World Journal of Educational Research
ISSN 2375-9771 (Print) ISSN 2333-5998 (Online)
Vol. 10, No. 5, 2023
www.scholink.org/ojs/index.php/wjer

Original Paper

A Study on How Becoming Bilingual Changes the Way We Think Focused on the Cognitive Category—Colour

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Received: August 17, 2023 Accepted: October 02, 2023 Online Published: October 24, 2023

doi:10.22158/wjer.v10n5p200 URL: http://dx.doi.org/10.22158/wjer.v10n5p200

1. Introduction

The central question of whether the language one speaks affects how one thinks is always debated in the last decade. There are basically two versions of the hypothesis—"strong version" and "weak version". The strong view of linguistic relativity is proposed by the linguist Benjamin Lee Whorf since the 1940s, which is also known as Whorfian hypothesis, saying language strongly influences thought (Whorf, 2012). He suggests that language determines speakers' different perceptions because speakers' language may guide them to perceive and conceptualize various cognitive domains differently (Park & Ziegler, 2013).

Overall, researchers propose that linguistic relativity mainly consists of three ideas. First, it believes that the meanings of words and the structure of syntactics might vary greatly between languages. Second, the semantics of language may influence how people perceive and conceptualize the world, and even completely shape their thought, which is a famous notion known as linguistic determinism (e.g., Benjamin Lee Whorf). This theory argues that differences in language cause differences in thought, which means that there is a relatively tight connection between language and thought while the connection between thought and the world is rather loose. This pattern of relationships implies that language determines thought rather than the world affecting it. Finally, linguistic relativity holds that speakers of different languages think in different ways given that language can affect thinking (Wolff & Holmes, 2010). According to the linguistic relativity hypothesis, cross-linguistic language variation may cause cross-cultural differences in cognition, including perception, attention and memory (Lowry & Bryant, 2018).

On the other hand, universalists are against the strong version of linguistic relativity believing that language and thought are relatively independent. They suggest that language is constrained by linguistic universals and one of the representatives is Chomsky (2000) who argues that human beings

could not learn natural languages unless they have a number of innate linguistic mechanisms to guide their way.

Recently, the research on the weak version of the linguistic relativity hypothesis that language influences perception has attracted more attention. Slobin, a professor emeritus of psychology and linguistics, proposes to replace thought and language with two different items: thinking and speaking. During the process of language encoding, speakers need to involve in a mental activity concerning different aspects of experience, which is called "thinking for speaking". It has been observed in patterns of attention and memory of humans for motion events (Wolff & Holmes, 2010). Furthermore, he implies the mother tongue of human beings may not help encode an objective reality in a neutral way and, instead, that is a subjective orientation to the world of human, influencing how humans think when they are speaking (Slobin, 1996). As a result, the weak form of linguistic relativity that thinking occurs before language use has developed through Slobin's research based on empirical studies.

This paper will be divided into four sections. The first section is the introduction offering an overview of the opinions in favour of the strong view of linguistic relativity and against this view and adding the weaker linguistic relativity. Second, one of the cognitive categories—colour, will be concentrated on and some discussion on language and thought will be shown in the third stage. Finally, a conclusion will be presented at the end of the paper.

2. Colour Language and Colour Cognition

To assess the relativity hypothesis, researchers need more accessible data that could be collected from the experiments. As a result, colour perception has triggered great interest in research on the relationship between language and thought, providing a natural test base for exploring the nature of bilingualism, as Athanasopoulos et al. (2010b) said, this is because languages differ widely in how people define boundaries between colour categories.

In detail, on the one hand, the physics of light suggests that segmentations of the spectrum are arbitrary because there are no concrete discipline drawing boundaries between colours at one exact spot. On the other hand, different languages have colour terms that cut the colour spectrum in different places. So, a person's colour cognition follows by their colour language since nothing in the physics of colour could determine how people think about colour (Swoyer, 2010).

2.1 Research on Colour in History

Research on colour language and colour cognition engaging in the debate over relativism versus universalism has increasingly been carried out. As Brown (1976) pointed out, the debate consists of two main phases: In the first phase, until about 1970 the prevailing assumption is that relativism is put in the dominant place whereas universalism becomes the dominant view in the second phase.

