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The Receptive and Productive Knowledge of Collocations: The Effects of Frequency, Exposure, and Phonological Short-term Memory

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The present study examined the receptive and productive knowledge of collocations of second language (L2) and heritage speakers of Korean and also investigated the influence of phrasal frequency, exposure to Korean, and phonological short-term memory (PSTM). Seventeen L2 learners and 14 heritage speakers of Korean were tested on 30 Korean noun-verb collocations, which varied in phrasal frequency, using an acceptability judgment task and a collocation completion test. The results showed that both L2 and heritage speakers demonstrated considerable receptive knowledge of Korean collocations while productive knowledge was more limited for both groups. The mixed-effects modelling results of four independent variables of interest (i.e., phrasal frequency, exposure via media, academic use, and PSTM) showed that phrasal frequency was the only significant predictor of receptive knowledge of collocations for both L2 and heritage speakers; none of the four factors had a significant impact on productive knowledge of collocations for either group. These data are discussed in relation to previous studies on collocation development of L2 learners and heritage speakers.

[collocation/frequency/TL exposure/phonological short-term memory, 연어/빈도수/목표어 노출/음운 단기 기억]

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I. Introduction

To date, there has been a wide acknowledgement among researchers that L2 learners have great difficulty developing and utilizing multiword expressions such as collocations, defined as grammatically well-formed combinations of words that co-occur frequently (e.g., Granena & Long, 2013, Granger, 1998; Kjellmer, 1994; Lee, 2007; Nesselhauf, 2003). Collocations also have been shown to present a major challenge for heritage speakers[1] as well (Lee, Moon, & Long, 2009; Moon, 2012). Some recent studies, however, have shown substantial L2 collocational proficiency in late L2 learners (e.g., Bolibaugh & Foster, 2013; Foster, Bolibaugh & Kotula, 2014). Some important factors that have been suggested for such exceptional late L2 learners include (but are not limited to) frequency of occurrence of collocations (i.e., phrasal frequency), target language (TL) exposure and use, and phonological short-term memory (PSTM).

First, language users in general have repeatedly been found to be sensitive to the frequency of linguistic units ranging from the smallest units (i.e., phonemes) to the largest units (i.e., lexical sequences) (Ellis, 2002). Specifically, a number of recent studies have shown that both native and nonnative speakers are sensitive to the frequency of collocations, which is compatible with the usage-based account (e.g., González Fernández & Schmitt, 2015; Kim & Kim, 2012; Sonbul, 2015; Wolter & Gyllstad, 2013).

Secondly, as suggested by Granena and Long (2013), if learning collocations is largely based on item learning, which requires extensive exposure to authentic L2, then L2 exposure and use should be another important factor. Based on the findings of their study, Durrant and Schmitt (2010) also argued that what is responsible for most L2 learners' inadequate collocational knowledge is lack of exposure rather than differences in how collocations are processed and acquired between native and nonnative speakers. Increasing evidence indicates that varied types of TL exposure and use play a critical role in collocational development for both L2 and heritage speakers (e.g., Bolibaugh & Foster, 2013; González Fernández & Schmitt, 2015; Zyzik, 2021).

Finally, a measure of PSTM, which is also referred to as the phonological

1) Valdés (2005) described heritage speakers as bilinguals of a minority language, who are in contact with a new dominant language.

loop in the working memory model developed by Baddeley and Hitch (1974), has been claimed to predict which learners are more likely to acquire nativelike word combinations in a L2 (Ellis & Schmidt, 1997). In line with this claim, previous research has demonstrated the robust effect of PSTM on L2 collocational proficiency and other types of multiword units in late L2 learners (e.g., Bolibaugh & Foster, 2013; Foster et al., 2014; Skrzypek, 2009).

Although a number of studies have examined L2 collocational competence and related factors as reviewed above (e.g., González Fernández & Schmitt, 2015; Macis & Schmitt, 2017; Shin & Jung, 2021), previous studies often included either receptive or productive measure only and rarely focused on heritage population. No study, to the best of my knowledge, investigated both receptive and productive knowledge of L2 and heritage speakers and related factors in one study. Such data will be valuable for expanding our understanding of differences between L2 and heritage speakers of Korean in collocational competence and contributing factors and can inform language teaching and learning. Thus, the current study will examine receptive and productive knowledge of collocations among L2 and heritage speakers of Korean and also factors relating to their acquisition. In the following section, previous research related to each factor will be reviewed in detail.

