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The Relationship between Attention and Extraneous Load: Bridging Second Language Acquisition Theory and Cognitive Load Theory

Abstract

There has been a call in recent years for an integration of cognitive load theory into instructed second language acquisition practices to assist language learners by taking advantage of theories on human cognitive architecture (Sweller, 2017). This paper seeks to move the conversation on how this integration might be achieved by presenting findings from survey data conducted with learners enrolled in online courses that use asynchronous video instruction at a cyber-university in South Korea (*n* = 68). Findings show a statistically significant positive relationship between distraction and extraneous load. These results are used to postulate a model for explaining how the relationship between extraneous load on attention can be integrated into second language learning theory. Pedagogic implications of this model are then offered. These include explicitly signaling key vocabulary and grammar, ensure spatial and temporal considerations are made when using multimodal instruction, and placing learners at the center of decisions on the blend of media they experience in instruction.

Keywords: cognitive load, second language learning, media, online learning, video lectures

An increasing number of university courses are offered partially or entirely online (Seaman & Allen, 2017). This includes language learning courses offered online by universities in South Korea (Lim et al., 2019). Online courses in these contexts will often use asynchronous video instruction as a means of transfer-

ring learning content to learners (Costley, Hughes, & Lange, 2017; Scagnoli et al., 2019; Chorianopoulos, 2018; Crook & Schofield, 2017). Asynchronous video instruction, when used in online learning environments, is said to be beneficial to both the learner and the instructor. For the instructor, there exists the capacity to review their lecture, making edits and corrections before sharing with learners, to tailor instruction for different audiences, and to play with different combinations of media to control for cognitive load (Hughes, Costley, & Lange, 2019; Morgan, 2002; Sorg et al., 1999). For the learner, these recorded forms of instruction are said to offer affordances of ubiquity, self-pacing, and review (NCES, 2008; Traphagan et al., 2010). Two ways to explain how individuals learn languages from asynchronous video instruction that could provide a framework for deciding the appropriate blend and use of multimedia instruction in the context of language learners engaged in online learning environments are instructed second language acquisition theory (ISLA) and cognitive load theory (CLT).

Research into ISLA occurs in an environment featuring instruction or formal exposure to the L2. This instruction or formal exposure could be facilitated by a teacher, in a classroom, online, or a hybrid/blend of these mediums (Allen & Seaman, 2013). Definitions of instructed second language acquisition point to three features as explained by Leow (2019a):

> (1) the instructed setting, (2) the focus on the 'mechanisms of learning' (cognitive processes) employed in this instructed setting, that is, *how* L2 learners process L2 data in this setting, and (3) the potential manipulation of these processes by instructional intervention with the assumption that superior or faster L2 development will result. (p. 2)

The most prominent theories that seek to explain second language acquisition through cognitive processes all state the importance of *attention* as a variable or process of language learning (Leow, 2015).

Cognitive load theory seeks to explain the way learners process information input into their short term memory and then on to the long term memory where it is incorporated into schemas (Cierniak, Scheiter, & Gerjets, 2009; Paas et al., 2010). Learners are said to possess a finite amount of processing capacity to complete this process. Cognitive load is said to comprise three constituent parts: *extraneous*, *germane*, and *intrinsic*. Germane load is the information related to a topic that needs to be processed for a learner to understand and generate meaning schemas leading to retention and output. Intrinsic load is the naturally occurring difficulty inherent to a topic and is relative to the complexity of the topic. Extraneous load is that which is detrimental to learners' ability to process information. Extraneous load may be caused by distracting elements in the instruction, unclear explanations, or unclear language whether spoken or

written. The greater degree of strain, the less processing power is available to learners to cope with intrinsic and maximize germane load.

Sweller (2017) has pointed out second language acquisition theories have focused on authenticity and immersion in a second language at the expense of factoring in the kind of cognitive architectural considerations CLT provides to employ explicit instruction. This echoes discussions in the field of second language acquisition centered around how L2 input should be processed to maximize internalization of input: implicit/incidental or explicit/intentional (Chen et al., 2011; Faretta-Stutenberg & Morgan-Short, 2011; Hama & Leow, 2010; Leow, 2000).

