Proceeding Paper

Grammatical Gender Effect on Object Similarity Perception of Indonesian–German Bilinguals: Use of Big Data Analysis and Computation [†]

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Abstract: We investigated how grammatical gender affects the way bilinguals perceive the similarity of an object. We adopted the Sapir–Whorf hypothesis regarding the effect of language on a person's way of thinking. Different language characteristics allow for different ways of thinking when using other languages. Forty-six Indonesian–German bilinguals participated in this study to explore the perception of 112 pairs of object pictures. A pair of pictures of a person and an object or an animal were shown to the participants. Fourteen pictures of objects and animals were used, each of which was used with a masculine and feminine noun article. The language used in the study did not affect the similarity scores of the participants in different languages for the gender of objects shown.

Keywords: grammatical gender; perception; similarity; Sapir–Whorf hypothesis; bilingual; object similarity; big data analysis

1. Introduction

Language is the communication means used by humans to exchange information. Language usage is an individual's experience, which has the most intense and continuous involvement [1] (pp. 233–262). When communicating with one another, individuals prefer to use their mother tongue [2] to ensure the information is easily grasped. However, communication can be difficult when carried out in different languages. Recently, the number of bilinguals is increasing. Being bilingual allows individuals to obtain information and communicate more broadly. Bilingualism impacts the brain structure and function, improving adaptive abilities in their lives [3,4] (pp. 7565−7574 in [3]). Differences in individuals' behavior in each language are related to grammatical capacity and affect individuals' perspectives on the language [5] (pp. 1−9). Each language has its characteristics, including systematic pronunciation patterns, word formation, and grammatical construction, that contribute to the development of different grammar [6]. Different language characteristics allow individuals to have different ways of thinking. An example of the influence on the way of speaking in language is the perception of its speakers [7,8] (pp. 928−933 in [8]). Perception is an evaluation process of an individual's performance toward specific objects [9]. The Sapir–Whorf hypothesis [10,11] explains that the language used by individuals influences how they think about reality [12] (pp. 13486−13490). Language influences and determines how individuals perceive their surroundings, including nature and their social environment [13] (pp. 1−5). The Sapir–Whorf hypothesis is used to examine how language influences how individuals think about reality and how they perceive objects.

The grammatical distinctions of each language can be seen in nouns. When naming an object, the gender article of the noun (i.e., masculine, feminine, or neutral) is taken into consideration. The determination of noun articles to grammatical gender is different in languages. In different languages, noun articles are assigned to objects differently, resulting

in grammatical genders that do not correspond to their functions. For example, female genitals in French have the gender le, which is a masculine noun article; the skirt in German has a masculine noun article, der; and the moon in German has a masculine gender, whereas it is considered feminine in other languages. An understanding of the variations in the article assignment of grammatical gender and its impacts on speakers is needed.

The effect of grammatical gender on perception was conducted in Ref. [8] (pp. 928−933). The researcher discovered that speakers view an object as biologically female or male using grammatical gender, depending on the object's article. The Sapir–Whorf hypothesis was used to reveal that the language an individual uses affects how they think about something. Another influence is observed in speakers of languages with grammatical gender in the description of an object [14]. Spanish speakers describe "bridge" by giving adjectives related to masculinity, such as strong, big, towering, and solid, because the article "bridge" in Spanish is masculine. Meanwhile, German speakers associate "bridge" with feminine adjectives, such as elegant, fragile, and peaceful, because in German, "bridge" has a feminine noun article. This demonstrates that grammatical gender influences speakers in describing adjectives on an object according to its noun article.

Despite the grammatical differences between Bahasa Indonesia and German, many Indonesians are learning German. Since Bahasa Indonesia does not have grammatical gender, research on it has never been conducted in Indonesia. As many Indonesians are learning a second language that has grammatical genders, it is necessary to study the influence of grammatical gender on a person's way of thinking, especially the perception of daily.

2. Materials and Methods

This experiment was conducted to explore how the participants assigned similarities between female or male objects that have feminine and masculine noun articles. The participants were Indonesian–German bilinguals. They were randomly assigned to the Bahasa Indonesia version or the German language version of the test. The participants were shown pairs of colored pictures describing people and objects or animals. This study was a conceptual replication of Ref. [8] (pp. 928−933). We hypothesized that there were differences in the perceived similarity of objects in the gender in different languages. More specifically, the subject group tested in German showed a higher level of similarity between pairs of pictures with the same gender (pairs of images of women with objects or animals of feminine noun articles) compared to pairs of images with different gender references (different genders, for example, pairs of images of women with objects or animals with masculine noun articles). However, this similar pattern was not observed in the experiment group of Bahasa Indonesia.

2.1. Participants

We recruited 46 Indonesian–German bilingual participants aged 17−52 years (M = 26 years). There were 23 female and 23 male participants. Most participants had a high school diploma. Three randomly selected participants were rewarded for their participation in the study. Most participants rated their reading and speaking skills in Bahasa Indonesia at the C2 level. Then, most participants rated their German reading and speaking skills at the C2 level, too. On average, the participants had learned their second language for 6.7 years and had lived or were living in their second language country for an average of 6.3 years.