II. Theoretical Background

1. Role of Phrasal Frequency

There has been increasing evidence in the literature demonstrating robust frequency effects on L2 collocation knowledge (e.g., González Fernández & Schmitt, 2015; Sonbul, 2015; Wolter & Gyllstad, 2013). For example, Wolter and Gyllstad (2013) reported evidence for effects of phrasal frequency on L2 collocational knowledge. They gave a timed acceptability judgment task to both native and advanced nonnative speakers. Target collocations involved English adjective-noun pairs from eight frequency levels. The results showed a main effect of phrasal frequency on the response accuracy and response time for both groups. A more recent study by Sonbul (2015) examined the effect of phrasal frequency on adjective-noun collocations for native and advanced nonnative speakers, using a typicality rating task and eye-tracking

methodology. Results of the typicality rating task showed a significant main effect of phrasal frequency for both native and nonnative speakers, but with a clear interaction effect of proficiency such that native and highly proficient nonnative speakers demonstrated a stronger effect of phrasal frequency than lower-level nonnative speakers. Similarly, for the eye-tracking data, a significant main effect of phrasal frequency was found on initial reading times for both native and nonnative speakers, but this time with no interaction with their level of proficiency. In addition to the strong relationship of phrasal frequency and scores on the collocation recognition measures, a significant association between phrasal frequency and productive collocation knowledge was found by González Fernández and Schmitt (2015). Testing L2 learners' productive knowledge of 50 collocations, they found that raw corpus frequency correlated moderately with the nonnative speakers' production test scores. Other studies examining different types of multiword expressions (i.e., phrasal verbs) also reported a significant relationship between phrasal frequencies and productive knowledge of target multiword units (e.g., Schmitt & Redwood, 2011; Sonbul, El-Dakhs, & Al-Otaibi, 2020).

Overall, the findings of a frequency effect on collocational knowledge for nonnative as well as native speakers are largely consistent in previous studies. Such findings are compatible with the usage-based account, which maintains that language acquisition is influenced by the frequency of co-occurrence of a linguistic unit (Bybee, 2008; Ellis, 2002). However, it should be noted that, previous studies often included measures of receptive collocation knowledge only, with a focus on L2 learners. Thus, the questions of whether frequencies of collocations play a significant role for heritage speakers and also affect productive collocation knowledge still remains to be verified.

2. Role of TL Exposure and Use

In addition to a significant influence of phrasal frequency, another factor that has been frequently addressed in L2 collocation studies is the facilitating role of L2 exposure and use on L2 collocational learning. Dörnyei, Durow, and Zahran (2004) argued that extensive L2 natural exposure is central for successful acquisition of multiword units. In line with this claim, engagement and interaction with L2 were repeatedly found to have a significant effect on

L2 collocational development (González Fernández & Schmitt, 2015; Macis & Schmitt, 2017; Siyanova & Schmitt, 2008). Specifically, González Fernández and Schmitt (2015) found that informal L2 exposure (composite score of exposure variables of reading, watching TV/films, and social networking), among the three factors they examined (the other two were phrasal frequency and amount of L2 instruction), was the most strongly associated factor, explaining over 31% of the variance in the participants' productive collocation knowledge. Bolibaugh and Foster (2013) also found that active interaction with TL community had a significant effect on the receptive knowledge of multiword expressions including collocations. Specifically, all three predictors they examined in relation to the receptive knowledge of various multiword expressions (i.e., L2 interaction, PSTM, and disposition towards interaction) were significantly correlated, together accounting for 60% of the variance in the knowledge. In a more recent study, Macis and Schmitt (2017) found that some variables related to engagement with the L2 (i.e., years at university, time spent in an English-speaking country, and time spent reading) were significant predictors of EFL learners' collocational knowledge. Previous studies focusing on heritage speakers also provided evidence for a crucial role of exposure and use in collocational development (Moon, 2012; Zyzik, 2021). Zyzik (2021) found a significant relationship between some variables relating to exposure and use (i.e., text messaging, posting on social media, listening to music, and reading for fun) and heritage speakers' receptive and productive collocation knowledge. Examining Korean-American heritage speakers' Korean language proficiency, Moon (2012) also found that amount of media exposure during childhood had a significant effect on receptive knowledge of collocations even after accounting for the age effects (which had the largest impact) while the other factors she examined (i.e., aptitude, attitude, amount of instruction) did not have significant impacts.

In sum, previous studies have generally shown that L2 exposure and use are significant factors in developing both receptive and productive knowledge of L2 collocations. However, some previous studies failed to distinguish different types and contexts of L2 exposure and use. Instead of merely examining the length of L2 exposure or asking participants whether they had regular L2 interaction or not, as Dörnyei et al. (2004) pointed out, thorough examination of types and contexts of L2 input and use is necessary to have a

clearer picture of the link between different types of L2 exposure and use and L2 collocational development. Citing Bardovi-Harlig and Bastos' (2011) study, Bolibaugh and Foster (2013) also pointed out that some L2 learners do not make use of the interaction opportunities they have in the TL community, and that using measures of L2 exposure such as length of stay only is likely to mask the variety of experiences they may have. Thus, to fill such a gap, the current study will distinguish among different types and contexts of L2 exposure in order to find which aspects of language exposure and use are more strongly related to learners' collocational knowledge.