This paper goes some ways towards suggesting how CLT and ISLA could be bridged by taking the element of *attention*, central to ISLA, and the element of *extraneous load*, central to CLT, and calculating the strength of the relationship between these two constructs as reported by university students ($n = 68$) engaged in English as a Foreign Language courses at a cyber university in South Korea. It is shown that Loew's (2015) model of L2 learning process in ISLA draws on all preceding theories and places attention as a vital factor for language learning. It is also shown that CLT offers explanations of distraction through extraneous load. A model is presented factoring extraneous load into Loew's (2015) model. This augmented model is followed by suggestions on possible pedagogic implications pulling from Sweller's (2107) ideas on how CLT can positively be combined into ISLA. This is of value because CLT has presented answers to the problems incurred by extraneous load. By determining whether a statistically significant relationship can be identified between attention (as a key element in ISLA) and extraneous load (a key element in CLT), it may be possible to address inattention/distraction as a construct of extraneous load and for ISLA practitioners to take advantage of the oven ready research and solutions offered by CLT.

Literature Review

The Role of Attention in Instructed Second Language Acquisition

Loew (2019b) supplies a synopsis of the cognitive processes and variables postulated in the ISLA literature to play important roles in the L2 learning process. The synopsis shows *attention* is the only process or variable featured in every one of the theoretical underpinnings reviewed. Some theories, McLaughlin's (1987) cognitive theory, Schmidt's (1990) noticing hypothesis, Tomlin & Villa's (1994) model of input processing in SLA, Van Pattens's (2007)

intake processing model/theory, and Swain's (2001) output hypothesis posit that linguistic data needs to receive attention/be noticed and receive repeated activation at the input or intake stages in the short-term memory for it to be processed on to long-term memory where new information is worked in with existing information.

Other theories have sought to provide more holistic or unifying theories to explain second language acquisition. In Robinson's (1995) model of the relationship between attention and memory, detection (i.e., attention) occurs before noticing in the process of acquisition. When detection is combined with rehearsal in the short-term memory, noticing occurs. This noticing is necessary for information to be passed to long-term memory. Gass's (1998) integrated model of second language acquisition, meanwhile, suggests the addition of *apperceived input*. This is, according to Gass, the first stage of input, occurring in advance of detection and noticing. Acting as a priming device, apperception is the internal cognitive act of observing and identifying qualities of a linguistic object and relating them to past experience in order to *notice* the input. This primes the learner to further analyze the input into meaningful units of language.

A third group of theories suggest that language acquisition skills are the same as any other type of skill. Ellis's (2007) associative-cognitive CREED states that learning a language is subject to the same associative and cognitive learning as any other type of human knowledge. L2 learning is more challenging than L1 learning because, when learning an L1, learners have come to pay attention to the constructions inherent in that language, but, when they learn an L2, this attention works against them as the constructions are different. This can be overcome by the learner being involved in a dialectical process of conscious-language development through the analysis of deficiencies. This requires sustained attention by the learner with distraction being detrimental.

De Keyser's (2007) skill acquisition theory proposes that, initially, learning is explicit. After enough exposure and practice, learning shifts to an implicit process. With sufficient practice, through constant display of the particulars, learners develop skills with total fluency, spontaneously, and without error. Attention, therefore, is required in higher degrees at the early stages for the more automatic stage to be reached. At these earlier stages, learners are also more susceptible to interference or distraction from other input irrelevant to development of the skill.

Lastly, Truscott and Sharwood-Smith's (2004) modular online growth and use of language (MOGUL) attempts to explain how acquisition occurs through interaction between language and cognition. The mind is divided into modules or systems that perform specialized tasks, with two modules specializing in language. There is interaction between the language and other specialized

modules (including *conceptual*, *auditory*, and *visual*) as language grows and is processed in the mind. If the conceptual, auditory, or visual systems are strained attempting to process information, there may be inhibitions to their working effectively with the language systems.

The Model of L2 Learning Process in ISLA

The model of L2 learning process in ISLA draws on all the theories discussed thus far (Leow, 2015). The model proposes three processing stages: input processing, intake processing, and knowledge processing. At the input processing stage, input transforms to intake. Initially, intake is stored in working memory. The success of this stage is dependent on the level of attention (which can be peripheral, selective, or focal) and accompanying depth of the process, cognitive registration, and level of awareness. Leow states that learning is unlikely to occur if the learner does not pay minimal attention to new information in L2 instruction. Leow proposes three types of intake. These are attended intake (high peripheral attention, low cognitive registration, and low depth of processing), detected intake (high selective attention, high cognitive registration, and minimal depth of processing), and noticed intake (high focal attention, high cognitive registration, low levels of awareness, and low depth of processing). All three of these types can be lodged in working memory where they are available for recognition and incorporation into learners' internal systems. Deeper levels of processing could result in higher levels of awareness and allow learners to restructure or reinforce newly internalized information lodged in the system.