2.2. Materials

The measuring tool was adopted from Phillips and Boroditsky (2003), which consists of 8 pictures of people and 14 pictures of objects and animals [8]. Four female images (woman, ballet dancer, bride, and little girl) and four male images (man, king, giant, and little boy) were used in the experiment. Fourteen images of objects and animals were chosen according to their grammatical gender: seven images with feminine gender articles (sun, clock, toothbrush, fork, cat, mouse, and snail) and seven images with masculine gender

articles (toaster, spoon, moon, broom, fox, whale, and frog) in German. The set of images of people, objects, and animals were paired in one picture, where the images of people were located on the left side and the images of objects and animals on the right side, resulting in 112 pairs of images. A total of 112 pairs of pictures were grouped into two: pairs of pictures with the same gender (feminine–feminine or masculine–masculine, Figure 1) and pairs of pictures with a different gender (feminine–masculine or masculine–feminine, Figure 2). The pictures were colored and original (except for the king and the giant). The rating scale in the similarity ranged from 1 (very unlikely) to 9 (very likely). To answer the questions, the participants writy/(aere not given a time limit. The order of the image pairs was different for each participant. The participants were split into two language groups: those tested with Bahasa Indonesia and those tested with German. There were no differences in the procedures and stages of the study between the two language versions.

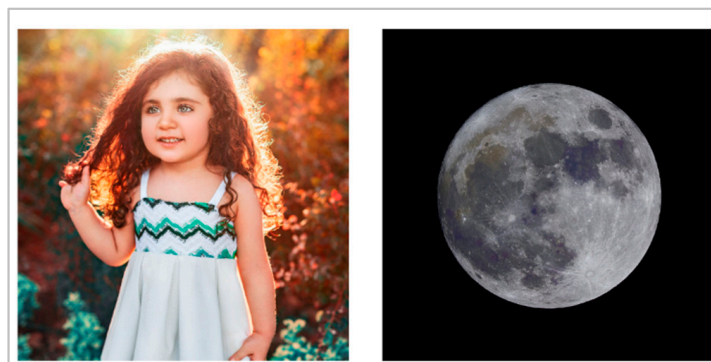**Figure 1.** Same gender (masculine–masculine) items.

Figure 2. Different gender (feminine–masculine) items.

The group of participants tested in Bahasa Indonesia received the following research instructions: "Each time you will be shown a pair of pictures. We ask you to rate how similar the two pictures are. Choose the number 1 if you think the two pictures are VERY UNLIKELY and choose the number 9 if you think the two pictures are VERY LIKELY. There is no wrong answer, please choose the answer that suits you best. If you need a short break, you can close this page and continue by clicking on the following page address [https://binuspsy.limequery.org/392351?lang=id] and please save this page (e.g., by bookmarking this page)/do not close this page. Please try to complete this survey in one sitting. This survey takes approximately 20 min". The group tested using German was given the same instructions in the German language and was given a different survey link.

2.3. Procedure

The experiment was conducted using an online-based platform, LimeSurvey, which was disseminated through social media. Participants who fit the criteria received a randomly generated link to one of the language versions. The participants did not choose

a particular language. After accessing the link, the participants were asked to fill out an informed consent before conducting the study. The research procedures and instructions before rating the level of similarity were explained to the participants. The participants proceeded to the next question if they rated the level of similarity in the previous question. After answering all questions, the participants rated their reading and speaking abilities in Bahasa Indonesia and German.

3. Results

We used an independent sample *t*-test to compare the mean of the similarity ratings of the two groups in Bahasa Indonesia and German instructions. To determine the interaction between the item types (same gender vs. different genders) of the two groups, we used mixed ANOVA in 2×2. Analyses were conducted using Jeffry's Amazing Statistics Program (JASP). Before comparing the similarity between language groups, the data obtained were analyzed using the chi-squared test and independent sample t-test to ensure that no other variables (i.e., gender, final education level, language proficiency, age, duration of stay in the second language country, active use of the second language, and length of second language acquisition) affected the research hypotheses. There were no extraneous variables that affected the results of the research hypotheses.

