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Title

Lexical and Contextual Emotional Valence in Foreign Language Vocabulary Retention: An Experimental Study and the Deep Epistemic Emotion Hypothesis

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Abstract

Studies suggest that not only words per se but also surrounding contexts play significant roles in foreign language vocabulary retention. This study investigated how different conditions of lexical and contextual emotional valence differently affect foreign language vocabulary retention. The target words were either positive (LexVal+), neutral (LexVal=), or negative (LexVal-) in meaning. Each visually enhanced target word was embedded in a sentence either positive (CtxVal+), neutral (CtxVal=), or negative (CtxVal-) in meaning. Sentences with different combinations of lexical valence and contextual valence were presented in the Study Session, which were later incidentally recalled in the Test Session. It was revealed that positive and negative words were remembered more often than neutral words and that negative contexts resulted in better retention of the embedded words than neutral contexts. These findings are in accordance with the predictions of the emotionally enhanced memory, the Emotion-Involved Processing Hypothesis, and the role of affect in the Modular Cognition Framework. Further, even if the target item is not emotional, embedding it in emotional context may result in better retention, a finding with potential pedagogical implications. Interestingly, words embedded in emotionally congruent contexts were not learned better than those in incongruent contexts, a finding contrary to expectation. The result may be explainable via the Deep Epistemic Emotion Hypothesis, calling for more empirical study.

Keywords: emotion, valence, vocabulary, emotional context, contextual word retention, congruency, recall memory, epistemic emotions, foreign language

Introduction

Having seen the rise of affectivism with trans-disciplinary impacts (Dukes et al., 2021), modern researchers in the 21st century are well aware of the pervasive effect and significance of emotion on perception, cognitive development, and education (de Vignemont, 2021; Pekrun, 2011; Immordino-Yang et al., 2019). Furthermore, emotion permeates various cognitive processes, including foreign language vocabulary processing and retention – a topic with increasing importance in the global multilingual era. Affective factors in foreign language vocabulary learning have been

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investigated via such perspectives as affective vocabulary learning strategies (Schmitt, 2000), emotional word studies (Dewaele & Pavlenko, 2002), affective input enhancement (Oyama, 2020), and lexis retention (Kráľová et al., 2022). Although there are a number of applied studies with practical value on foreign language vocabulary learning, there has been a relatively small number of fundamental studies that empirically investigate the effect of emotionality on foreign language vocabulary memory.

For example, Ayçiçegi and Harris (2004) experimentally showed that memory performance of foreign language words is significantly affected by the emotionality of words. Namely, participants recalled and recognized emotional words significantly more often than neutral words. Another study by Ayçiçegi-Dinn and Caldwell-Harris (2009) revealed that emotional attributes of words boost memory in both shallow and deep processing tasks, corroborating the emotion-memory effects in the foreign language recall paradigm. In terms of emotional valence – a continuum from positivity, neutrality, to negativity, there have been mixed empirical results with respect to whether foreign language words with positively valenced meaning (LexVal+) or words with negatively valenced meaning (LexVal-) are best remembered (Kanazawa, 2016; 2020b; 2021) although nonemotional words (LexVal=) are usually remembered less well than emotional words (Ferré et al., 2010; 2013). Previous studies reported different results between positive and negative conditions, calling for a study that separates positivity and negativity instead of grouping them together as a single emotional condition (Rozin & Poyzman, 2001; Kanazawa, 2016; 2020b).

Most previous laboratory-based fundamental studies on the effect of emotional valence on foreign language vocabulary retention adopted the conventional two-phase incidental learning paradigm in which participants encoded de-contextualized single-word stimuli presented one at a time (Study Session), followed by a surprise recall or recognition test (Test Session). On the other hand, there are several studies that suggest that memory performance is affected by surrounding contexts (Godden & Baddeley, 1980; Grant et al., 1999). Regarding foreign language vocabulary learning literatures, where the word *context* usually refers to the sentence or passage in which the target word item is embedded, researchers have proposed that it is necessary to go beyond single words – learning and testing vocabulary in context (Webb, 2008; Sasao & Webb, 2018). Inferring from a plethora of studies on context-dependent memory and encoding specificity (Dorobish & Walls, 2012) as well as neuroscientific studies about emotional context and memory (Erk et al., 2003), it is logical to assume that different emotional contexts have different impacts on foreign language vocabulary memory. In other words, the following differently valenced contexts may well have different memory impacts on the incidental retention of the target word item *victory* (LexVal+), *fabric* (LexVal=), and *destruction* (LexVal-):

1a. I am proud of the *victory*. (LexVal+ embedded in a positively valenced context: CtxVal+)

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1b. I have heard of the *victory*. (LexVal+ embedded in a neutrally valenced context: CtxVal=)

1c. I am ashamed of the *victory*. (LexVal+ embedded in a negatively valenced context: CtxVal-)

2a. The *fabric* was good. (LexVal= in a positively valenced context: CtxVal+)

2b. The *fabric* was average. (LexVal= in a neutrally valenced context: CtxVal=)

2c. The *fabric* was bad. (LexVal= in a negatively valenced context: CtxVal-)

3a. We like the *destruction*. (LexVal- in a positively valenced context: CtxVal+)

3b. We see the *destruction*. (LexVal- in a neutrally valenced context: CtxVal=)

3c. We dislike the *destruction*. (LexVal- in a negatively valenced context: CtxVal-)