The Implicit/Incidental vs. Explicit/Intentional Debate in SLA

This debate focuses on the merits of L2 input processed either *implicitly/ incidentally*, without awareness and in the absence of deliberate exposure to a targeted L2 data set to be processed, or *explicitly/intentionally*, with learners' attention being drawn to target language via formal instruction (Loew, 2019b). There is empirical research to suggest that L2 learners may learn incidentally some elements of a target language without any formal instruction. Studies have shown learners acquiring knowledge of syntax or morphosyntax in this fashion (Grey et al., 2014; Hamrick, 2014; Kachinske et al., 2015; Rebuschat & Williams, 2012; Robinson, 1995; Rogers et al., 2016). Other studies have shown implicit vocabulary learning is possible implicitly (Day et al., 1991; Godfroid et al., 2013; Krashen, 1989; Pitts et al., 1989). Additionally, studies have pointed to the learners acquiring knowledge of phonology and form-meaning connections

(Chan & Leung, 2014; Chen et al., 2011; Graham & Williams, 2016; Leung & Williams, 2014; Marsden et al., 2013; Williams, 2005).

The weight of empirical research, however, points to the benefits of explicit/intentional learning. Studies seeking to confirm L2 learners' acquisition of phonology and form-meaning connections have been unable to demonstrate empirical evidence for this phenomenon (Chen et al., 2011; Faretta-Stutenberg & Morgan-Short, 2011; Hama & Leow, 2010; Leow, 2000). Additionally, when conditions are compared, the benefits of explicit/intentional learning are evident (Barcroft, 2009; Denhovska, Serratrice, & Payne, 2016; Hamrick & Rebuschat, 2014; Kachinske et al., 2015). Furthermore, of four meta-analyses into the benefits of implicit/incidental vs. explicit/intentional, three showed significant effect sizes favoring explicit/intentional (Goo et al., 2015; Norris & Ortega, 2000; Spada & Tomita, 2010), while the fourth (Kang et al., 2018) also showed an effect in favor of explicit instruction in immediate post-tests, but an effect size for implicit instruction on delayed post-tests.

CLT and SLA

Recently, Sweller (2017) has argued that language acquisition instruction ignores what is known of evolutionary educational psychology and would benefit from heeding recommendations that stem from the understanding of cognitive architecture put forward by CLT. The central structures and processes of this architecture are, says Sweller, made up of five principles (see Sweller & Sweller, 2006 for a full overview). Two of these principles are of relevance to this paper: *the borrowing and reorganizing principle* and *the randomness-as-genesis principle*.

The borrowing and reorganizing principle states that learning a second language requires large quantities of clear written or spoken instruction and that anyone deliberately engaging with this instruction is using the principle. Information gathered by borrowing from the instructed content is reorganized with existing information to achieve learning.

The randomness-as-genesis principle states that a greater amount of accurate information being available will reduce the need for learners to attempt to fill in gaps by generating at random and testing their own interpretation of information without support or correction. Knowledge that has randomness as its genesis is more likely to be inaccurate. Missing instruction because of distraction will, then, reduce the amount of exposure to accurate information and increase the need for generation from randomness.

Extraneous Load and Language Learning Contexts

There is much related to attention/distraction and extraneous load in research carried out in the field of language learning. Of most interest are studies focused on confirming the existence of two theories said to explain negative effects of multimedia on learning: the redundancy principle and the split attention hypothesis. Redundancy has been shown to exist when a combination of text, narration, and images is used to explain a single concept. It has been demonstrated in multiple contexts that learners process information more effectively from images + narration only than they do when text is added (Adesope & Nesbit, 2012; Kalyuga & Sweller, 2014; Mayer, 2009; Mayer et al., 2014; Mayer & Fiorella, 2014). While some studies suggest that the redundancy principle does not apply to language learners (Liu et al., 2018), it has been confirmed by a number of others (Diao et al., 2007). Additionally, the use of images to annotate text is said to be redundant for language learners (Plass et al., 2003). The use of competing stimuli from multimedia forces language learners to be selective with their attention (Wickens, 2007).

The spatial split-attention principle occurs when learners view images and text that are poorly integrated. This can negatively affect cognitive processing because students are forced to split their attention between sources (Liu & Lin, 2011; Mayer & Moreno, 1998; Rasch & Schnotz, 2009). While questions have been raised about whether cognitive load explains this phenomenon in language learners (Schroeder & Cenkci, 2019) and there has been a suggestion that a reverse split-attention principle could be put forward to account for the combination of image + text to reduce cognitive load (Lin et al., 2016), other studies have shown influences from this principle can be detected in language learning contexts (Cierniak, Scheiter, & Gerjets, 2009; Hung, 2009; Al-Shehri, & Gitsaki, 2010).

