bilingual can decrease the chances of developing a neurodegenerative disorder such as dementia (Alzheimer's Society, 2017), then one would expect that bilingualism would affect the severity and recovery process of a language disorder such as aphasia. The goal of this literature review is to determine whether there is any evidence to support the idea that aphasia is less severe in bilinguals, an whether they respond better to treatment.

Bilinguals and Aphasia

Aphasia is a language disorder that affects nearly 180,000 Americans each year (National Institute of Deafness and Other Communication Disorders, 2017). Aphasia is caused by brain injury, which can range from a hard hit to the head, gunshot wounds, brain tumors or infections, or even progressive neurodegenerative disorders like Alzheimer's (National Institute of Deafness

and Other Communication Disorders, 2017). However, the most common cause of aphasia is a lesion due to a stroke (National Institute of Deafness and Other Communication Disorders, 2017). The site and size of the lesion has a huge impact on the type of aphasia, its severity, and the process of recovery. Aphasia can affect all people from all walks of life, no matter what language or how many languages they may speak.

Bilingualism

Bilinguals who suffer from aphasia are quickly becoming more and more common throughout the world. Because of the greater reach of communication, overlapping communities, and other factors, multilingualism has become quite commonplace in most countries. Though there are millions and millions of bilingual speakers around the world, and each one of them is unique, it can be useful for researchers to categorize them.

To better understand bilingualism, I sought to find a definition for what makes a person bilingual. Ansaldo et al. (2008) defined a "bilingual" as someone who uses two or more languages or dialects in his or her everyday life, regardless of the context of use. There were two categories of bilinguals that the study looked at -- simultaneous or "native" bilinguals, and successive or "late" bilinguals (Ansaldo et al., 2008). Native bilinguals are people who learn their mother tongue at the same time as their second language during infancy, while late bilinguals are people who learn their first and second language at different times in successive order (Ansaldo et al., 2008). However, these categories are too broad, as the context in which the language is learned is just as important as the time. In the study, Ansaldo et al. (2008) cited

another researcher, Weinrich (1953), who stated there are three groups of bilinguals: Coordinate, compound, and subordinate (Ansaldo et al., 2008). Coordinate bilinguals learn their first and second language (L1 and L2) in two different contexts (such as at home and at school), while compound bilinguals acquire their L1 and L2 in the same contexts and are theorized to have only one semantic system but two different codes for it (Ansaldo et al., 2008). Finally, subordinate bilinguals learn their L2 by reference to their L1, or successively (Ansaldo et al., 2008).

Ansaldo et al. (2008) states the mental processes used to learn the second language can differ from each other depending on the age of acquisition (p. 540). For example, early bilinguals tend to learn their L1 and L2 in an everyday environment, which is considered an "informal" setting as they are simply exposed to the language and do not need to actively learn vocabulary or grammatical rules (Ansaldo et al., 2008). Late bilinguals, however, tend to learn their second language in a "formal" setting like a classroom, where they consciously need to be made aware of the rules that govern their second language and consciously learn new words (Ansaldo et al., 2008). To quote Ansaldo et.al (2008), "In other words, the age of acquisition determines a more or less incidental way of acquiring L2, which in turn determines the relative contribution of implicit and explicit memory processes" (p. 540). Implicit memory can be defined as a more unconscious retention of information that usually occurs through experience, and explicit memory can be described as a conscious retention of information where an individual actively participates in learning information (Ansaldo et al., 2008). This tells us that the age at which the L2 is learned can determine what memory process the brain is going to use to learn. From what has been observed, early bilinguals use different memory resources to learn language than late bilinguals (Ansaldo et al., 2008). Given that the age of acquisition for early bilinguals is infancy, they tend to acquire their second language through exposure rather than explicitly "learning" it (Ansaldo et al., 2008). This leads us to believe that they use implicit memory, since they do not need to consciously learn the rules and structure of the language (Ansaldo et al.,

2008). Late bilinguals, however, learn their L2 after infancy, at which point they tap into their explicit memory processes (Ansaldo et al., 2008). They do so because they can no longer acquire the language through mere exposure and need to consciously learn the phonology, syntax, morphology, and semantics of the language (Ansaldo et al., 2008).