Judging from the Emotion-Involved Processing Hypothesis (Kanazawa, 2020a; Kamenická, 2021), processing involved with emotionality is deeper and more elaborate than perceptual or conceptual processing, leading to better retention. Under this hypothesis, emotional conditions (+/-) are expected to result in better retention compared to neutral (=) conditions. It is, however, unclear how different combinations of LexVal and CtxVal result in potentially different retention outcomes. Furthermore, almost no previous studies investigated whether emotionally congruent conditions (e.g., 1a and 3c above) and incongruent conditions (e.g., 1c and 3a above) have different consequences for foreign language vocabulary retention. The mood-congruency effect and perceptual emotion congruence effect (Mayer et al., 1990; Niedenthal & Setterlund, 1994) imply that emotional congruency could result in better retention outcome, but this hypothesis awaits empirical support. Thus, it is promising to conduct a basic study to empirically investigate how different conditions of contextual emotional valence and lexical emotional valence differently affect foreign language vocabulary memory and the potential interaction of the valence conditions.

One relevant theory in corpus linguistics is semantic prosody, which is "a form of meaning which is established through the proximity of a consistent series of collocates" (Louw, 2000, p. 57). For example, the phrasal verb *to set in* and the verb *to cause* often collocate with bad things or negative words (Winter, 2019). As McEnery et al. (2006) eloquently puts it, "[a]s the Chinese saying goes, 'he who stays near vermilion gets stained red, and he who stays near ink gets stained black' – one takes on the colour of one's company – the consequence of a word frequently keeping 'bad company' is that the use of the word alone may become enough to indicate something unfavourable" (p. 84). Although the phenomenon of semantic prosody could be extended as "the transfer of affect to a word from its context" (Snefjella et al., 2020, p. 14), the present study leaves the details of the consequences of semantic prosody for vocabulary retention for further research, and focuses instead on simple local negative, neutral, and positive contexts.

Although limited in number and different in scope, recent studies on contextual vocabulary

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retention provide insights into the present study, providing further insight on the role of emotional congruency. One such study is Frances et al.'s (2020a) that utilized a research approach similar to Frances et al.'s (2020b) content learning experiment. This study documented the facilitatory effect of emotional context compared to neutral context in remembering the factual information about invented countries. Frances et al. (2020a) examined how emotionality of the surrounding semantic context influences vocabulary retention. In their study, participants were instructed to read paragraph-long definitions about the presented images of invented novel objects. The description was either in their first language (Spanish) or their foreign language (English). There were two contextual conditions – emotional (positively valenced) context and neutral context. In the subsequent test session, participants were asked to recall and recognize the object's names (pseudowords) that had been encoded in the study session with the aid of visual cues.

They found that the target items in positive context conditions were recognized significantly more often than the ones in neutral context conditions. An effect of positive semantic context, however, was absent in the recall tasks. They ascribe its absence to a lack of statistical power and argued that increasing familiarity with learned items and manipulating variables or amount of information should reveal the effect. In other words, their experimental design may not have been strong enough to form robust memory trace needed for recall tasks, which is more difficult than recognition tasks. A notable finding was that the emotionality effect was observed not only in the first language conditions but also in the foreign language conditions. They suggested that manipulating emotionality and semantic context – namely making it positively valenced – may well be a useful way to improve vocabulary retention.

Although being an insightful pioneering study, one limitation is that their emotional condition was restricted to only a positive condition, leaving the other pole of emotionality (viz., negative context) uninvestigated. Since emotional valence is a fundamental characteristic of emotionality, negativity as well as positivity should be taken into account; as pointed out by Kanazawa (2020b), differently valenced stimuli could be utilized to facilitate retention upon careful planning. In addition, the experimental design could be modified to investigate whether the emotional context effect is detected for the recall test. Compared to recognition tests that are affected by the familiarity value of the stimuli and distractors as well as the encoded memory (Mandler, 1980), recall tests are known to be less error-prone and more valid as a measure of foreign language knowledge (Kanazawa, 2021); and recent foreign language vocabulary testing studies encourage using recall instead of recognition tests (e.g., McLean et al., 2020).

Another relevant study is Hao et al.'s (2021) experiment on foreign language contextual word learning. In the study session, Chinese-speaking participants read paragraphs in English. Each paragraph contained a pseudoword which corresponded to an English word with neutral meaning. There were three contextual conditions: positive, neutral, and negative contexts. They also investigated

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the effect of exposure frequency by repeating the processing phase up to 15 times (5 days). Each study session was followed by a test session, where recall and recognition tests were carried out for the target words. It was revealed that the negative context condition resulted in better memory performance for both recall and recognition tests while the positive context condition was more effective than the neutral context condition only for the recall test.

In terms of exposure frequency, a notable finding was that both positive and negative conditions boosted recall performance more powerfully than the neutral context from the third day onwards, making the slope of the learning curve of the emotional conditions steeper than that of the neutral condition. They concluded that both positive and negative emotional contexts boost foreign language vocabulary learning, requiring fewer exposure times compared to neutral contexts – a result that dovetails well with the findings of Frances et al. (2020a). Hao et al.'s (2021) study, however, is not free from limitations. They noted that the repeated processing and testing phases may well have made the participants expect that there would be tests after the processing phase, making the study deviate from the incidental vocabulary learning paradigm. It is desirable not to repeat the tasks to ensure that learning is truly incidental, when the aim of the study was to clarify the role of emotional context rather than exposure frequency – the design of the present study of this paper. Another limitation was that the coupling of the target pseudowords and the context was fixed across the participants. It is preferable to change the context-target pairing between participants to avoid item-driven intervening effects.