Hypotheses

H1. There will be a positive relationship between distraction and extraneous load.
H2. There will be a positive relationship between illustration distracting from text and extraneous load.
H3. There will be a positive relationship between text distracting from illustrations and extraneous load.
H4. There will be a positive relationship between difficulty relating text to illustrations and extraneous load.

Method

Participants

This study was conducted on 68 students who were taking English as a Foreign Language (EFL) classes at the Open Cyber University (OCU) in South Korea. Many students responded to the survey, but only the students taking EFL classes were used in the present study. As many as 2,225 students submitted surveys. From the 2,225 surveys that were submitted, 230 were removed from the analysis used as part of this study, as the respondents had failed to fill out significant parts of the survey relevant to the study. This left 1,995 valid respondents, of which 1,027 were female (51%) and 968 were male (49%). The oldest subject was 61 while the youngest was 16, with an average respondent age of 25.2 and a standard deviation of 3.0. The respondents took a wide range of classes from several different colleges within the OCU. There were 122 different classes represented in the original data set, and they can be divided based on the OCU categorization as follows: lifestyle and health 28%, social science 27%, humanities 9%, business and management 10%, computers and information technology 8%, foreign language 7%, natural science 7%, and mathematics 4%. As the present study was about EFL classes in the OCU, from the 1,995 subjects, students who were taking language learning classes were separated for the specific analysis used in this study. Out of the 1,995 valid submitted surveys, 68 (4%) participants were taking EFL classes online in the OCU. Of these participants 35 (51%) were male and 33 (49%) were female. The ages ranged from 20 to 45 with a mean age of 26 and a standard deviation of 6.7.

Research Context

The OCU is the largest open online university in South Korea with 23 member universities participating to provide online full-credit classes (Jung & Rha, 2001). The classes and subjects covered by the OCU are varied and the design, contents, and instruction within the OCU are provided by the 23 universities that make up the consortium (Jung & Rha, 2001). The classes in the OCU are mainly focused around the video lecture with limited learner-to-learner interaction as part of the formal class instruction.

Research Procedures

The research that the data used in this study comes from was part of a series of surveys into the OCU. These surveys were varied, but many of them focused around the application of media within the context of cognitive load theory. The survey used was originally written in English, with items coming from previous research in online environments (see Instrument Development below). The items were then translated into Korean, which is the language of the OCU. The translation was checked by an expert in online learning and an expert in the OCU itself. After the translation was found to be acceptable, the survey items were put into a Google Sheets form and sent to the OCU's research ethics administrative department. Once the OCU had determined that the research items were appropriate for their learners a link to the Google Sheet was put up on the OCU's main administrative board with an invitation to take the survey as part of this research. All students who logged into the OCU during the time the survey was active were invited to participate. Not all students who logged in completed the survey, so the data collection was one of convenience. However, this still gives some insight into how students perceive the learning context that is the OCU. The survey was left online for one month before it was taken offline and the data was downloaded for analysis.

Instrument Development

To create the construct used to measure media diversity in the lectures two differing approaches were used then combined. Initially, 20 videos from the OCU were watched by the authors and the differing types of media contained therein were made into a list by the authors. Also, 10 students who had taken OCU classes were asked to list the types of media that were used in the video lectures and how they interacted with them. These students were drawn from a group known to one of the authors of this paper to have taken OCU classes. They were helpful in double checking the initial list of media. The students agreed that the final compiled list accurately represents the way how they interacted with the media that was present in the OCU video lectures. The list created by the authors was then discussed with them, and the students agreed that the list seemed to accurately note the differing aspects of the ways they might interact with the lectures. Thus, three items were drawn: (1) during the videos it was difficult to relate text and illustration to each other; (2) during the videos illustrations distracted from text; (3) during the videos text distracted from illustrations.

To create the construct used to measure extraneous load, three items were used from Leppink et al.'s (2013) article entitled "The Development of an

Instrument for Measuring Cognitive Load." This paper presents an overview of the three types of cognitive load (intrinsic, extraneous, and germane) and how to measure them. The present study uses three items from this research: the explanations during the lecture were very unclear; the explanations were, in terms of learning, very ineffective; the explanations were full of unclear language. The Cronbach's Alpha for the extraneous load construct was .933.

Results

In order to examine the relationship between distraction and extraneous load in an instructed second language acquisition context, the relationship between the combined *distraction* and *extraneous load* were analyzed. Results from this analysis can be seen in Table 1 and Figure 1.

Table 1.