It is difficult enough to characterize bilingualism in healthy individuals. It is even more difficult to characterize the patterns of language deficit and bilinguals with aphasia. According to Fabbro (2001), several clinical studies have found that bilingual aphasics do not necessarily manifest the same type of aphasic disorder with the same degree of severity in both languages (Fabbro, 2001, p. 203). Each patient presents differently. The recovery process is also variable. According to Ansaldo et al. (2008), there are six common patterns that are frequently observed among aphasic patients: recovery is *parallel* when both impaired languages improve to a similar extent and concurrently, *differential* when better recovery is observed in one language than the other, *selective* when only one language recovers, *blended* when there is an inappropriate amount of language mixing, *successive* when the complete recovery of a language is followed by the recovery of the other, and *antagonistic* when one language recovers but the other regresses. The incidence for these recovery patterns is unclear, and if they are mentioned in literature, it is often due to the case being unique or atypical (Fabbro, 2001, p. 204).Fabbro conducted some research focusing on parallel and differential recovery, and found within his study that thirteen patients (65%) presented with similar impairment in both languages (parallel), four patients (20%) showed a greater impairment of L2, and three patients (15%) showed a greater impairment of L1 (differential) (Fabbro, 2001, p. 205). Many factors have been presented in an attempt to explain why one language recovers better than the other while other times they both recover at a similar rate, yet none have provided a

satisfactory explanation (Fabbro, 2001). One could believe that the native language, the most familiar language at the time of the stroke, the most socially useful, or the language of the environment would recover first or better than the other, but this is not the case (Fabbro, 2001). Nor does it seem to be a matter of whether the two languages were acquired and used in the same context as opposed to different contexts, or at different times of development (Fabbro, 2001). Not even the aphasic features themselves -- site of the lesion, type of lesion, and aphasia type -- appear to influence the recovery pattern (Fabbro, 2001). In short, the reason why some recovery patterns emerge in an individual while others don't is a mystery.

Aphasic patients also often struggle with different symptoms of aphasia depending on the site, size, and type of lesion. The one thing all aphasia syndromes seem to have in common is that all grammatical aspects of a language are impaired, even if at varying degrees of severity (Fabbro, 2001). The grammatical disorders that are typical of aphasia are heavily dependent on the structure of the language itself in terms of what it can or cannot break down (Fabbro, 2001). For example, Fabbro (2001) assesses in his study some Friulian-Italian bilingual aphasics. The type of aphasia was not provided , but Fabbro mentions that the obligatory pronouns of the language were affected. In Friulian, where obligatory pronouns are a part of the language system, the patient omitted the pronoun whereas in Italian (whose structure allows the omission of an obligatory pronoun) the patient did not produce an error (Fabbro, 2001).

The Theory of Cognitive Advantage

Bilingualism is comprised of a series of complex processes that researchers work to better understand even to this day. Because of this, it is hard to say with certainty that bilinguals have a cognitive advantage over monolinguals. However, the real argument for or against

cognitive advantage can be found within the theory itself. Though cognitive advantage has been widely accepted in popular culture as scientific fact, the evidence is inconclusive. Some studies have found supporting evidence while others have not, and some studies have simply ended up with mixed results. In a review done by de Bruin, et al. (2014), the researchers reviewed a total of 50 published articles that each discussed 52 studies out of a total 100 conference abstracts. de Bruin et al. (2014) looked at multiple studies investigating whether bilinguals show a cognitive advantage and classified four "types" of outcomes that the research articles had obtained. The first category contained the studies whose data was found to only support the bilingual advantage theory, and the second category consisted of studies who concluded that their study yielded mixed data, but still supported the bilingual-advantage hypothesis (de Bruin et al., 2014). The third category consisted of studies whose data yielded mixed results that partly challenged the bilingual advantage idea, and the fourth category contained studies that found no data supporting a cognitive advantage, or even appeared to indicate a cognitive disadvantage in bilinguals (de Bruin et al., 2014). In the experiments of Category 4, a bilingual advantage was expected within some tasks, but the data was not found, or it indicated that the advantage in some tasks could be explained by other processes. In their assessment of the studies, they found that 40 abstracts (38%) reported studies that supported a bilingual advantage or bilingual-advantage theories, whereas fourteen studies (13%) found mixed results in supporting the theories (de Bruin et al., 2014). Thirty-three studies (32%) showed mixed results that partially challenged the bilingual-advantage hypothesis, and finally, seventeen studies (16%) found no differences between monolinguals and bilinguals (13 studies) or a monolingual advantage (4 studies) (de Bruin et al., 2014). In the end, Bruin, et al. (2014) found that up to half of their selected studies

(48%) at least partially challenged the existence of the hypothesis due to results of some tasks that demonstrated there was no effect from bilingualism where it was expected.