Apropos of the aim of the present study of the present paper (investigating how different conditions of contextual emotional valence and lexical emotional valence differently affect foreign language vocabulary retention and the potential interaction of the valence conditions), replicating the studies above will not suffice. First, using pseudowords as the target stimuli will make the form recall too difficult in a single set of sessions. Furthermore, due to their lack of semantic content, pseudowords are inadequate to investigate the effect of differences in lexical emotional valence. On the other hand, using existing words with their own semantics and valence as the target stimuli is well-established in experimental paradigms investigating the effect of emotionality on vocabulary memory (Majerus & D'Argembeau, 2011), which is also seen in a neuropsychological study on contextual word learning (Mestres-Missé et al., 2007). For example, Hertel and Parks' (2002) study found that known words in emotional context (accompanying emotional adjective) were more frequently recalled than those in neutral context. Bock and Klinger (1986) revealed that known words that aroused stronger emotion were recalled better than emotionally less arousing words. As the current study investigates foreign language vocabulary retention rather than acquisition of novel items, measuring memory of known word stimuli is appropriate.

Second, memory evaluation should be implemented only once to ensure incidental learning and to prevent the risk of the first test contaminating the performance of any tests that follow. A recall

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test is more suitable than a recognition test in view of its higher authenticity in foreign language vocabulary retention measurement. Third, more rigorous control is required to ensure the uniformity of contexts. Namely, paragraph-long descriptions with different grammatical and logical structures may well affect processing and memory in different ways, involving intervening factors difficult to keep under experimental control. To overcome this risk, it is advisable to use strictly controlled minimal contexts with almost homogeneous structures across different valence conditions, such as a sentence differing only in one word across conditions. Incorporating the aforementioned points, the following research questions were posited for the present study:

Research Question 1 (RQ1): In what way do differences in lexical emotional valence (LexVal+, LexVal=, LexVal-) and differences in contextual emotional valence (CtxVal+, CtxVal=, CtxVal-) affect the recall of foreign words in a free recall task?

Research Question 2 (RQ2): Does emotional congruency (e.g., positive words in positive contexts) result in better foreign language free recall than emotional incongruency (e.g., positive words in negative contexts)?

The hypotheses of both RQs are affirmative, it is expected that valance results in different retention outcomes and that an emotion congruency effect is found.

Method

Participants

The participants were Japanese-speaking learners of English as a foreign language ($N = 120$; age: $M = 18.57$, $SD = 1.45$; 36 males and 84 females). All participants were college students majoring in international studies and their English proficiency levels ranged from beginner to advanced, the majority being intermediate (CEFR A1 = 4, A2 = 16, B1 = 73, B2 = 22, C1 or others = 5). The sample size is large enough because the prior power analysis using G*Power (Faul et al., 2007) suggests that repeated-measure 3 x 3 ANOVA requires at least 118 participants when the power is .95, and the effect size is medium. Informed consent from each participant was obtained through the pre-study digital explanatory instruction of the procedure, the privacy policy, and the consent form. The procedure abides by the Kwansei Gakuin University Regulations for Behavioral Research with Human Participants and the American Psychological Association (APA) Ethics Code (Article 8.02; informed consent to research; APA, 2017).

Stimulus words

Forty-five target English words were selected from the proto-ANEW-JLE database (Kanazawa, 2016) based on their emotional valence scores. The selected words were categorized into three groups: 15 LexVal+ words (*joy, love, gold, dream, honor, beauty, reward, flower, success, wedding, victory, present, pleasure, birthday, champion*), 15 LexVal= words (*bowl, cell, habit, manner,*

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circle, fabric, square, column, office, theory, opinion, context, machine, material, corridor), and 15 LexVal- words (*war, bomb, hell, fight, crime, death, victim, horror, damage, prison, danger, trouble, disaster, depression, destruction*). All the selected words were nouns, presented in lowercase. Lexical attributes known to affect processing and retention were controlled, as a consequence, groups differed significantly only with respect to valence (Table 1; Appendix 1).

Table 1. The descriptive statistics of the word groups

Group	[LexVal+] group	[LexVal=] group	[LexVal-] group
n	15	15	15
Valence [a]	3.74 (.14)	2.98 (.18)	1.25 (.18)
Number of letters [c]	6.07 (1.58)	6.13 (1.19)	6.13 (2.17)
Number of syllables [c]	1.80 (.56)	2.00 (.66)	1.80 (.78)
Corpus frequency (BNC) [b]	9495.47	11313.20	9484.00
Familiarity for Japanese speakers [b]	5.60 (.98)	4.74 (1.21)	5.02 (1.08)
Familiarity for English speakers [c]	546.73 (32.81)	543.73 (36.77)	543.13 (37.16)
Concreteness [c]	396.53 (103.01)	468.53 (120.18)	409.27 (88.08)
Imageability [c]	510.53 (67.34)	483.40 (112.63)	510.20 (55.42)
Lexical decision latency [d]	593.16 (48.52)	623.55 (28.61)	615.17 (45.75)

Note. Values in parentheses are standard deviations. [a]Proto-ANEW-JLE (Kanazawa, 2016); [b]LFD-JEL (Yokokawa, 2009); [c]MRC Psycholinguistic Database (Coltheart, 1981); [d]The English Lexicon Project (Balota et al., 2007)

