

Numeral Classifiers and Counting Speed Differences between Korean and English

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Abstract

This study examines if languages with detailed systems of object classification affect processing speeds of counting. Much research suggests that particular system of organization of a given language can affect non-linguistic cognitive systems. This study attempts to offer support of this relativistic view of language by testing differences between Korean and English speakers' reaction times in object counting in matching and non-matching numeral classifier (NC) conditions. However, results failed to reach significance, and a discussion of improved methodology is provided.

Keywords: numeral classifiers; counting; Korean; English.

Introduction

Korean numeral classifiers (NCs¹) provide a system of object categorization similar to Japanese and other Southeast Asian languages. Oh (1994) argues that NCs are unique from other noun classifiers because they share a direct and closer relation to numerals rather than nouns. Specifically, NCs are morphemes that categorize the noun referent (Aikhenvald, 2006). General word order for count statements in Korean is object-numeral-NC (1) or numeral-NC-object (2). In either order, the numeral always precedes the NC. This relationship causes a particular cognitive organization in which counting objects requires additional processing to connect numerals with appropriate NCs.

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|----|----------------------------|----------|---------------|
| 1) | Subak-ul | du-t'ong | meok-eoss-ta. |
| | watermelon-Obj | two-NC | eat-Pst-Decl |
| | '(I) ate two watermelons.' | | |
| 2) | Se-mari | kae-rul | iss-da. |
| | three-NC | dog-Obj | have-Decl |
| | '(I) have three dogs.' | | |

In English, there are few terms for object count; instead, counted nouns are preceded with a number (e.g. 'three cats'). Commonly, object count terms in English are for mass-nouns, such as 'herd of cattle' and 'flock of birds.' These mass-nouns generally do not indicate exact number,

¹ We use Oh's (1994) distinction of a numeral classifier (NC) as different from the commonly known noun classifier (Cl) notation. NCs are types of noun classifiers, which Aikhenvald (2006) aptly defines as morphosyntactic units that appear in semantically-defined constructions.

except in the case of 'dozen eggs.' Classifiers such as 'sheets' to count paper demonstrate qualities of NCs, but the clitic relationship between the NC and numeral is such that they are unable to be separated even by adjectives (Oh, 1994), as possible in 'Three clean sheets of paper.' The term 'sheets' also may stand alone; in context of paper, 'Give me two sheets, please,' is entirely comprehensible². This same pattern applies to quantifiers such as 'a portion of,' 'a slice of,' as Uchida and Imai (1999) try to offer as approximate English NCs. However, these types of classifiers are understood to be a subtype of genitive construction (see Aikhenvald, 2006; Yamamoto & Keil, 2000). However, this separation between the NC and numeral and isolation of the NC is impossible in Korean.

In the present study, Korean NCs are used in matching and non-matching conditions to test counting speed of objects. Expected results are that in images of non-matching objects, Korean speakers will show slower response times than English speakers. The matching counter condition response times should be the similar for both Korean and English speakers. This difference would indicate that Korean speakers are inhibited to count non-matched items due to a conflict in mental categorization. Importantly, this may also be due to a cognitive necessity to combine the required linguistic segments (objects, numerals, and NCs) into a comprehensive unit (Uchida & Imai, 1999). However, due to methodology, results failed to reach significance, and these errors and suggested improvements are described in the Discussion.

Experiment

Subjects

Twenty-two Korean and English native speakers enrolled at the University of Hawai'i at Mānoa participated in exchange for baked goods or course credit. Five subjects were male and 17 were female, ages ranging from 19 to 37 years.

Materials

Full-color photos of 24 white-isolated objects were organized into a Latin Square of two sets of 12-object pairs. Images were acquired either through the Creative Commons

² Aikhenvald (2006) differentiates sortal NCs (characterizes referents directly) and mensural (e.g. 3 inches of string) NCs. Our discussion is primarily concerned with non-mensural NCs.

database or the iStock website. Each object-paired image was set at 800x600 pixels, and each object within the image was no greater than 240 pixels in any dimension. Also, images were controlled for color brightness.

Images were created based on the Korean NC system for matched and non-matched conditions. For example, the Korean NC *mari* is used to count small animals such as dogs and cats, while *myeong* is used for humans regardless of age and gender. The matched images would contain dogs and cats or males and females; the non-matched images would pair a combination of the groups, such as dogs and males or cats and females (see Table 1).

Each image contained 9-13 objects randomly scattered within the 800x600 white space in an attempt to decrease subitization effects (see Figure 1). The experiment was created and run on a PC using ePrime 2.0. Headphones were used to decrease background noise, and the input device was the number-pad on a keyboard.

Table 1: Sample of Object-Paired Set.

	Image	Numeral Classifier
Match	dog + cat	<i>mari + mari</i>
	male + female	<i>myeong + myeong</i>
Non-Match	dog + male	<i>mari + myeong</i>
	cat + female	<i>mari + myeong</i>

Procedure

Subjects completed a general survey to confirm normal to corrected-to-normal vision, age, and gender. They then were seated in front of a computer and given written instructions on screen in their native language to view images and count the number of objects seen.