During the first phase, it is assumed that the physical continuum of the colour spectrum is arbitrarily spliced into different categories, which correspond to lexical phrases in linguistics (Davies & Corbett, 1997). Brown and Lenneberg (1954) conducted experimental tests based on the Whorfian hypothesis

mainly use recognition memory as the cognitive task to investigate the linguistic influence on colour cognition. Their classic study was demonstrated only on English speakers to test whether their colour recognition memory is different considering their various colour spectrums. Hence, they found that it is possible that perceptual distinctiveness may be universal instead of being relative in culture.

While in the second phase of investigation on the relationship between colour and language, the prevalent belief supporting cultural relativism lost its favour, shifting to notion of colour universalism mainly due to Berlin and Kay's (1969) theory (Davies & Corbett, 1997; Özgen & Davies, 1998). They proposed that there is far less diversity in the foci of colour terms found in languages than in colour terms' boundaries and all the languages they researched have colour terms with foci taken from a single set of 11 "universal" foci depicted in the array. Furthermore, if a language has a certain colour term in this series, for instance, brown, then it will have corresponding colour terms placed earlier in this series such as blue, yellow, green, red, black and white (Davies & Corbett, 1997).

Another influential experiment is about the colour of Dani people. Heider (1972) demonstrated a study on learning and memory in the Dani of New Guinea who only have two basic colour terms—mifi "light" and mola "dark". This study compares English speakers who use 11 basic colour terms with Dani speakers. She found that the Dani speakers remember focal colours even better than non-focal colours although there is no terms to describe them in their language. So Heider confirmed that she find the evidence to strongly support that the perceptual salience of the focal colours are universal, which is largely inconsistent with the linguistic relativity hypothesis (Tohidian, 2009; Davies & Corbett, 1997).

The 1969 theory is extended by Kay and McDaniel (1978). They interpreted that the origin of the universal colour categories lies in universal visual physiology and perception. Moreover, they provided a model of the mechanism driving color-category evolution based on the relationship between perceptual physiology and vague logic formalism.

Although Berlin and Kay's (1969) great influence in changing the relativist-universalist debate in favour of universalism, they failed to totally dismiss linguistic relativity because they still hold the belief that it is the number of basic terms of languages that differ and the universals only exist in the universals of foci instead of boundaries. Similarly, while Heider's study has had a huge impact on supporting universalism by offering evidence consistent with universal perceptual salience of the focal colour, her findings provide the possibility for the idea that language influences colour memory. As she responded, in her study of Dani speakers, the reason why Dani speakers have worse performance in remembering both the focal colour and non-focal colour compared with American group is that they lack 'games' experience. However, the possibility that their colour vocabulary is restricted should also be put into consideration (Davies & Corbett, 1997).

There are also other researchers questioning Heider's findings, Lucy and Shweder (1979) argued that her results are totally inconsistent with universalism, instead, the array of focal colours she used is a distinction. To confirm this, they created a different series aiming to allow all the colours to be distinctive equally. In the short-term memory task, participants' recognition of the focal colours is not

significantly better than non-focal colours, on the contrary, participants behave reversely in the long-term memory task.

Davies (1997; 1998) and Corbett (1997) conducted a cross-cultural study of the relationship between language and colour cognition to test the linguistic relativity hypothesis. They compared the speakers of English, Russian and Setswana whose numbers of basic colour terms are different and participants are required to experiment on a colour sorting task. Participants need to sort a representative set of 65 colours into "N" groups ranging from 2 to 12 on the basis of their perceptual similarity and then the researchers will evaluate the similarity and differences through their choices of colour group. As the result of the colour grouping in the green-blue region of colour space, Setswana uses a single term for this region (botala), whereas English uses two terms (green and blue) and Russian uses three terms (zelenyj "green", sinij "dark blue" and goluboj "light blue"). Hence, perceptual universalism is supported by the fact that colour grouping is similar in these three languages. However, colour grouping slightly differs, which is consistent with the fact that linguistic differences may influence colour grouping. Moreover, the three languages have structural disparities in grouping, which could be due to the different distribution of colour category structures in the three languages. Therefore, colour perception is regard to be universal although there could be room for small-scale alteration due to language and other cultural elements.

2.2 The Recent Studies

Until recent years, it provides opportunities for accessing exact temporal information regarding the influence of language on online visual processing due to the impulse of neuroscientific methods. According to Thierry (2009) and his colleagues, even when colour is unrelated to the task, language-specific characteristics between two colours affect early visual processing. The findings of the study show that native language terminology has an unconscious impact on early stages of colour perception.

Moreover, the study of Athanasopoulos (2010a) and his colleagues takes a first step towards exploring the long-term effects of using a second set of category divisions on early perceptual processing as bilinguals do. They would re-analyze the previous paper to see whether cognitive processing, linguistic descriptions and pre-attentive perception of colour will be converged.