The relationship between distraction and extraneous load

Mean distraction	n	Mean extraneous load
5.33	2	2.83
5.00	2	4.00
4.33	4	2.83
4.00	8	3.50
3.67	10	3.57
3.33	5	3.27
3.00	9	2.93
2.33	2	3.00
2.00	14	2.29
1.67	2	1.67
1.33	1	2.00
1.00	9	1.00

Table 1 and Figure 1 show that when students reported multimedia was distracting in asynchronous video instruction, their experience of extraneous load increased. In other words, the higher levels of extraneous load students experienced, the more positive was their relationship with distracting media employed in the video lectures. In order to further investigate the relationship between the distraction from multimedia and the resulting extraneous load, statistical analysis was conducted to generate p and r values. These results can be seen in Table 2.
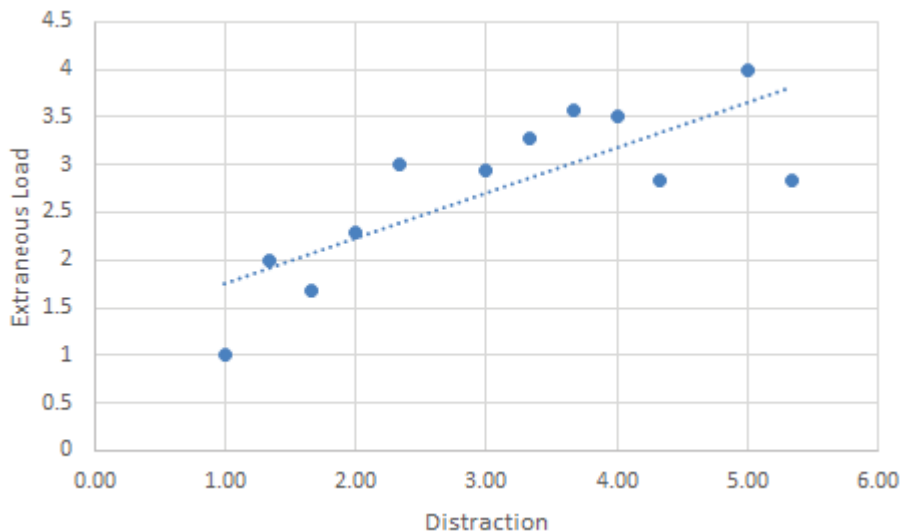
Figure 1. The relationship between *distraction* and *extraneous load*

Table 2.

Statistical analysis of results

	n	Mean	Range	SD	P	r
Distraction	68	2.89	1–5.33	1.19	.00*	.31
Extraneous Load	68	2.7	1–5.67	1.33		

*Sig. at .05

Table 2 shows that there was a statistically significant relationship between the distraction experienced by learners when processing multimedia information and extraneous load as the *p* value is <0.05. It also shows that the strength of this relationship is, for this field, moderate at .31. In order to examine the correlations between variables, Pearson's bivariate analysis was conducted. The results of these analyses can be seen in Table 3.

Table 3.

Correlations between variables

	Variables	1	2	3	4	5	6
1	Distraction	1					
2	Extraneous Load	.56*	1				
3	Age	.13	−.00	1			
4	Gender	.12	−.01	.05	1		
5	Years of study	.13	−.01	.41*	−.18	1	
6	Experience online learning	−.11	−.28*	−.13	−.15	−.06	1

*Sig. at .05

Table 3 shows a correlation of .56 between extraneous load and distraction. That is, students who experienced greater challenges from the distracting use of multimedia also experienced greater extraneous load. Results also showed that older learners, those who identified as female and those who had studied for more years of study, experienced greater distraction from multimedia instruction. However, those with more experience of online learning experienced a negative relationship with distraction. All these groups had a negative relationship with extraneous load. This means that, while older, learners, and those with more years of language learning experienced greater levels of distraction, they were able to process distracting information better and therefore experienced less extraneous load than those younger, male, and with fewer years of experience of language learning.

Results showed that learners with greater experience of online learning also experienced a negative relationship with extraneous load as shown in Table 3. Of greatest significance (and two points that the reader should remember for the discussion section) is that those with more years of study and greater experience of online learning both experienced a negative relationship with extraneous load.

Next, the relationships between the distraction and extraneous load items were examined. Correlations between the items can be seen in Table 4.

Table 4.