Images were presented for 3000 milliseconds before switching to instructions asking subjects to report the number of objects seen via keyboard. If the total number of objects was less than 10, subjects were instructed to first

type 0 and then the following number to keep all entries to two digits. The next image was presented after subjects entered data, and this continued for 12 images total per participant. All subjects went through a single image trial run to familiarize them with the procedure.

As described in the earlier Materials section, images were designed to contain object pairs with total numbers of objects per image ranging from 9 to 13. The experiment took approximately five minutes to complete.

Results

Response time (RT) in milliseconds and response accuracy were measured, but only RT was analyzed via Repeated Measures ANOVA. Overall, accuracy was high (90% and higher). Independent variables were language (Korean and English) and NC condition (Match and Non-Match). The response time was measured from the moment an image cleared and switched to the data entry screen to the first keystroke entered by subjects.

The RTs for the two sets of 12-object pairs were collapsed together in order to report the overall analysis. Then, values of mean RTs 2.5 SDs above or below the mean were shed to eliminate outliers.

Within-subjects factors included the 11 Korean speakers (3 males, 8 females) and 11 English speakers (2 males, 9 females) participated. Results follow the prediction that Korean speakers would take longer to count objects in the non-matching condition, with mean RT for non-matching images (1278ms) being slower than matching images (1246ms). However, this difference failed to reach significance in a repeated-measures ANOVA, $F(1,10)=0.29$, $p=0.87$ (see Table 2).

Within the English speaking group, mean RTs for NC condition do not show a significant main effect, $F(1,10)=1.32$, $p=0.72$. Again, these results conform to the hypothesis that English speakers would not be inhibited when counting objects grouped by Korean counters.

Between-subjects repeated measures ANOVA also



Figure 1: Sample of Images with Matched and Non-Matched Image Pairs.

showed no significant interaction between image sets A and B, $F(1,21)=0.16$, $p=0.70$. This was anticipated within the design as the sets were cross-controlled purposefully.

Table 2: Mean Reaction Time (RT) in Milliseconds

	Korean (n=11)		English (n=11)	
	Mean RT	SD	Mean RT	SD
Match	1246	1285	2428	3440
Non-Match	1278	1045	2188	1925

Discussion

This study failed to produce the expected results in Korean speakers between the NC conditions due to several possibilities. However, we believe linguistically relative effects exist in the NCs and that the results are reflective of a failure to eliminate subitization effects and subjects' unequal typing and math skills. Each of these issues are discussed below and followed by recommended corrections to methodology.

Subitization Even though images were randomized with scattered objects, the objects numbered less than 13 total. This enabled most subjects to quickly devise a problem-solving method by subitizing the two sets and adding their totals. This experiment's design limited the stimuli presentation to 3000 milliseconds to increase pressure and difficulty of the task.

Instead, a comparison task of two images on the screen, each image containing greater than 20 scattered objects will be performed by subjects (more below). Also, using three object types per image rather than two may also draw more differences. For example, in a matched condition, images of a man, woman, and child could be used since they all use the same NC.

Typing Skills Observation of subjects in the lab revealed that the Korean subjects were more comfortable with the number-pad input method than English subjects. This skill difference was not considered in the experiment design and most likely resulted in the significant difference in mean RTs between English and Korean subjects noted in the Results.

To correct for this error, subjects will be asked to perform a series of tasks. The first, as mentioned earlier under Subitization, will be a comparison task of two images that remain on-screen until keyboard input. Subjects will select which of two images contains the most objects by pressing a key corresponding to that image. There will only be two keys to press, both clearly marked, and subjects will be encouraged to keep their hands near the keyboard. Response time will be measured from the stimuli onset to the key entry. To ensure accuracy, the second task will require them to enter the numerical value for the image with the most images.

Math Skills It was unexpected that the counting task would be performed via addition. In hindsight, there is no surprise that Korean speakers showed faster response times overall in the experiment since much research has shown that Korean students are generally superior to American students in mathematics (Song & Ginsburg, 1987). However, the differences between Korean and English speakers are not as interesting as a difference in performance within the Korean group between matching and non-matching conditions. We still expect that English speakers should have similar times in both conditions.

Addition pretests will be performed to ensure similarity between subjects. If a subject falls outside average pretest scores, the data will be excluded.

Conclusion

Despite this pilot experiment's poor results, the reality of classifier effects on non-linguistic cognitive systems has been seen in earlier studies. A popular example is Lucy and Gaskins (2001) work with Yucatec Mayan and Dutch speakers. They found that in a triad experiment, Yucatec Mayan speakers classified objects based on substance rather than morphology (as Dutch speakers did). We anticipate stronger outcomes with the improvements described in our Discussion and hope to contribute Korean NC effects to other linguistic relativism studies.

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