3. Role of PSTM

Ellis (2001, 2002, 2003) claims that chunking is a crucial process in language learning. He claims that just like child L1 learners, adult L2 learners have a capability to perceive co-occurrences among words without conscious attention. The frequent co-occurrences of words in linguistic input drive multiword units to be associated in long-term memory and consolidated into chunks. This theory would then expect adult L2 learners with a longer memory span to be more likely to store such chunks as they should be able to hold L2 phonological information long enough in short-term memory. In fact, ability to hold sequences of verbal material in short-term memory has long been thought to be associated with long-term vocabulary acquisition both in L1 and L2 (Ellis, 1996; Gathercole & Adams, 1993, 1994; Service, 1992; Speciale, Ellis, & Bywater, 2004).

Specifically, a couple of studies have focused on the relationship between PSTM and collocational knowledge. Skrzypek (2009), for example, in a longitudinal classroom-based study, examined the effect of PSTM on gains in collocational knowledge by L2 immigrants in Ireland over a six-month English language course. The results showed that PSTM had a significant effect on collocation gains, accounting for large amounts of variance (30% in elementary learners, and 26% in lower intermediate learners). In two more recent studies (that were also reviewed in previous sections), a significant association between PSTM and L2 learners' receptive knowledge of multiword expressions including collocations was reported (Bolibaugh & Foster, 2013; Foster et al., 2014). Both studies used a nativelike selection test in which

participants were asked to underline any nonnativelike words or phrases in the given text. Bolibaugh and Foster (2013) reported that among all three factors that were significantly associated with L2 learners' nativelike selection ability (i.e., L2 interaction, PSTM, disposition towards interaction), PSTM accounted for the largest portion of variance (36%). However, in a related study, it has also been suggested that PSTM may differentially affect L2 nativelike selection ability depending on the context of learning. Foster and colleagues (2014) showed that PSTM remained a significant predictor of receptive nativelike selection ability for late L2 learners who were living in the TL community (i.e., the U.K.), even after both age of L2 onset and length of exposure had been taken into account. It is also noteworthy that two late L2 learners living in the TL community achieved scores comparable to those of native speakers and had relatively high PSTM scores compared to other L2 participants. However, PSTM had no significant effect on nativelike selection ability for participants who were living outside the TL community (i.e., Poland), regardless of age of L2 onset or length of exposure.

In sum, previous studies, although limited in number, have demonstrated the significant effect of PSTM on knowledge of L2 collocations and multiword units in L2 learners. The effect was found to remain significant and robust even after other significant factors such as age of L2 onset or length of exposure were taken into account. However, to the best of my knowledge, there is no study that attempted to look at the relationship between individual differences in PSTM and both receptive and productive collocation knowledge for L2 and heritage speakers. Moreover, two recent studies reviewed above used a task (i.e., nativelike selection task) that may not tap into L2 learners' knowledge of multiword expressions fully. They also included a relatively wide range of multiword units such as *robbers of a bank* or *gun fighting* or *were too full* that can be affected differentially by the same factors.

III. The Present Study

1. Research Questions

The present study examined receptive and productive knowledge of

collocations of L2 and heritage speakers of Korean and also investigated how each knowledge is related to (a) phrasal frequency (b) various types of TL exposure and use and (c) PSTM. The research questions posed in this study include the following:

1) How well do L2 and heritage speakers receptively know a diverse set of Korean collocations?
2) How well do L2 and heritage speakers productively know a diverse set of Korean collocations?
3) Which factor(s) best explain(s) the variability in the L2 and heritage speakers' knowledge of collocations?

2. Method

1) Participants

The participants for the study consist of 17 L2 learners of Korean and 14 heritage speakers of Korean recruited in Korea and the US (16 L2 learners were recruited in Korea while one L2 learner and 14 heritage speakers were recruited in the US[2]). Twenty native speakers of Korean were also recruited in Korea to serve as a baseline comparison group. All the L2 learners spoke English as their native language. The heritage speakers in the present study were limited to those who were born to Korean immigrant parents in the US or who immigrated before the age of 10. All the heritage speakers were literate in Korean and reported that both parents were originally from Korea. All participants except for one (13 out of 14) also reported that they were exposed mainly to Korean until age 4 but currently speak English better and more frequently than Korean. Except for three individuals, all the heritage speakers identified English as their dominant language. The other three participants identified both Korean and English as their dominant languages. Table 1 summarizes the language background information of L2 and HL (heritage language) learners obtained in the questionnaire. Based on their

2) The L2 learner recruited in the US had been living in Korea but was only visiting the US at the time of participating in the study, and thus comparable to the other L2 learners recruited in Korea.

Korean proficiency test scores (as measured by the Korean C-test developed by Lee-Ellis, 2009), the heritage speakers were more proficient in Korean (M=108.63, SD=23.04) than the L2 learners (M=86.79, SD=22.63), $t(29)=-2.65$, $p=.013$.