Their brain potential research strongly shows that neural restructuring of basic perception components may occur in bilinguals as a result of time spent with second-language speakers. This effect has never been discovered previously although it could have shed light on the developmental aspect of the human brain's connections between language, cognition, and perception.

The case of Japanese blues looks at how Japanese and English monolinguals, as well as Japanese–English bilinguals, processed colour in their cognition, Japanese monolinguals display categorical perception at the ao (a daker shade) and mizuiro (a lighter shade) boundary, whereas English speakers do not. This study may help to explore a possible link between language and thought in the bilingual mind (Athanasopoulos et al., 2010b). Researchers of this study found that the extent to

which advanced bilinguals rated perceptual distinctions in colour as similar to monolinguals in their second language depended on the language they use most frequently in their daily activities. As shown in the study, bilinguals who speak primarily English perform similarly to English monolinguals, while bilinguals whose dominant language is Japanese perform similarly to Japanese monolinguals. These investigations suggest that it is ultimately language that promotes the observed cognitive effects.

3. Evidence for Changes in Thinking

3.1 The Study of Borodisky

Some scholars view that it is obvious that speakers think differently about the world because they speak different languages. On the other hand, scholars do not find the differences in the way people talk convincing. It is possible that everyone differs in talking but they think the same way and focus on the same things (Boroditsky, 2009).

Proponents of cross-linguistic differences argue that it is impossible for everyone to pay attention to the same things. Otherwise, acquiring new languages will be too simple. In fact, learning a foreign language especially one that is not primarily linked with the native language is never a simple process, which needs to accept a new set of linguistic systems. No matter which language, acquiring these languages requires not only learning more vocabulary but also involving themselves in the proper things of the world so that people could be equipped with the relevant information to add in what they are speaking (Boroditsky, 2009).

Given that empirical studies lack strong evidence to support them, Boroditsky (2009) and her colleagues collected data from various countries: from China, Greece, Chile, Indonesia, Russia, and Aboriginal Australia. They implemented an experiment to see if differences in colour language result in differences in colour perception by comparing the ability of Russian and English speakers to discern shades of blue. As mentioned above, there is no exact single word in Russian to convey the concept of "blue" that English speakers refer to. Russian divide blue into two sides—light blue (goluboy) and dark blue (siniy). In her finding, Russian speakers are better at distinguishing between two colours of blue that have different names in Russian than if they are in the same category, whereas English speakers still refer to two shades as the same category.

3.2 "Stroop Task" and ANT

Previously, bilingualism was seen as more like a burden than a privilege, especially among children, because people have to acquire multiple lexical items and grammatical structure in order to become bilinguals. As a consequence, they may lose the connections between real words and the meaning of words. However, many bilinguals are fully functional in both two languages under the certain circumstances. Instead, evidence suggests that bilinguals have advantages over monolinguals in both non-language thinking and brain functioning (Byrd, 2012).

Given the widespread prevalence of bilingualism, researchers from a wide range of disciplines show considerable interest in the effects of speakers knowing two or more languages on both language

processing and general cognition. Over the past two decades, one of the most central debates involves how bilingualism influences cognitive control (Sabourin & Vinerte, 2018). Aiming to see how bilingualism affects linguistic and non-linguistic cognitive control, Sabourin and Vinerte (2018) conducted two experiments regarding both linguistic and non-linguistic tasks.

One experiment is called the “Stroop task”. In the Stroop task (Stroop, 1935), participants will be given colour terms, some of which are consistent with the colour of ink while other are not. In other words, the consistent condition means the written word matches the ink colour, like the word “blue” written in blue ink, while the inconsistent condition refers to the mismatch between the colour word and the ink colour, like the word “blue” written in green ink. Involved in the inconsistent condition, it usually takes participants more time to name colours, and this effect is known as the “Stroop effect”.

Although the “Stroop task” provides opportunities for examining cognitive control in language processing, it may mix this process with more broad cognitive processes considering it is a language task. As a result, the ANT (Attention Network Test) task has been introduced in their study to measure non-linguistic cognitive control. A variety of findings demonstrate that bilingualism does not impair cognitive processes and bilinguals are capable to do both linguistic and non-linguistic cognitive control.