Stimulus sentences

Forty-five stimulus sentences were created as follows: First, fifteen sentences with contextual positive valence were created with a blank for the target noun (e.g., *The ___ was good.*). Second, minimal modifications were made to these sentences to produce fifteen neutral contexts (e.g., *The ___ was average.*) and fifteen negative contexts (e.g., *The ___ was bad.*) while ensuring all the words in the contexts are highly frequent and easy enough for Japanese-speaking learners of English (L1 ~ L5 Word Level in the New JACET List of Basic Words; Mizumoto, 2021). Third, sentences were double-checked by an English speaker in academia. Fourth, students were requested to rate the sentences for valence; these ratings supported the group distinctions. Finally, the blanks were filled with target words. Each word group and each contextual valence was coupled differently between participants to nullify potential item-derived intervening effects. Allocation of lexical valence and contextual valence was counterbalanced between participants in a Latin-square design (Appendix 2).

Procedure and research design

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In the Study Session, sentences with different combinations of LexVal and CtxVal were presented serially on a computer screen via testing functions of LUNA, the official online learning platform of the university. To ensure semantic processing of each presented word and sentence, a naturalness judgment task was implemented, in which participants were asked to judge whether the target words fit naturally with the embedded contexts (Figure 1). The order in which the 45 trials were presented was randomized for each participant. Target words were presented in a larger font, in bold, with underlining, to make them more salient for the participants (see also Han et al. 2008). In the subsequent Test Session, incidental recall tests were implemented, in which participants were asked to recall as many target words they had read in the Study Session as possible. Only a free recall test and a cued recall test were conducted in the Test Session because implementing multiple memory tests will result in more confounding variables. A recognition test, another popular memory test, was not used as it has been reported to be less sensitive to valence effects (MacMillan et al., 2022). Only those items which were recalled exactly accurately were coded as correctly recalled (Kanazawa, 2021).

Translation of the instruction: *Read the English sentence and judge whether the underlined word matches the semantic context (whether the meaning of the sentence is natural for the word, whether the word is suitable for the underlined part). Possible choices: 1. Unnatural/unsuitable, 2. Not sure, 3. Natural/suitable*

Figure 1. An example of a study trial

Results

Table 2 shows the descriptive statistics of the recall test result (see Appendix 3 for the results of the naturalness judgment task).

Table 2. Descriptive statistics of the effects of LexVal and CtxVal: Correct Free Recall Frequency

Condition (LexVal)	Condition (CtxVal)	n	Correct Free Recall Frequency (M)	Correct Free Recall Frequency (SD)	Correct Cued Recall Frequency (M)	Correct Cued Recall Frequency (SD)
LexVal+	CtxVal+	600	0.203	0.407	0.298	0.458
	CtxVal=	600	0.198	0.399	0.205	0.404

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	CtxVal-	600	0.238	0.426	0.277	0.448
LexVal=	CtxVal+	600	0.160	0.367	0.145	0.352
	CtxVal=	600	0.128	0.335	0.127	0.333
	CtxVal-	600	0.128	0.335	0.100	0.300
LexVal-	CtxVal+	600	0.260	0.443	0.230	0.421
	CtxVal=	600	0.203	0.403	0.153	0.361
	CtxVal-	600	0.203	0.403	0.253	0.435

[LexVal+] = Positive Lexical Valence, [LexVal=] = Neutral Lexical Valence, [LexVal-] = Negative Lexical Valence; [CtxVal+] = Positive Contextual Valence, [CtxVal =] = Neutral Contextual Valence, [CtxVal -] = Negative Contextual Valence, n = 600 (120 participants × 5 word items per sublist)

Imageability and concreteness ratings were scaled using R. Recall Accuracy was modeled with a logistic generalized additive model (GAM, Wood, 2017) with random intercepts for Participant, LexVal, and CtxVal, Imageability and Concreteness as covariates, and as factorial predictors Test (*cued recall*, free recall), CtxVal (*negative*, non-negative), and Lexical Valence (*neutral*, negative, positive). Treatment dummy coding was used, with as reference levels the levels mentioned in italics. The model included interactions of Test with all other factorial predictors, and in addition with interactions of CtxVal by LexVal, as well as CtxVal by Concreteness. Removal of any of these predictors or interactions resulted in a substantial decrease in goodness of fit, as assessed with Akaike's Information Criterion (AIC), by minimally 10 AIC units. Crucially, removing the interactions with Test led to an increase in AIC equal to 45.2, indicating that the two tests give rise to different patterns of results. For ease of interpretability, the two tests were subjected to separate analyses.

For free recall, a logistic GAM with the same random intercepts revealed that Accuracy varied with Imageability and with Concreteness in interaction with CtxVal. As can be seen in Table 3, a greater imageability favored higher probability of recall (slope 0.63), irrespective of CtxVal. There also was an effect of Concreteness, but this was robust only in negative contexts (slope in neutral context: -0.32, slope in negative context: -0.32--0.43 = -0.75). There was no main effect of CtxVal. Lexical Valence did not contribute anything to the model fit and therefore was removed from the model.