TABLE 1
Description of L2 and Heritage Speakers
(mean values and standard deviations in parentheses)

	L2 (N=17)	HL (N=14)
Age	27.82(5.10)	21.5(1.40)
AoE to Korean	20 (3.48)	0 (0)
Years of formal instruction	3.65(1.40)	1.34(2.13)
Years of residence in Korea	5.29 (3.48)	4.87(4.04)
KOR C-test scores (max=130)	86.79(22.63)	108.63(23.04)

Note. AoE refers to mean age of exposure while years of formal instruction refers to mean total years of formal instruction of Korean.

2) Materials

For the construction of test materials, 65 Korean noun-verb collocations such as sal-eul ppayta were first selected using two Korean collocation dictionaries (Han, 2016; Kim & Ju, 2016). The selected collocations were then trimmed down to 30 items based on the following criteria: (a) Their constituent words had to be frequent (all within the most frequent 6,000 words of Korean in the list of 6,000 most common Korean words, constructed by the National Institute of Korean Language); (b) They could not have direct translational equivalents in English to control for any L1 transfer effects; (c) They needed to vary substantially in frequency, with a minimum frequency of occurrence of 10 to avoid atypical word combinations. The target collocations can be found in Appendix. For the current study, the phrasal frequency information was obtained on the basis of a corpus of contemporary written Korean (a corpus of 36 million words)[3] created by the National Institute of Korean Language (NIKL). For analyzing and retrieving the frequency data from the raw corpus, the software Hanmaru 2.0 developed by NIKL was employed.

3) This corpus was chosen because it was the largest Korean corpus publicly available and represents a cross-section of written language from a wide range of resources.

In addition to 30 target collocations, 30 non-collocate noun-verb pairs were constructed to serve as the baseline condition. These pairs were atypical combinations of two words from the list of 6,000 most common Korean words such as yeunghyang-eul tanghata. All the non-collocate pairs had zero phrasal frequencies, based on the corpus of contemporary Korean. Additionally, all the non-collocate items were piloted with three native speakers of Korean to ensure that they were perceived as truly unusual constructions.

As shown in Table 2, both the length of the word sequences and the frequency of individual words in the test items were matched as closely as possible between the lists of the target collocations and non-collocational control items to ensure that there were no major differences between the lists in terms of individual words.

TABLE 2
Lexical Properties of the Stimuli (30 items in each condition)

	Collocations	Non-collocate controls	*t*
Length	4.87	5.13	-1.52
Noun frequency	1721.93	1708.3	.04
Verb frequency	1230.41	1102.3	.68

Note. Length is the mean number of letters. Noun and verb frequencies refer to raw frequencies based on the Korean corpus of 36 million words.
All comparisons are pairwise.

3) Instruments

(1) Acceptability Judgment Task

An acceptability judgment task was used as a measure of an ability to recognize a given collocation in Korean. This task has been frequently used in previous studies investigating the acquisition of collocations and other types of multiword expressions in a L2 (e.g., Jiang & Nekrasova, 2007; Lee et al., 2009; Moon, 2012; Yamashita & Jiang, 2010). In the present experiment, after the instruction and 12 practice items, the experimental items (i.e., 30 collocation items and 30 non-collocational control items) were presented to the participants in an individually randomized order. Both the practice and test items began with a series of asterisks in the center of the screen for 500

ms for the purpose of eye fixation. The asterisks were followed immediately by the presentation of an item, to which the participant responds. The participants were asked to decide whether or not the word combinations presented are "acceptable Korean expressions" by pressing a specified key on the keyboard as quickly as possible when they see it. Response times (RTs) were measured from the onset of an item to a key press.

(2) Collocation Completion Test

A collocation completion test was used to measure productive knowledge of the target collocations. The test was in the form of a fill-in-the-gap task in which the participants were asked to provide the two-word Korean collocations missing in each Korean sentence. Each sentence contained gaps, with the first letter of each of the two words provided in order to help the participants do the task and constrain the range of potential collocations elicited.

(3) Nonword Recognition Task

A nonword recognition task, in which participants were asked to listen to two presentations of a list of nonwords and decide whether they are the same or different, was used to measure PSTM. The nonwords taken from Martin and Ellis (2012), which were originally adapted from Gathercole, Pickering, Hall, and Peaker (2001), were used for the present study. The materials include 30 one-syllable nonwords. The set of nonwords were divided into eight lists at each of three lengths: five, six, and seven items. The eight lists at each length included four identical and four different sequences. Within each list, the order of the items was randomized across the participants. For the 'same' trials, the same list was presented twice with a 1,200 ms delay in between. For the 'different' trials, the first presentation of the list was followed by a 1,200 ms delay and then a second presentation of the list with two adjacent items transposed. The locations of the transposed pair were randomized across the participants but the first and last syllables were never be transposed. This exception was included to reduce the salience of the transposed items and encourage the participants to process the entire

sequence (Martin & Ellis, 2012).