The relationships distraction and extraneous load variables

Items	The explanations were full of unclear language.	The explanations during the lecture were very unclear.	The explanations were, in terms of learning, very ineffective.	EL Combined
Difficult to relate text and illustration to each other	.30*	.36**	.37**	.40**
Illustration distracted from text	.47**	.62**	.26*	.52**
Text distracted from illustration	.46**	.64**	.37**	.57**

* Sig. at. .05 ** Sig. at 0.1

Table 4 shows a positive correlation between all the variables. Of these the strongest relationships were between the diversity items *Textual information distracted me from the illustration* and *Illustration distracted from text* and the extraneous load item *The explanations during the lecture were very unclear* at .64 for the former and .62 for the later. This indicates that text—when used in a manner that will distract learners from illustrations—will cause the greatest amount of extraneous load caused by making explanations difficult to

understand. The relationship between *Illustration distracted from text* and *The explanations during the lecture were very unclear* was the joint second strongest at .62. This demonstrates that the more distracting students found illustrations, the less clear explanations became.

Behind these were the relationships between *Illustration distracted from text* and *The explanations were full of unclear language* (.47) and *Text distracted from illustration act* and *The explanations were full of unclear language* (.46). These indicate that when text and illustrations are used in ways that are distracting, students are more likely to find the language used in instruction unclear. *The explanations were, in terms of learning, very ineffective* had a correlation of .37 with both *Difficult to relate text and illustration to each other* and *Text distracted from illustration*. This shows that when texts and images have unclear relationships, extraneous load is more likely to occur in the form of ineffective explanations. *Text distracted from illustration* had a correlation of .36 with *The explanations during the lecture were very unclear* and .3 with *The explanations were full of unclear language*. This indicates that when text and images seem unrelated students will experience higher extraneous load through unclear language and explanations. Finally, *Illustration distracted from text* and *The explanations were, in terms of learning, very ineffective.* had the lowest correlation with .26. This depicts a weaker, but still positive, relationship between the distracting nature of illustrations and extraneous load caused by ineffective explanations.

Discussion

All four of the hypotheses offered in this paper were proven: H1 stated there will be a positive relationship between distraction and extraneous load; H2 stated there will be a positive relationship between illustration distracting from text and extraneous load; H3 stated there will be a positive relationship between text distracting from illustrations and extraneous load; and H4 stated there will be a positive relationship between difficulty relating text to illustrations and extraneous load. These hypotheses were based on theories and findings in language learning contexts that suggested distraction would cause strain on learners' ability to manage cognitive load. Explanations for these findings could be found in the redundancy principle, said to occur when text, narration, and images appear together in instruction that explains a single concept (Mayer, 2009; Mayer et al., 2014). Evidence of the redundancy principle existing in language learning contexts is supported by findings in this paper as text was shown to be distracting from illustration and illustration from text correlating with extraneous load. These findings support others that have shown

redundancy to exist in language learning instruction (Diao et al., 2007) and counter those that suggest the principle does not apply in language learning contexts (Liu et al., 2018).

The positive correlation between distraction and extraneous load could also be explained by the split-attention principle. This principle states that using multimedia in ways that force learners to split their attention between text and images negatively affects cognitive processing. The research results showed that learners were distracted from illustrations by text and from text by illustration correlating with extraneous load and could, therefore, support the contention that split-attention is a valid principle in language learning contexts (Cierniak, Scheiter, & Gerjets, 2009; Hung, 2009; Al-Shehri & Gitsaki, 2010) and counter those that suggest image + text reduces cognitive load (Lin et al., 2016).

The last result of note is that more experienced learners, both in terms of years of study and experience of online learning, experienced a negative correlation with extraneous load. This suggests the reverse-split attention principle, in which more experienced learners benefit from text + illustration combinations, may be present in this language learning context. This finding can add weight to the suggestion that reverse-split attention exists and should be considered when creating instruction (Lin et al., 2016).