A complicating factor is that a disproportionate number of articles supporting the bilingual advantage were being published in comparison to articles that yielded mixed or negative results. Sixty-eight percent of the published abstracts were studies that clearly found a bilingual advantage, compared to the 50% published articles of studies with mixed results, 39% of studies with mixed results that partly challenged the theory, and 29% of the studies that found no differences between monolinguals and bilinguals, or even found a bilingual disadvantage (de Bruin et al., 2014). Overall, 63% of the studies supporting the bilingual advantage were published, compared with only 36% of the studies that challenged it (de Bruin et al., 2014). This could be the result of publication bias in which publishers favor positive results rather than negative ones, as the readers of these articles would be more interested in reading about positive results than negative ones (de Bruin et al., 2014). There was also evidence that those studies which had achieved positive results performed less tasks than the studies that yielded negative results (de Bruin et al., 2014). Statistically speaking, decreasing the number of tasks performed increases the variability of the data, and as a result, increases the risk for a Type II error. It also makes it harder to reject the null hypothesis, which in this case would be that there is no significant difference between the cognitive abilities of bilinguals versus those of monolinguals (indicating negative results for the bilingual advantage theory). For more accurate results, those studies should increase the number of tasks they perform in order to narrow down their confidence interval and yield more accurate results. In the end of de Bruin et al. 's (2014) research, they were unable to say definitively whether there was enough or was not enough support for the bilingual advantage.

At the moment, the evidence seems to be mostly against the cognitive advantage theory. However, it is important to remember that there have been studies that find positive. In a study done by Dehktyar et al. (2020), the data partially challenged and partially affirmed the theory of cognitive advantage. Dekhtyar et al. (2020) asked the same question as I did and looked to see if there was a cognitive advantage in bilingual aphasic adults. In the beginning of their study, they discussed the limited and conflicting data regarding the subject of the bilingual advantage in aphasic adults. They cited Bialystok et al. (2004), whose results showed that aphasic bilinguals appeared to have better cognitive control in terms of language inhibition or "resolving [language] conflict" in distracting situations than monolinguals (Dekhtyar et al., 2020). Dekhtyar et al. (2020) wanted to see if they could corroborate those results in their own experiment. In their study, they gathered 62 participants and separated them into four groups (Dekhtyar et al., 2020). There were 18 in the group for Spanish-English bilingual aphasic adults (5 males, 8 females), 18 in the English monolingual aphasic adult group (6 males, 7 females), 13 in the Spanish-English bilingual healthy adult group (9 males and 9 females) and 13 in the English monolingual healthy adult group (13 male, 5 female) (Dekhtyar et al., 2020). All bilingual participants filled out the Language Use Questionnaire so that the experimenters could gather data about their language abilities, and in the case of bilingual aphasic subjects, before and after the stroke (Dekhtyar et al., 2020). The questionnaire used a 5-point Likert scale. Subjects rated themselves on skills such as overall ability of speaking and listening in casual and formal conversations, and reading and writing (Dekhtyar et al., 2020). Afterwards, all groups were tested using the Non-Linguistic Triad Task, which is a series of trials that assesses non-linguistic cognitive control by utilizing congruent and incongruent shape puzzles, in which the participants are asked to identify either