3.3 Memory Task

According to Davies and Corbett (1997) who partly replicated Heider’s recognition memory task using a much easier version. They invited Setswana (the main language of Batswana), English and Russian speakers and participants are required to choose a colour chip they have seen before from three or six alternatives. This method ensures that differences are expected on linguistic grounds in some contexts while not seen in other circumstances. What strikes researchers most is not the relation between performance differences and linguistic differences, but Setswana speakers score much lower than the English and Russian groups across the board for all stimuli settings, owing to Setswana does not supply enough readily available and effective labels. This result may present either linguistic impacts on recognition memory or the difficulty of such memory tasks especially for certain speakers. The findings of Davies and Corbett (1997) are consistent with Heider’s (1972) results of Dani population, indicating that the speed of their making choices is quicker than the American participants although they get lower recognition scores and the task is also seen to be inappropriate for the Dani.

When Boroditsky (2011) focused on the memory data of their studies, they discovered the changes in eyewitness memory predicted by linguistic patterns. Speakers of English, Spanish and Japanese use agentive language to express purposeful events, such as “He popped the balloon”, and all three groups have a relatively equal memory of people who perform the intentional actions. However, when it comes to accidents, there are some noteworthy distinctions. It is more likely for English speakers to describe the accidents in an agentive manner than Spanish and Japanese speakers and they also remember who do it better than Spanish and Japanese speakers do. This is not because people who speak Spanish and Japanese have poorer memory, in fact, they remember the agents of intentional events just as well as English speakers do.

3.4 Naming and Categorization

According to Ameel et al. (2005), how people conceptualize objects non-linguistically may be basically universal, whereas objects naming and how people categorise them linguistically is language-specific. They also concluded that naming is not entirely motivated by a shared perception of object similarities. Language-specific features, as well as similarity, may all play an important role in how people divide an area into linguistic categories.

Athanasopoulos and Kasai (2008) used a matching task to compare what are their preferences when categorize object inviting Japanese and English monolinguals as well as Japanese-English bilinguals whose proficiency levels are quite different in which they would be put in various experimental settings. In addition, they also investigated the usage of grammatical number labelling of bilinguals in English during speaking in their study. This may make it easier to compare between nonverbal cognitive processes and automatic linguistic performance on the basis of the grammatical component that is seen to influence object classification. Compared to previous studies, this experiment will provide a full view of the link between cognition and language in the mind of bilinguals.

It is clear that a within-language correlational study matching a linguistic variable aiming to measure the degree to which the language "favours" a colour to a nonlinguistic cognitive variable like memory and categorization is an indirect test of the Whorfian hypothesis, regardless of how one judges the claims and counterclaims in this research tradition (Kay & Kempton, 1984).

All these findings reveal that language processes pervade vast fundamental realms of thought prevalently, moulding people unconsciously from the details of cognition and perception to abstract notions as well as important decisions in life. Language guide human beings to experience the world and the languages people speak have a significant impact on how they think, how people see the world, and how people live their lives.

4. Conclusion

The notion that different languages may have an impact on the way people think has lasted for centuries. At the very beginning, the American linguist Benjamin Lee Whorf firstly proposed that various language largely determines the thought of speakers differently since the 1930s and this idea is also regarded as the strong version of the linguistic relativity hypothesis. By the 1970s many researchers challenged this Whorfian hypothesis, they provided a great amount of evidence to totally abandon it, suggesting that language and thought are both universal concepts. Until recently, empirical evidence are investigated to explain how languages shape people's thinking in 'real-time'. One of representatives is "thinking for speaking" by Slobin, his view is a typical weak form of linguistic relativity. All these developments give an insight into the origins of language and the construction of reality.

Research explores the relationship between language, thought and reality because language not only forms how people perceive the world but also the reality can shape the way people use language.

Although many supporters like Whorf adhere to the belief that language has a substantial influence on cognition and other opponents believe that language has no such influence, the findings of research indicate that language has a great impact on thought and reality, but it does not totally control them (Tohidian, 2009).

Language plays an essential role in philosophy, anthropology, linguistics and psychology, which may be used in small simple tasks in everyday life including distinguishing colour lexicons, counting dots on a screen, or orienting themselves in a small space. It is obvious that categories and distinctions are embraced in different languages in people's mental lives.

This paper mainly focuses on colour cognition, exploring the difference between bilinguals and monolinguals in grouping, naming, categorizing and memorizing colour terms and investigating the performance of bilinguals in nonlinguistic tasks. Although this paper has discussed the language and thought in the colour category, there are many other categories that are worth discussing such as time, space and motion. Future studies will shed more light on the relationship between language and cognition under the influences of other elements.

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