This paper started from the position of exploring the suggestion by Sweller (2017) that ideas generated in CLT be applied to ISLA contexts to explain the process of learning and hindrances to that process. These findings present an opportunity for a model to help explain the detrimental effects of extraneous load on attention by adapting the input processing section of Loew's Model of the L2 learning process in instructed SLA (2015, p. 242). Figure 2 shows a graphic illustration of extraneous load as hindrance in the L2 learning process.
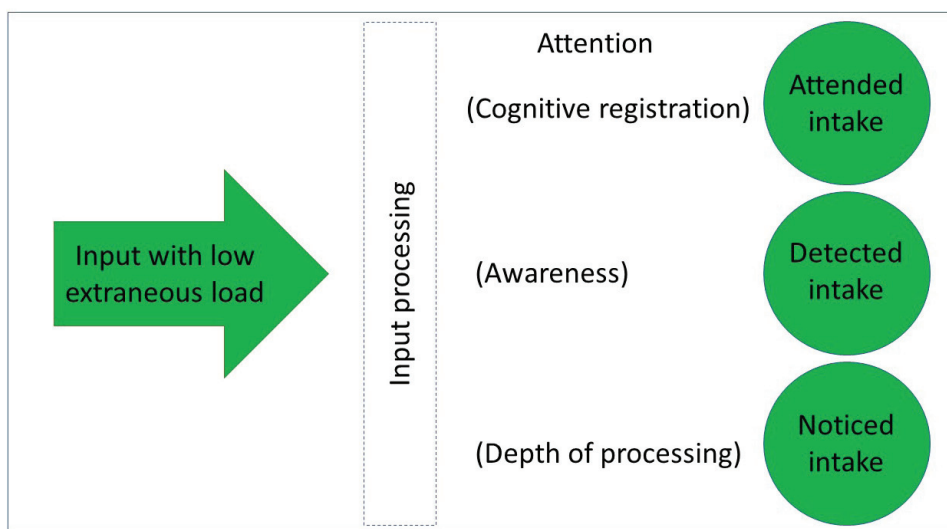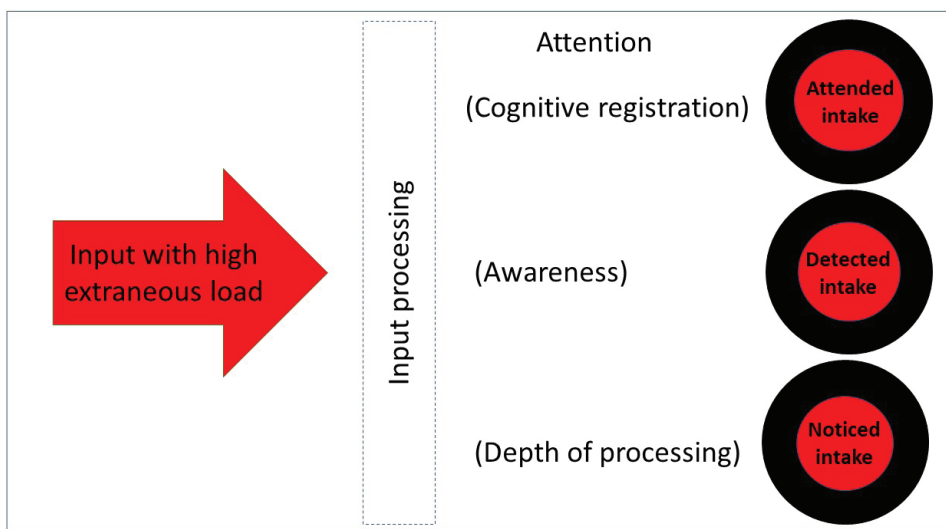
Figure 2.
The model of extraneous load as hindrance in the L2 learning process

This model can be called *the model of extraneous load as hindrance in the L2 learning process.* The model shows the proposed effects of extraneous load on input processing, attention, and intake in the working memory. In Figure 1, low levels of extraneous load are present in the input. As a result of this low level of extraneous load, there is little strain on input processing meaning that cognitive registration, awareness, and depth of process are fully activated as are the related attended, detected, and noticed intake. In Figure 2, input is shown with high extraneous load. There is strain on input processing because of increased extraneous load. This means cognitive registration, awareness, and depth of processing are not fully activated. This, in turn, means attended, detected, and noticed intake are reduced. If one integrated these figures in the full version of Loew's model of the L2 learning process in instructed SLA, the effects of extraneous load would show that less information is transferred to long-term memory meaning it is not available to learners when needed and learning is impeded.

Pedagogic Implications

It has been established that it is possible to model how extraneous load might be a hindrance on attention in L2 learning processes. This section suggests some practical implications of this idea. These are guided by Sweller's (2017) set of implications for applying CLT to language teaching and focus on the benefits of reducing extraneous load.

Sweller states that a reduction of extraneous load on working memory should be made essential in the organization of instruction. This is supported by the findings in this paper because a positive relationship between extraneous load and distraction was demonstrated. Sweller recommends that instruction should be explicit and makes use of the borrowing and reorganizing and randomness-as-genesis principles meaning learners are not left to fill in gaps caused by extraneous load and distraction by creating their own meaning. One way instructors can do this is to clearly and explicitly signal to learners key vocabulary and grammar items. This takes advantage of the signaling principle (Mayer, 2001), which says using cues and highlights, either aurally or visually, helps learners organize and process novel instruction. This will ideally be done by presenting words and pictures to each other and simultaneously to take advantage of the spatial and temporal contiguity principles (Mayer, 2001) and to avoid split attention. In asynchronous video content this could be achieved by the instructor using vocal variety to direct learners through change and stress in the voice, explicitly stating an item is important, or the explicit presenting of keywords. If control over the display or hiding of keywords is placed with the learner, so much the better as more experienced learners have been shown to experience redundancy when audio, text, and illustration are all present (Lin et al., 2016) leading to the expertise-reversal effect (Sweller, 2017). This view is supported by findings in this paper that showed learners with more years of experience of language learning experienced less extraneous load. Additionally, having narration that is conversational in nature and avoids using machine voices exploit the personalization principle that suggests people learn more when they are spoken to casually and the voice principle that states a human voice is more effective than a computerized one (Mayer, 2001).