a matching shape (congruent) or a non-matching shape (incongruent) with their non-dominant hand as quickly and accurately as possible (Dekhtyar et al., 2020). This test has been found to effectively assess cognitive control in adults with aphasia via non-linguistic means (Dekhtyar et al., 2020). The results showed that the bilingual and monolingual aphasic adults (BAA and MAA, respectively) were significantly slower than their healthy counterparts (BHA and MHA, respectively) on both congruent and incongruent tasks (Dekhtyar et al., 2020). Furthermore, within the healthy group, MHA and BHA exhibited no difference in RT on either the congruent or the incongruent conditions, indicating that BHA did not exhibit a bilingual advantage over their monolingual counterparts (Dekhtyar et al., 2020). In regard to the aphasic groups, it appeared that BAA and MAA performed similarly on the congruent problems and there was no significant difference between them (Dekhtyar et al., 2020). However, the BAA group performed slightly better on the incongruent puzzles than the MAA group (Dekhtyar et al., 2020). This indicates that there may be an advantage on tasks that require conflict resolution and suggests that bilingualism may act as a cognitive reserve factor in the face of stroke or acquired brain injury that may lead to aphasia (Dekhtyar et al., 2020). In regard to the healthy adults, however, no cognitive advantage was found (Dekhtyar et al., 2020). Although this data does not fully support the cognitive advantage hypothesis, it also yields data that indicates there may be some protective effects that come as a result of bilingualism.

Conclusion

Initially, the theory of cognitive advantage sounds like a reasonable assumption to make when one considers the complexity of the brain functions necessary to be a successful bilingual. Yet upon closer research, it reveals that the data produced between multiple studies is inconclusive. There are studies in which the data yielded supportive results, while others produced non-

supportive data, and others that resulted in mixed conclusions. Ultimately, the current answer to the question of whether bilinguals hold a cognitive advantage is that we do not know. There are many reasons for this, ranging from publication bias to too small sample sizes, or from different focuses/research questions to simply not enough knowledge about the underlying processes. However, despite these setbacks, the only way to move forward is to keep researching. The world of bilingual aphasia is one that is becoming increasingly common, and the lives of people with bilingual aphasia could be forever changed as we learn more about their brains work. Even if the bilingual cognitive advantage is not a real phenomenon, the knowledge we will have gathered about bilingualism and aphasia along the way could provide significant opportunities for other and more effective treatments options for patients suffering from aphasia.

References

Alzheimer's Society. (2017, January 30). Bilingual brains are more resilient to dementia caused by Alzheimer's disease. Alzheimer's Society. https://www.alzheimers.org.uk/news/2018-05-15/bilingual-brains-are-more-resilient-dem entia-cause-alzheimers-disease

Ansaldo, A. I., Marcotte, K., Scherer, L., Raboyeau, G. (2008). Language therapy and bilingual aphasia: Clinical implications of psycholinguistic and neuroimaging research. Journal of Neurolinguistics, 21, 539-557. https://doi.org/10.1016/j.jneuroling.2008.02.001

Bialystok, E. (2011, August 1). Reshaping the Mind: The Benefits of Bilingualism. Canadian Journal of Experimental Psychology, 65, 229–235. DOI: 10.1037/a0025406

Bialystok, E., Klein, R., Craik, F.I.M., Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon task. Psychology and Aging, 19, 290–303. https://doi.org/10.1037/0882-7974.19.2.290.

de Bruin, A., Treccani, B., Della Sala, S. (2014). Cognitive Advantage in Bilingualism: An Example of Publication Bias? Psychological Science, 26 (1), 99-107. https://doi.org/10.1177/0956797614557866

Dekhtyar, M., Kiran, S., Gray, T. (2020). Is bilingualism protective for adults with aphasia? Neuropsychologia, 139, 1-7. https://doi.org/10.1016/j.neuropsychologia.2020.107355

Fabbro, F. (2001). The Bilingual Brain: Bilingual Aphasia. Brain and Language, 79, 201-210. https://doi.org/10.1006/brln.2001.2480

National Institute of Deafness and Other Communication Disorders. (2017, March 6). Aphasia. National Institute of Deafness and Other Communication Disorders. https://www.nidcd.nih.gov/health/aphasia#:~:text=About%201%20million%20people%2

0in,to%20the%20National%20Aphasia%20Association

Pavlenko, A. (2014, November 12). Bilingual Cognitive Advantage: Where Do We Stand? Psychology Today. https://www.psychologytoday.com/us/blog/life-bilingual/201411/bilingual-cognitive-advantage-where-do-we-stand

Weinreich, U. (1953). Languages in contact. *Publications of the Linguistic Circle of New York*. New York.