(4) Korean Proficiency Test

A short version of the Korean C-test (Lee-Ellis, 2009) was used to measure participants' Korean language proficiency. Previous research has shown high reliability (e.g., α=.95) and a high predictive validity (e.g., r=.825 between this C-Test and self-assessment) of this test (Lee-Ellis, 2012). Four passages were included with 25 blanks in each. Anything after half of the content words including any postpositions or inflections were deleted to ensure that both content words and functional elements are deleted for testing. All the L2 and heritage speakers were informed that some of the items and tests might be challenging for them and advised to try their best and work on all four passages.

(5) Language Experience and Proficiency Questionnaire

The LEAP-Q (Marian, Blumenfeld, & Kaushanskaya, 2007) was used to elicit information regarding the TL exposure and use factor such as years of residence in Korea or average TL exposure via media, friends, family, and classroom. Specifically, seven items in the questionnaire were used to collect information about different types and contexts of participants' TL exposure and use. These items include: (1) years of residence in Korea, (2) TL exposure via listening to radio and music, (3) TL exposure via watching TV, (4) extensive reading in Korean, (5) L2 use with peers, (6) L2 use with family, (7) total years of formal instruction. The collected data were used as independent variables related to the TL exposure and use for the main analysis.

4) Procedure

The test was administered individually in a quiet room. The collocation completion test was given first, to both L2 and heritage speakers, followed by the nonword recognition task and the lexical decision task (the details and the results of which are not reported in this article). Then, there was a 10-minute break, in order to minimize any effect of the productive

collocation measure on the subsequent receptive measure. After the break, the acceptability judgment task was given. Upon completing the main tasks, L2 and heritage speakers were given the Korean proficiency test and the language experience and proficiency questionnaire. The native speakers as a control group took the lexical decision task (the details and the results of which are not reported in this article), and after a 10-minute break, the acceptability judgment task.

The collocation completion task was administered on paper. The participants were given enough time to complete the test. The three tasks (nonword recognition task, lexical decision task, and the acceptability judgment task) were all administered using DMDX (Forster & Forster, 2003).

5) Scoring and Analysis

When scoring the collocation completion test, a response that was correct in spelling and morphology was given a full score (2 points: one point each for each constituent of a target collocation). For example, if a participant provided a correct noun but a wrong verb for the response, only 1 point was given for providing the correct noun. Partial credit (0.5 point for a correct constituent of a collocation) was given if the word was misspelled but recognizable or if the correct stem was provided but a wrong affix or conjugation ending was used. A response was given zero if no response or a wrong response was given. Two raters independently scored the productive test and the Korean C-test with a satisfactory inter-rater reliability (Pearson correlation of .998 and .999, respectively).

For the main analysis, linear mixed-effects models (LMEMs) were fitted for the accuracy rates from the acceptability judgment task and the collocation completion test scores. Before constructing the mixed effects models, however, a principle component analysis (PCA) was performed on the seven measures of TL exposure and use with oblique rotation so that high multicollinearity among predictor variables can be avoided when fitting the mixed effects models. Based on the scree plot, the proportion of total variance accounted for, and factor loadings, only two components were retained, with eigenvalues over Kaiser's criterion of 1, in combination representing 81.44% of the variance. The Kaiser-Meyer-Olkin measure

verified the sampling adequacy for the analysis, KMO=.553, which is acceptable (Field, 2009). Bartlett's test of sphericity $x^{2(21)}$=36.86, p<.001, indicates that correlations between items were sufficiently large for PCA. Table 3 shows factor loadings after rotation. The items that cluster on the same component suggest that component one represents TL exposure via media and component two, academic use, and their component scores were used as predictors when developing mixed effects models. The rest of the variables related to TL exposure and use (i.e., L2 use with peers, L2 use with family, length of residence) were not included when fitting mixed-effects models.

TABLE 3
Factor Loadings for TL Exposure and Use Variables

Condition	Component 1	Component 2
TV	.94	-
Radio/music	.93	-
Reading	.32	.85
Years of Instruction	-.39	.74

To answer the third research question regarding the effects of phrasal frequency, TL exposure and use, and PSTM on L2 and heritage speakers' collocational knowledge, two separate analyses were conducted using LMEM each for the accuracy rates and productive test scores. Analyses were conducted with R version 2.11.1 (R Core Development Team, 2010) using the lme4 (version 1.1-9; Bates et al., 2015) and lmerTest (version 3.2.5; Kuznetsova, Brockhoff, Christensen, & Jensen, 2020) packages. Accuracy rates were analyzed using a generalized linear mixed effects model with a binominal distribution, and the "bobyqa" optimizer was used only when the model failed to converge.