The two language version groups showed no difference in the mean scores in the similarity of image pairs (in Bahasa Indonesia: M = 2.14, SD = 1.79; in German: M = 3.09, SD = 1.68; t(44) = 1.86, *p* = 0.007, d = 0.55; Figure 3).
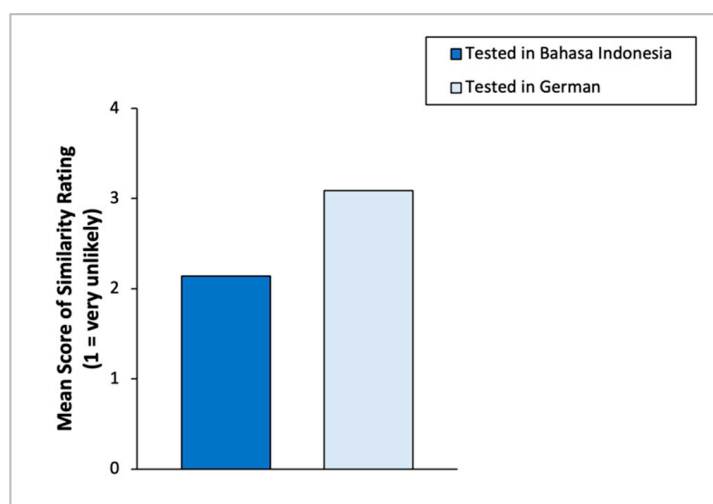

Figure 3. Comparison of mean scores in similarity.

The mixed ANOVA analysis result showed no significant interaction between the item types (same gender vs. different gender, Figure 4) in different groups. The German group rated similarity higher than the Bahasa Indonesia group (M = 3.11, SD = 1.72 in German; M = 2.15, SD = 1.82 in Bahasa Indonesia). The German group rated similarity higher than the Bahasa Indonesia group (M = 3.06, SD = 1.65 in the German group; M = 2.12, SD = 1.76 in the Bahasa Indonesia group). The interaction between item type and language version was not significant (F(1) = 0.05, *p* = 0.083, h2 < 0.05).

The results of the independent sample *t*-test and mixed ANOVA 2×2 showed no significant difference in the similarity context rated by the two groups.
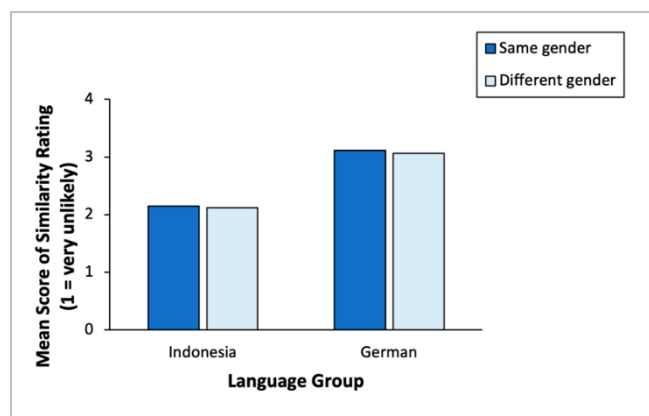
Figure 4. Comparison of mean of similarity (same gender and different gender) between groups.

4. Discussion

The difference in language did not affect the level of similarity of pairs of object images in this study. The Bahasa Indonesia and German groups showed no difference in the score for the similarity context for the same and different gender items. The result is different from that in Ref. [8] (pp. 928−933), which found that the language affected the assessment of the level of similarity in the gender of an object. The speakers of languages with grammatical gender perceived an object as biologically feminine and masculine based on the noun article (feminine and masculine). Differences in the results between the results of this study and the previous one may be due to different methods. The use of instruction in different languages is insufficient to change the perception of the participants. However, the language used in the instructions affected the experiment results [7].

The items used also affected the results. The images used in this study were different from those in previous studies [8] (pp. 928−933). The items used in the experiment of this study were the original images of the object (except for the pictures of a king and a giant) in color. Color is one of the elements that affect an individual's visual perception [15]. In addition, since the background in the image was not uniform, it influenced the ratings of the participants. One of the participants in this study thought that a resemblance was found between the items and the background, which hindered him from focusing on the item. As a result, it was likely for the participants in this study to estimate the resemblance of items based on other aspects of the image (e.g., color and backdrop).

Apart from the research procedures that affected the results, the number of participants might influence the results. A total of 46 participants took part in this study, while 55 participants were recruited in the previous study. The normality of the result also might affect the results. The results of this study did not support the Sapir–Whorf hypothesis, which argued that one's perception is influenced by the language one speaks [10,11].

5. Conclusions

The way bilinguals think or perceive cannot be manipulated by the second language they speak. In this study, it was found that the language instruction used in the research did not influence the bilingual perception of objects. Thus, the way of thinking is influenced mainly by the mother tongue. There were no significant differences between the Bahasa Indonesia and German groups. The participants in the groups' similarity scores were not significantly different. There were also no significant differences in the perception of the similarity of items of the same and different genders in the two language groups. The language used did not affect the ratings of the similarity of the images between objects by the two groups. Differences in perception might have occurred when a non-colored (black-and-white) line drawing was used in this study. This implies that the color and background of the object may influence the perception of the similarity of the object. In the previous study [8] (pp. 928−933), the Sapir–Whorf hypothesis was supported, revealing

that language affects the assessment of the similarity of an object. More specifically, Phillips and Boroditsky found that the speakers of languages with grammatical gender perceive an object as biologically feminine and masculine based on the noun article (feminine and masculine).

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