Conclusion

This paper examined the relationship between attention and extraneous load experienced by language learners enrolled in fully online courses using asynchronous video instruction as the main form of instruction at a cyber-university in South Korea. It was shown that a statistically significant positive relationship exists between distraction and extraneous load. This means when media is used in ways that are distracting for learners, the learners will experience greater levels of extraneous load. This is an important point because extraneous load has been shown to inhibit learning. Using these findings, a model of extraneous load as hindrance in the L2 learning process was proposed that adapted the input & intake sections of Loew's (2015) model of L2 learning process. This

adaptation demonstrated a way in which an element of cognitive load theory could be integrated into ISLA. This integration addressed Sweller's (2017) assertion that language learners would benefit from practitioners employing ideas around human cognitive architecture in their pedagogic practice. Following from this, suggestions were made to inform practice by suggesting that consideration be given to the way multimedia is deployed in online language learning contexts to reduce cognitive load. It was suggested this could be achieved by explicitly signaling key vocabulary and grammar items and presenting illustrations and text in a way that makes them clearly related by considering spatial and temporal deployment.

Findings also showed individual differences among learners correlated differently with variables. The most important finding was that more experienced learners experienced less extraneous load. It was speculated that this was because experience as a variable affects how learners process multimedia in language learning and that, while multimedia use may be a hindrance for less experienced learners, it may be advantageous to more experienced learners. Following this finding, it was suggested that learners be given control of the media available in instruction so as to tailor and personalize content according to a learner's processing needs. These findings will be of interest to instructors and instructional designers engaged in developing online educational content for language learners.

Limitations

The findings presented in this paper should be treated with caution because they reflect the experiences of one group of learners consisting of a relatively small sample size engaged in a particular educational context. Additionally, the negative correlation between years of study and extraneous load was weak and not statistically significant. More research will need to be conducted in similar contexts and with larger sample sizes in order to confirm the validity of the model of extraneous load as hindrance in the L2 learning process and whether CLT can usefully be integrated into SLA.

Future Research

Based on the findings and discussion in this paper, a number of research questions can be proposed for future research. First, if extraneous load constricts attention, then does greater germane load expand attention? Second, what effect does placing learners in control of the media they consume in instruction have on distraction and extraneous load? Last, what effect does explicitly

signaling key vocabulary and grammar have on language learners' experience of distraction and extraneous load?

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Die Beziehung zwischen Aufmerksamkeit und extrinsischer Belastung: Zweitspracherwerbstheorie und Theorie der kognitiven Belastung

Zusammenfassung

In den letzten Jahren wurde immer wieder dafür plädiert, die Theorie der kognitiven Belastung in den gesteuerten Zweitspracherwerb miteinzubeziehen, damit Sprachlernende durch die Verwendung von Theorien der menschlichen kognitiven Architektur (Sweller, 2017) unterstützt werden. Der Beitrag setzt sich zum Ziel, die Diskussion darüber zu öffnen, wie diese Integration erreicht werden könnte. Hierfür werden die Ergebnisse von Umfragen analysiert, die unter Sprachlernenden in Online-Kursen an einer Cyber-Universität in Südkorea durchgeführt wurden, in denen asynchroner Videounterricht verwendet worden war (n = 68). Die Ergebnisse zeigen eine statistisch signifikante, positive Beziehung zwischen Ablenkung und der kognitiven Belastung. In Bezug darauf wird ein Modell postuliert, das erklärt, wie die Beziehung zwischen der kognitiven Belastung und Aufmerksamkeit in die Zweitspracherwerbstheorie integriert werden kann. Darüber hinaus werden pädagogische Implikationen dieses Modells vorgeschlagen. Sie berücksichtigen unter anderem eine explizite Signalisierung von Schlüsselvokabeln und Grammatik, räumliche und zeitliche Bedingungen im multimodalen Unterricht sowie die zentrale Stellung von Sprachlernenden bei den Entscheidungen hinsichtlich der Auswahl von Medien im Unterricht.

Schlüsselwörter: kognitive Belastung, Zweitspracherwerb, Medien, Online-Lernen, Videounterricht