When fitting the mixed-effects models, five independent predictors were considered for each analysis: phrasal frequency, TL exposure via media component, academic use component, PSTM, as well as Group (L2 or HL). As a covariate, proficiency as measured by the Korean C-test was added for all models to account for individual differences in Korean proficiency. All interval scale values were centered before analysis to reduce collinearity within the model (Cunnings, 2012). In addition, random intercepts for both

participants and items were included in all models. Random slope effects for either participants or items were included only when their inclusion led to a statistically significant improvement in the fit of the model based on x^2 likelihood ratio tests (Baayen, Davidson, & Bates, 2008).

When constructing the mixed effects models, each analysis started with a null model including each dependent variable (accuracy rates, or productive test scores) with participants and items as random effects. Then, the predictor variables that were of central importance were added incrementally in the following order: phrasal frequency, TL exposure via media, academic use, PSTM, and then the participant-related effects (group, C-test scores). Likelihood ratio tests were used to verify whether the inclusion of additional predictors contributes significantly to the model. In the following section, the results in response to the three research questions will be presented for receptive and productive measure, respectively.

IV. Results

1. Recognition Performance

With regard to receptive collocation knowledge of L2 and heritage speakers, the mean error rates (ERs) of acceptability judgment for the two item conditions for both groups is presented in Table 4. The native speakers' ER data was also analyzed for the comparison purposes. As for the target collocations, both L2 and heritage speakers performed relatively well, scoring 72.66% and 90.5% on average respectively while native speakers showed almost ceiling performance (95.28%). As for the non-collocate items, however, the two groups' mean accuracy scores dropped considerably; L2 learners scoring 62.62% and heritage speakers, 77.01% while native speakers' mean accuracy scores decreased only slightly (91.41%). As shown by the standard deviation, there was also considerable individual variation within L2 and heritage speakers compared to that of native speakers.

In order to examine patterns emerging from the ER data of the target collocations and non-collocate items, the LMEM analysis was conducted with group (i.e., NS, HL, or L2 groups) and item type (i.e., collocate and non-collocate items) as fixed effects, and participants and items as random

effects. The results revealed that the L2 and heritage speakers were more likely to produce incorrect responses than the native speakers ($p<.0001$ for both comparisons). The results of the same model refitted with the heritage speakers as the reference level showed that the L2 learners were more likely to produce incorrect responses than the heritage speakers ($p<.0001$). A main effect of item type was also found, indicating that collocations were responded to significantly more accurately than to the non-collocate items ($p<.0001$). However, there was no significant group × item type interaction, suggesting that the response pattern of the L2 and heritage speakers to the target collocations and their control items was comparable to that of the native speakers except for being more likely to be inaccurate.

TABLE 4
Mean ERs (SD) for the Two Item Conditions

	L2 (N=17)	HL (N=14)	NS (N=20)
Collocations	27.34 (14.06)	9.95 (10.16)	4.72 (4.68)
Non-collocate items	37.38 (15.28)	22.99 (11.64)	8.59 (7.12)

With regard to the third research question concerning the effects of phrasal frequency, TL exposure and use, and PSTM on L2 and heritage speakers' collocational knowledge, results of the best-fit LMEM (which best describes the overall variance in the research design) for accuracy rates are summarized in Table 5. The analysis showed that among the core variables of interest (phrasal frequency, TL exposure via media, academic use, and PSTM), only phrasal frequency led to significant improvement of the model. That is, the final best-fit model with phrasal frequency and group (i.e., L2 or HL) as main effects and proficiency as a covariate showed a significant main effect of phrasal frequency ($p<.01$), suggesting that higher frequencies are associated with the higher chance of collocation items being correctly responded to in the acceptability judgment. There was also a significant main effect of group, indicating that the L2 learners were more likely to make erroneous responses to the target collocations than the heritage speakers ($p<.05$). Note that adding phrasal frequency × group did not improve the model; thus, it was removed from the final model. Proficiency was also found to be a significant predictor of accuracy rates such that higher proficiency was associated with a higher chance of collocation items being correctly responded to in the acceptability

judgment task (p<.001).

TABLE 5
Results of LMEM for Accuracy Rates of L2 and Heritage Speakers

Random effects				
		Variance		SD
Subject	(Intercept)	0.31		0.56
Item	(Intercept)	1.86		1.36
	Group	0.65		0.8
Fixed effects				
	Estimate	SE	z-value	P value
(Intercept)	2.70	0.40	6.68	<.0001
Phrasal frequency	1.93	0.59	3.27	<.01
Group	-0.90	0.40	-2.24	<.05
Proficiency	0.03	0.01	4.87	<.0001

Note. HL group was the reference level for group.