Table 3. Coefficients of a logistic GAM fitted to Accuracy for Free Recall

	Estimate	Std. Error	*z*-value	*p*-value
Intercept (CtxVal=neutral)	-1.9078	0.2059	-9.267	<0.0001

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Imageability	0.6331	0.1514	4.181	<0.0001
Concreteness	-0.3245	0.1667	-1.947	0.0516
CtxVal=negative	0.084	0.2347	0.358	0.7202
CtxVal=positive	0.1734	0.2348	0.739	0.4601
Concreteness: CtxVal=negative	-0.4252	0.1241	-3.425	0.0006
Concreteness: CtxVal=positive	0.006	0.1225	0.049	0.961

The logistic GAM fitted to the data on cued recall clarified that cued recall was more accurate for negative and positive Lexical Valence, as compared to the reference level (neutral Valence). As can be seen in Table 4, compared to neutral Lexical Valence, the log odds increased by 1.27 for negative Lexical Valence, and by 1.42 for positive Lexical Valence. There was no main effect of CtxVal. However, in non-negative contexts, a negative Lexical Valence led to a reduction in accuracy of -0.81. For positive Lexical Valence, there was a smaller reduction in accuracy (-0.49) that, however, was associated with greater relative uncertainty, resulting in a relatively large *p*-value (0.03).

Table 4. Coefficients of a logistic GAM fitted to Accuracy for Cued Recall

	Estimate	Std. Error	*z*-value	*p*-value
Intercept (LexVal=neutral, CtxVal=negative)	-2.663	0.31	-8.593	<0.0001
CtxVal=non-negative	0.329	0.2521	1.305	0.1919
LexVal=negative	1.267	0.3514	3.605	0.0003
LexVal=positive	1.4227	0.3511	4.052	<0.0001
CtxVal=non-negative: LexVal=negative	-0.8073	0.2214	-3.646	0.0003
CtxVal=non-negative: LexVal=positive	-0.4876	0.2189	-2.228	0.0259

Discussion

Hypothesis 1 of this study was as follows: Different conditions of lexical emotional valence (LexVal+, LexVal=, LexVal-) and contextual emotional valence (CtxVal+, CtxVal=, CtxVal-) affect free recall of foreign vocabulary in different ways. As to free recall, more imageable words were retrieved more often, irrespective of context. In other words, contrary to previous study and theories, neither LexVal nor CtxVal per se played significant roles in memory performance. This could be due

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to the floor effect owing to the difficulty of recalling words presented just once under incidental learning. It is, however, notable that more concrete words were recalled less often in negative contexts, indicating potential effect of emotionality in contexts on lexical retention. As to cued recall, in negative contexts, negative and positive Lexical Valence afforded higher accuracies, with a slightly larger effect size for positive Lexical Valence. However, in non-negative contexts, these effects were reduced, and more so for negative Lexical Valence.

The present results give rise to the following considerations. First, the result for cued recall that positive and negative words were remembered more often than neutral words corroborates the claim that the theory that emotionality results in better retention (emotionally-enhanced memory; Talmi et al., 2012) holds true for foreign language vocabulary retention (i.e., Emotion-Involved Processing Hypothesis; Kanazawa, 2020a). The finding is in line with an influential body of research in multilingualism that affective processing bolsters other interlinked cognitive processing, leading to better retention outcomes (Sharwood Smith & Truscott, 2014; Truscott, 2015; Shartwood Smith, 2017; Sharwood Smith, 2021). According to the Modular Cognition Framework (Truscott & Sharwood Smith, 2019), positive or negative emotional value representations in the affective system strongly influence the degree of activation in other cognitive systems such as auditory, spatial, olfactory, gustatory, visual, somato-sensory, motor, and conceptual systems (and indirectly influencing linguistic modules), resulting in affective boosting, i.e., emotionality facilitating multifaceted cognitive aspects including learning and retention (Sharwood Smith, 2024).

Second, negative contexts resulted in better retention of the embedded words than neutral contexts in cued recall. This finding provides empirical support for the NEVER model (Bowen et al., 2018). Furthermore, a negativity effect in foreign language emotional prosody processing and retention has been reported in empirical studies (Bąk, 2016; Kanazawa, 2020b). Since emotional prosody of spoken sentences may be regarded as a different kind of emotional context, more theoretical and empirical elaboration are called for to integrate the present findings. What is especially notable is that the transfer of valence effect was found (Palombo et al., 2021), i.e., even if the target word itself was neutral, embedding it in emotional context results in better retention of the word. This may not have to be due to semantic prosody as the combination of words and contexts in this study is not based on frequent collocations. This implies that the emotional engine to boost retention does not have to come from the emotionality of the target items themselves but the surrounding/accompanying context. The implication is potentially useful for enhancing second language vocabulary learning since affective enhancement techniques may be applied regardless of their (lack of) intrinsic emotional saliency, even to target items which are nonemotional per se.

Third, high imageability resulted in better performance in free recall. This could be interpreted as the effect of imagery-involved processing, which denotes that visual elaboration utilizing both of the dual routes leads to stronger memory traces (Kanazawa, 2020a). Fourth, negative

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contexts were related to less successful free recall of concrete words. One potential rationale could be derived from the Deep Positivity Hypothesis (Kanazawa, 2020b), according to which negative emotions facilitate perceptual/shallow processing more than conceptual/deep processing. Since the processing task of the present study was semantic rather than perceptual, the facilitatory effect of negative valence may have been absent at the contextual level. More extensive insights will be attained by adopting more varied emotional dimensions in future study (cf. the seventh and eighth points in Limitations and Future Study).

Hypothesis 2 of this study was as follows: Emotional congruency (e.g., positive words in positive contexts) results in better foreign language free recall than emotional incongruency (e.g., positive words in negative contexts). The result rejected the hypothesis, in opposition to the emotion congruency expectation.