2. Recall Performance

With regard to productive collocation knowledge of L2 and heritage speakers, Table 6 shows the descriptive statistics for L2 and heritage speakers' collocation completion test scores. The mean collocation completion test score for L2 learners was 27.32 out of a possible 60 (45.53%), while that of heritage speakers was 45.79 (76.32%). As shown by the standard deviation and range, there was considerable variation in both L2 and heritage speakers.

TABLE 6
Descriptive Statistics for Collocation Completion Test Scores (Max=60)

	Minimum	Maximum	Mean	SD
L2 (N=17)	7.50	49	27.32	10.55
HL (N=14)	25	56	45.79	8.97

With regard to the third research question, results of the best-fit model for the collocation completion test scores are summarized in Table 7. The results of LMEM revealed that none of the core variables (phrasal frequency, TL exposure via media, academic use, and PSTM) led to a statistically significant improvement in the fit of the model based on x^2 likelihood ratio tests. The final best-fit model with group (i.e., L2 or HL) as a main effect and

proficiency as a covariate showed a significant main effect of group, which suggests that the heritage speakers performed significantly better than the L2 learners in the collocation completion test (p<.0001). A significant main effect of proficiency indicates that higher proficiency was associated with better performance in the productive test (p<.0001).

TABLE 7
Results of LMEM for Productive Test Scores of L2 and Heritage Speakers

Random effects				
		Variance		SD
Subject	(Intercept)	0.01		0.10
Item	(Intercept)	0.23		0.48
	Group	0.04		0.20
	Proficiency	0.00		0.00
Fixed effects				
	Estimate	SE	t-value	P value
(Intercept)	1.37	0.10	14.07	<0.0001
Group	-0.34	0.07	-4.78	<0.0001
Proficiency	0.01	0.00	8.82	<0.0001

Note. HL group was the reference level for Group.

V. Discussion

The present study examined the L2 and heritage speakers' receptive and productive collocation knowledge and also the influence of four factors (phrasal frequency, TL exposure via media, academic use, and PSTM). To summarize the findings, first, both L2 and heritage speakers were found to have relatively high level of receptive collocation knowledge, although both groups were outperformed by the native speakers. It is also important to note that heritage speakers significantly outperformed L2 learners in correctly identifying collocations. Considerable receptive collocation knowledge of L2 and heritage speakers found in the current study are in line with the results of previous studies (Gyllsatd, 2009; Moon, 2012; Wolter & Gyllstad, 2013). For example, Gyllsatd (2009), and Wolter and Gyllstad (2013) reported high receptive collocation test scores of L2 learners (e.g., 78%-82%; Gyllstad, 2009, 74.6%-86.4%; Wolter & Gyllstad, 2013). Moon (2012) also reported that groups of heritage speakers with differing amount of L1 exposure, generally performed well on the receptive collocation test (67.93%-95.42%). In addition,

superior performance of heritage speakers over L2 learners on the recognition task found in the current study are consistent with the previous finding as well. Based on the results of several perception tasks, Lee et al. (2009) also found superior performance of heritage speakers in various linguistic domains including collocation competence.

Contrary to high level of receptive collocation knowledge, however, both L2 and heritage speakers were found to perform poorer in the productive test. The L2 learners showed slightly below-average performance (45.53%) while the heritage speakers performed better, scoring 76.32%. The finding of limited productive knowledge of collocations compared to stronger receptive knowledge is in line with the results of some previous studies. Zyzik (2021), for example, reported that heritage speakers performed much better in a collocation recognition test in comparison to the collocation production test (mean score: 88.17%, and 67.55%, respectively). Other studies examining L2 learners' knowledge of phrasal verbs also reported weaker productive knowledge than that of receptive knowledge, with below-average production performance (Schmitt & Redwood, 2011; Sonbul et al., 2020). González Fernández and Schmitt (2015) also reported that L2 learners scored only slightly above average on the productive collocation test (56%).

Overall, the finding seems to indicate that for both L2 and heritage speakers it is far more difficult to acquire productive knowledge of collocations than receptive knowledge, and thus more attention and time should be devoted to developing productive knowledge of collocations in classroom. However, the results of the current study should be interpreted with care as the different tasks and materials were used to measure receptive and productive knowledge despite testing the same target items.

As for the influence of the four factors (phrasal frequency, TL exposure through media, academic use, and PSTM,) on the recognition and recall test scores, phrasal frequency was found to be the only significant predictor of response accuracy (from the acceptability judgment task) for both L2 and heritage speakers; none of the four factors had any reliable effect on productive test scores. A strong negative relation observed between phrasal frequencies and L2 learners' ability to recognize a given collocation replicates what has repeatedly been found in previous studies (González Fernández & Schmitt, 2015; Sonbul, 2015; Wolter & Gyllstad, 2013). That is, higher phrasal

frequencies were associated with more accurate responses in making judgments about collocations. The results also lend support to the usage-based account which predicts that repeated exposure or experience that is likely to be reflected in higher frequency is essential for a lexical item to be stored and entrenched (Bybee, 2008; Ellis, 2002). According to this theory, frequent items are more likely to be identified as legitimate units in the target language.

In contrast to the significant relationship between phrasal frequencies and receptive collocation knowledge, lack of reliable relationship between phrasal frequency of collocations and the productive test scores is in contrast with González Fernández and Schmitt (2015), who found a moderate relationship between phrasal frequencies and productive knowledge of collocations. However, this difference may be due to their test items with a much higher range of frequencies than the ones in the present study. For example, in González Fernández and Schmitt (2015), the test items had raw frequencies ranging from 100 to 17,214 occurrences (normalized frequency: 0.22 to 38.25 frequency per million words) while the target items in the present study had raw frequencies ranging from 10 to 722 occurrence (0.28 to 20.1 frequency per million words). Moreover, given the ability to use collocations productively requires greater depth of knowledge than being able to recognize collocations receptively (Groot, 2000; Nation, 2001), the participants in the present study may have not developed the productive knowledge of the target collocations yet even if they are frequent items.

As for the role of TL exposure via media, academic use, and PSTM in developing collocational knowledge, it was surprising to find a lack of any reliable effects on either recognition or recall test scores for both L2 and heritage speakers. The results are at odds with some of the previous findings (González Fernández & Schmitt, 2015; Macis & Schmitt, 2017; Moon, 2012; Zyzik, 2021). The conflicting results may be due to sample size and little variability in the variables relating to exposure factor in the current study. As the amount and extent of L2 exposure of the participants was assessed using self-report questionnaires, the estimates could have been slightly underestimated or overestimated. Furthermore, the lack of any significant relationship between PSTM and receptive and productive collocation knowledge for both L2 and heritage speakers is not consistent with the

findings in some relevant studies (Bolibaugh & Foster, 2013; Foster et al., 2014; Skrzypek, 2009). As mentioned earlier, the conflicting results may be due to the small sample size and also to the little variability in the PSTM scores. Given complex and diverse learning experiences of L2 and heritage speakers, further research with a greater number of participants and several measures of PSTM will be useful to fully understand the role of TL exposure and PSTM in L2 and heritage speakers' collocational development.

Finally, it is important to note that learners' proficiency was found to have a significant effect on both receptive and productive collocation knowledge for both L2 and heritage speakers. That is, the more proficient a learner is, the better one can understand and produce a collocation. Thus, supporting findings of earlier studies (e.g., González Fernández & Schmitt, 2015; Keshavarz & salimi, 2007; Nizonkiza, 2012; Wolter & Gyllstad, 2013), collocational knowledge seems to develop with proficiency level.

VI. Conclusion

The present study examined L2 and heritage speakers' receptive and productive knowledge of Korean collocations and also the influences of phrasal frequency, TL exposure via media, academic use, and PSTM. The results showed that both L2 and heritage speakers had considerable receptive collocation competence but limited productive competence. The heritage speakers were significantly better at understanding and using Korean collocations than the L2 learners, even after accounting for differences in Korean proficiency between the two groups. This suggests that collocations are indeed difficult to learn for late L2 learners as repeatedly reported in previous studies (e.g., Abrahamsson & Hyltenstam, 2009; Granena & Long, 2013; Lee et al., 2009; Moon, 2012; Nesselhauf, 2003). More importantly, phrasal frequency was found to be the only significant predictor explaining receptive knowledge of collocations for both L2 and heritage speakers but not for productive knowledge. Given the limited number of the participants in the study, larger scale studies are clearly needed to confirm the robustness of the present findings and to better understand important factors that contribute to the development of collocation knowledge for L2 and heritage speakers. At the same time, it would be useful to investigate instructional practices in

relation to those factors that can best promote collocation learning in language classrooms.

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APPENDIX

LIST OF TARGET ITEMS

Target Collocations
질문을 던지다 (ask a question)
기대를 하다 (look forward to)
욕심을 내다 (be greedy)
장난을 치다 (play jokes)
겁을 주다 (scare someone)
반지를 끼다 (wear a ring)
눈을 붙이다 (take a nap)
습관을 버리다 (break a habit)
판단이 들다 (speculate)
판을 깨다 (spoil the mood)
살을 빼다 (lose weight)
수업을 듣다 (take a class)
시험을 보다 (take an exam)
길이 막히다 (traffic is heavy)
목이 마르다 (be thirsty)

불이 나다 (catch fire)
뒤를 밟다 (follow)
벌을 서다 (have a detention)
주먹을 쓰다 (use violence)
속이 상하다 (feel bad)
전화를 걸다 (make a call)
잔치를 열다 (throw a party)
안경을 쓰다 (wear glasses)
약을 먹다 (take medicine)
도망을 가다 (run away)

예시언어(Examples in): Korean
적용가능 언어(Applicable Languages): All Foreign Languages
적용가능 수준(Applicable Levels): Tertiary

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