One potential rationale is related to a limitation of the present study. In other words, regarding the stimulus sentences, the incongruency may not have been caused purely by emotional incongruency per se. Although affective dimensions and semantic properties are not necessarily dichotomous (Osgood, 1969), the incongruency effect found in this study could be attributed to semantic as well as emotional incongruency (especially for a sentence like "The *disaster* saved many people" which does not make good sense). Some of the word-context combination may well have caused N400-ERP-component-increasing semantic incongruity (Kutas & Hillyard, 1980; Kutas & Federmeier, 2011). The violation to the participants' expectations may have made some stimuli more salient (Frank & Kafkas, 2021; Stahl & Feigenson, 2017). Further experiments are required to disentangle emotional inconsistency from semantic inconsistency. Other potential associative factors include prediction (Hutchinson & Barrett, 2019; Kuperberg & Florian Jaeger, 2016), prediction error (Menenti et al., 2009), probabilistic inference (Kuperberg, 2016), interoceptive inference (Seth & Friston, 2016), and Bayesian surprise (Itti & Baldi, 2009). These possibilities should be included, tested, and compared in future studies. This, however, will not be a conclusive rationale because not all incongruent conditions are nonsense (e.g., "The *wedding* was bad" "I am ashamed of the *victory*" "I don't know that to do with the *present*" are incongruent sentences that make some sense.).

Focusing on the emotional rather than semantic incongruency, there seem to be at least two factors. First, the emotion congruency effect is often reported for perceptual processing rather than retention in memory. For example, emotional auditory cues guide visual attention toward emotionally congruent pictorial stimuli (Gerdes et al., 2021). The present study, however, does not address concurrent perceptual attention, but memory performance as a delayed outcome of processing (adopting the two-session paradigm of Study Session and Test Session). It is true that automatic attention could have been directed to emotionally congruent stimuli during the Study Session, but so do other stimuli under the current research paradigm, and something more must have happened that impacted the performance at the Test Session.

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Second, qualitative reports (post-study oral feedback from the participants) reveal a different effect at play that would compensate for the first factor. After the study, a few participants voluntarily reported that some sentences were surprising, making them wonder what was happening in the sentence, and that they remembered them better. Indeed, incongruent sentences tended to evoke such emotions as *surprise* (e.g., "I am proud of the *crime*" – who is making such a remark!?), *confusion* (e.g., "How cold of you to tell me about the *birthday*" – how could taking about one's birthday offend someone, is there some traumatic experience or unfamiliar cultural belief about birthdays!?), and *curiosity* (e.g., "The *disaster* saved many people" – what kind of disaster was it and what intriguing causal chains brought about a happy ending!?). These thought-provoking emotions aroused in the presence of cognitive disequilibrium are recently known as *epistemic emotions* (Nerantzaki et al., 2021). Epistemic emotions are known to promote knowledge exploration, strongly related not only with basic cognition but also with higher-order cognition (Vogl et al., 2019; 2020). One probable rationale of the present findings was that the semantic emotion incongruency evoked epistemic emotions, and that the epistemic emotion effect was bigger than the emotion congruency effect in facilitating deeper processing and incidental retention. This may be different from lexical or contextual emotion per se, but the epistemic emotions aroused facing the incongruent sentences may have played some roles in facilitating deeper processing and thus better retention. Indeed, epistemic emotions might also explain why cued recall resulted in more significant findings concerning emotional conditions; by utilizing the richer contextual cues, the participants may have been able to access the memory with surprise, confusion, and curiosity more easily, which could be separated out from mere lexical incongruity. The notion of potentially facilitatory effect of epistemic emotions insight echoes the Deep Epistemic Emotion Hypothesis (Kanazawa, 2024d). According to the hypothesis formulated through applied insights of expected free energy regulation in the theory of active inference / free energy principles (Parr et al., 2022), epistemic emotions such as intellectual surprise, wonder, and curiosity are deeper and more valuable than hedonic emotions in learning (Kanazawa, 2024d), the hypothesis worth empirical testing in future study (cf. the tenth point in Limitations and Future Study).

Limitations and Future Study

This study is not free from limitations. First, studying and testing were conducted only once. It is true that the single phase was designed intentionally to prevent the risk of the first test contaminating the performance of any tests that follow. However, now that the result was found in the single-phase study, incorporating multiple study and test sessions would be a potential future direction.

Second, there was only one type of task in each session. For instance, the only memory tests implemented were form recall, which would have different results if meaning recall tests were also implemented. In fact, although emotionality of context affects both orthographic and semantic learning of known words (Snefjella & Kuperman, 2016), the effect is reported to be found only in the semantic

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learning of novel words (Snefjella et al., 2020). Again, incorporating multiple tasks could have confounded the variables and thus the single task design was adopted, but more varied experimental tasks may well be utilized in future study. One promising direction is to utilize neuroscientific and physiological equipment such as functional magnetic resonance imaging, electroencephalograms, and galvanic skin response, which would provide more fine-grained insights about neural substrates, such as whether negative emotional stimuli are prioritized in right hemispheric attentional competition for foreign language processing (Hartikainen, 2021).

Third, only one level of context – the embedding sentences – was investigated. The sentential context is a minimum context, beyond it can we find paragraph-level contexts, passage-level contexts, and a wider learning context in which learners are situated (Webb & Nation, 2017). Now that this basic study has been implemented, extending the scope of the concept of context is a required step for future study. Fourth, the target words were highly frequent familiar words, limiting the scope to retention rather than acquisition. Incorporating unknown stimuli will provide further insights into foreign language acquisition. Fifth, it is not clear whether a similar outcome would be replicated when the stimuli are presented in the first language. Future studies comparing first and foreign languages have the potential of extending the scope of the findings and theories of the present study. Sixth, although most experimental studies relevant to this topic utilize two (emotional vs nentral) or three (positive, neutral, vs negative) conditions, it is worth keeping in mind that emotional valence is continuous rather than discrete. In other words, different degrees of positivity/negativity are found in positive/negative word groups.

Seventh, regarding the emotionality of the lexical attributes, the present study focused on and controlled only one type of emotionality that was available – valence. Although valence is the most fundamental and the well-studied factor, studies in affective psychology suggest there are other emotional dimensions to consider as well, such as arousal and dominance (Citron et al., 2014; Russel & Mehrabian, 1977). The foreign language emotional valence scores in this study were retrieved from the proto-ANEW-JLE (Kanazawa, 2016), which include only emotional valence scores. There is neither a foreign language arousal database nor dominance database. In fact, consulting the first speakers' database (the original ANEW, Bradley & Lang, 1999), the first language arousal scores and dominance scores significantly differed between the word groups. Namely, the first language arousal scores of [LexVal+] group (M = 5.72, SD = .87) and [LexVal-] group (M = 6.17, SD = .99) turned out to be significantly higher than those of [LexVal=] group (M = 4.01, SD = .45): $F(2,42) = 30.11$, $p < .001$. In addition, the first language dominance scores significantly differed between [LexVal+] group (M = 6.21, SD = .64), [LexVal=] group (M = 4.94, SD = .41), and [LexVal-] group (M = 3.96, SD = .73): $F(2,42) = 51.71$, $p < .001$. The original ANEW is a first language database, thus the extent of applicability to foreign language study is debatable. However, these differences in the first language wordlist indicate arousal and dominance could have worked as the external variables in this foreign

language study as well. To overcome this limitation, collecting foreign language learners' data for these other dimensions of emotionality will pave the way for closer and more sophisticated analyses.

Eighth, the standard dimensions of emotional valence may not always be optimal. For example, Wurm (2007) proposed the orthogonal dimensions of Danger and Usefulness as better predictors for lexical processing, which are applied to neurophysiological study (Kryuchkova et al., 2012). To study epistemic emotions, the emotional dimension of epistemicity (Kanazawa, 2024c) may be useful. These new dimensions that better cater to the research perspectives may clarify the nature of the benefits for different conditions.

Ninth, the power analysis should take into account that the items are also a source of noise and uncertainty (Westfall et al., 2020). Finally, the Deep Epistemic Emotion Hypothesis (Kanazawa, 2024d) needs to be tested in future study, such as by pseudo-autoethnography (Kanazawa, 2024a), by emotionally analyzing pedagogical approaches (Kanazawa, 2024b), by measuring different epistemic emotions separately during tasks (Pekrun, et al., 2017), or by dimensionalizing epistemic wonder (Kanazawa, 2024c).

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Appendix 1. Inferential statistics between target word groups

Group	ANOVA Results
Valence	$F(2,42) = 866.30$, $p < .001$
Number of letters	$F(2,42) = .01$, $p = .992$
Number of syllables	$F(2,42) = .45$, $p = .643$
Corpus frequency (BNC)	$F(2,42) = .19$, $p = 828$
Familiarity by Japanese speakers	$F(2,42) = 1.38$, $p = .263$
Familiarity by first speakers	$F(2,42) = .04$, $p = .957$
Concreteness	$F(2,42) = 2.02$, $p = .145$
Imageability	$F(2,42) = .54$, $p = .588$
Lexical decision latency	$F(2,42) = 2.11$, $p = .135$

Post-hoc tests with Bonferroni correction showed that there are significant differences between all three pair-wise combinations of [LexVal+] group, [LexVal=] group, and [LexVal-] group ($p < .001$).

Appendix 2. The stimulus sentences in the present study

Stimulus sentences with a blank (The blanks were replaced with embedded words in the study in a Latin-square counterbalancing design.)	Embedded words for Between-participant Condition 1	Embedded words for Between-participant Condition 2	Embedded words for Between-participant Condition 3
(CtxVal+) The ___ saved many people.	(LexVal+) champion	(LexVal-) disaster	(LexVal=) corridor
(CtxVal=) The ___ affected many people.	(LexVal=) corridor	(LexVal+) champion	(LexVal-) disaster
(CtxVal-) The ___ killed many people.	(LexVal-) disaster	(LexVal=) corridor	(LexVal+) champion
(CtxVal+) The children enjoy singing the song titled "___".	(LexVal+) joy	(LexVal-) death	(LexVal=) circle
(CtxVal=) The children practice singing the song titled "___".	(LexVal=) circle	(LexVal+) joy	(LexVal-) death

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(CtxVal-) The children hate singing the song titled "___".	(LexVal-) death	(LexVal=) circle	(LexVal+) joy
(CtxVal+) The ___ was good.	(LexVal+) wedding	(LexVal-) fight	(LexVal=) fabric
(CtxVal=) The ___ was average.	(LexVal=) fabric	(LexVal+) wedding	(LexVal-) fight
(CtxVal-) The ___ was bad.	(LexVal-) fight	(LexVal=) fabric	(LexVal+) wedding
(CtxVal+) Luckily, the answer was "___".	(LexVal+) honor	(LexVal-) war	(LexVal=) cell
(CtxVal=) Basically, the answer was "___".	(LexVal=) cell	(LexVal+) honor	(LexVal-) war
(CtxVal-) Unfortunately, the answer was "___".	(LexVal-) war	(LexVal=) cell	(LexVal+) honor
(CtxVal+) Upon hearing the word "___", he said "Oh, yes."	(LexVal+) success	(LexVal-) hell	(LexVal=) context
(CtxVal=) Upon hearing the word "___", he said "Oh, really."	(LexVal=) context	(LexVal+) success	(LexVal-) hell
(CtxVal-) Upon hearing the word "___", he said "Oh, no."	(LexVal-) hell	(LexVal=) context	(LexVal+) success
(CtxVal+) The ___ will make him a better person.	(LexVal+) reward	(LexVal-) damage	(LexVal=) theory
(CtxVal=) The ___ will make him a normal person.	(LexVal=) theory	(LexVal+) reward	(LexVal-) damage
(CtxVal-) The ___ will make him a worse person.	(LexVal-) damage	(LexVal=) theory	(LexVal+) reward
(CtxVal+) More and more people come to see the ___.	(LexVal+) flower	(LexVal-) prison	(LexVal=) bowl
(CtxVal=) Some people come to see the ___.	(LexVal=) bowl	(LexVal+) flower	(LexVal-) prison
(CtxVal-) Less and less people come to see the ___.	(LexVal-) prison	(LexVal=) bowl	(LexVal+) flower
(CtxVal+) She passed the test because of her ___.	(LexVal+) beauty	(LexVal-) trouble	(LexVal=) opinion
(CtxVal=) She took the test because of her ___.	(LexVal=) opinion	(LexVal+) beauty	(LexVal-) trouble

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(CtxVal-) She failed the test because of her ___.	(LexVal-) trouble	(LexVal=) opinion	(LexVal+) beauty
(CtxVal+) She remembered the ___ and thought that it was the best one in her life.	(LexVal+) love	(LexVal-) victim	(LexVal=) office
(CtxVal=) She remembered the ___ and thought that it was an ordinary one in her life.	(LexVal=) office	(LexVal+) love	(LexVal-) victim
(CtxVal-) She remembered the ___ and thought that it was the worst one in her life.	(LexVal-) victim	(LexVal=) office	(LexVal+) love
(CtxVal+) I am proud of the ___.	(LexVal+) victory	(LexVal-) crime	(LexVal=) square
(CtxVal=) I have heard of the ___.	(LexVal=) square	(LexVal+) victory	(LexVal-) crime
(CtxVal-) I am ashamed of the ___.	(LexVal-) crime	(LexVal=) square	(LexVal+) victory
(CtxVal+) The life of the great leader can be summarized in the word "___".	(LexVal+) dream	(LexVal-) depression	(LexVal=) habit
(CtxVal=) The life of the everyday worker can be summarized in the word "___".	(LexVal=) habit	(LexVal+) dream	(LexVal-) depression
(CtxVal-) The life of the poor slave can be summarized in the word "___".	(LexVal-) depression	(LexVal=) habit	(LexVal+) dream
(CtxVal+) The ___ will come on a bright sunny morning.	(LexVal+) pleasure	(LexVal-) horror	(LexVal=) machine
(CtxVal=) The ___ will come on a usual regular afternoon.	(LexVal=) machine	(LexVal+) pleasure	(LexVal-) horror
(CtxVal-) The ___ will come on a dark rainy night.	(LexVal-) horror	(LexVal=) machine	(LexVal+) pleasure
(CtxVal+) How kind of you to tell me about the ___.	(LexVal+) birthday	(LexVal-) danger	(LexVal=) manner
(CtxVal=) How typical of you to tell me about the ___.	(LexVal=) manner	(LexVal+) birthday	(LexVal-) danger
(CtxVal-) How cold of you to tell me about the ___.	(LexVal-) danger	(LexVal=) manner	(LexVal+) birthday
(CtxVal+) We like the ___.	(LexVal+) gold	(LexVal-) destruction	(LexVal=) column
(CtxVal=) We see the ___.	(LexVal=) column	(LexVal+) gold	(LexVal-) destruction

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(CtxVal-) We dislike the ___.	(LexVal-) destruction	(LexVal=) column	(LexVal+) gold
(CtxVal+) I already know what to do with the ___.	(LexVal+) present	(LexVal-) bomb	(LexVal=) material
(CtxVal=) I may know what to do with the ___.	(LexVal=) material	(LexVal+) present	(LexVal-) bomb
(CtxVal-) I don't know what to do with the ___.	(LexVal-) bomb	(LexVal=) material	(LexVal+) present

Appendix 3. Results of the naturalness judgment task

Condition (LexVal)	Condition (CtxVal)	N	M	SD
LexVal+	CtxVal+	589	2.52	.76
	CtxVal=	632	2.32	.84
	CtxVal-	595	1.84	.89
LexVal=	CtxVal+	558	2.19	.85
	CtxVal=	590	2.19	.84
	CtxVal-	552	2.03	.88
LexVal-	CtxVal+	599	1.75	.87
	CtxVal=	644	2.07	.89
	CtxVal-	593	2.48	.79

1. Unnatural/unsuitable, 2. Not sure, 3. Natural/suitable

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