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## Processing glosses: A qualitative exploration of how form-meaning connections are established and strengthened

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### Abstract

Using a think-aloud procedure this study explored why certain vocabulary interventions are more facilitative for word learning than others. Second Language (L2) readers' *quality* and *quantity* (Hulstijn, 2001) of word processing strategies were recorded to determine the effect on (a) establishing and (b) strengthening lexical form-meaning connections (FMCs) as well as (c) text comprehension. L2 learners read a text enhanced with either multiple-choice glosses (MCGs) or single-translation glosses (STGs). In both conditions the target words (TWs) occurred three more times in the text after the first glossed occurrence. The data-analyses suggested that MCGs may lead to more robust and complete FMCs than STGs. Strengthening of FMCs seemed to be related to the integration of multiple meta-cognitive and semantic-elaborative resources, the repeated search and evaluation of individual word meanings as well as recursive reading strategies. Weaker FMCs were marked by the use of only meta-cognitive resources, linear text processing, and a lack of motivation to assign concrete word meaning. Readers in both conditions comprehended main ideas equally well. But MCG readers showed a tendency to comprehend more supporting ideas.

*keywords:* lexical acquisition, word interventions, word processing, involvement load hypothesis, text comprehension

### Introduction

Which reading interventions facilitate lexical form-meaning connections (FMCs) that are robust and retained over time? This question has been the incentive for recent studies on lexical development through reading (e.g., Rott, 2000; Rott and Williams, 2003). These studies have focused on reading as an avenue for lexical development because texts provide readers with meaning-bearing, semantically, syntactically, and pragmatically rich input. Logically, second language (L2) learners need to master such aspects of the lexicon to reach advanced and near native speaker language abilities (Judd, 1978; Nation, 2001; Richards, 1976).

At the same time, researchers have addressed the shortcomings of unenhanced reading. Repeated research (e.g., Parry, 1993; Parry, 1997) has shown that even though L2 readers may comprehend hitherto unfamiliar words in a text, they may not be able to access the word meaning after completing the reading task. This suggests that comprehending a word in its context does not necessarily result in

a FMC, or if an initial FMC is established it may not result in a robust entry in the mental lexicon. Accordingly, it is well accepted that comprehension and learning may be complementary processes but not the same phenomena (e.g., Lee and VanPatten, 1995; Sharwood Smith, 1986). In fact, learning a new word seems to require that it be momentarily "isolated from its context" (e.g., Prince, 1996: 489)<sup>1</sup> to assign a specific meaning to the lexical form. This isolation permits the reader to allocate attentional resources (e.g., Schmidt, 2001) to orthographic, syntactic and semantic aspects of the new word to potentially encode it in the mental lexicon. Subsequent lexical studies have, therefore, used interventions that direct the L2 readers' attention to individual target words (TWs) in the input passage. Some of the interventions supplemented the text with semantic resources to promote the *establishment* of initial FMCs; others supplemented the text with word-focused tasks to *strengthen* FMCs.

Numerous investigations have enhanced reading material with first language (L1) or L2 glosses (e.g., Hulstijn, 1992; Hulstijn, 1993; Hulstijn, Hollander, and Greidanus, 1996; Hulstijn and Trompetter, 1998; Jacobs, Dufon and Fong, 1994; Ko, 1995; Laufer and Hulstijn, 2001; Watanabe, 1997). Such semantic word interventions direct readers' attention to an unfamiliar word, stimulate the processing of its meaning and thereby promote the initial establishment of correct FMCs. Findings, however, have been inconclusive regarding the robustness, i.e., long-term retention, of the established FMC. Comparing the effect of an L1, an L2, and a no-gloss condition Jacobs et al. (1994) observed a significant effect for the gloss conditions immediately after the treatment but not four weeks later. Ko (1995) further found not only that the gloss condition outperformed the no-gloss condition but that learners receiving L1 glosses gained significantly more words than learners receiving L2 glosses. Word retention was measured after one week. Likewise, Hulstijn et al. (1996) found superior word retention, which was assessed within one hour of the treatment, for L1 glosses as compared to a dictionary access and an incidental acquisition group. Further exploring the effectiveness of glosses on word retention, Watanabe (1997) revealed that readers in the gloss condition outperformed readers whose text was semantically enhanced with appositives. He assessed word knowledge immediately after the treatment and two weeks later. In turn, two other studies (Hulstijn and Trompetter, 1998; Laufer and Hulstijn, 2001) found that when students engaged in an output task, such as writing a composition, they remembered significantly more words than readers who processed a text enhanced with glosses. However, the researchers were only concerned with word learning, neglecting reading as a tool to simultaneously provide semantically and pragmatically rich lexical input and present content information.

In order to address strengthening and long-term retention of lexical FMCs, researchers have compared interventions based on various theoretical constructs to explain why some word tasks are more effective than others. A majority of these interventions are based on Craik and Lockhart's (1972) levels of processing depth theory. It states that the chance that a new lexical or grammatical form will be stored in long-term memory is determined by the shallowness (sensory properties, such as orthographic and phonemic features) and depth (semantic-associative features) with which it is initially processed. Hulstijn (1992) proposed that a higher degree of "mental effort", through inferring and hypothesis-testing of word meaning, leads to better word retention. In a series of studies (see below) he found support for his claim. Hulstijn (2001) further attributed long-term retention of words to more elaborate processing. The level of elaboration increases as learners pay attention to more aspects of word meaning, such as morphophonological, orthographic, prosodic, semantic and pragmatic features, and interword relations. Fraser (1994 and 1999) reported that when readers engaged in more elaborate processing, through inferencing plus consulting, for example, word retention was higher than when readers engaged in less elaborate processing strategies. Additionally, Wesche and Paribakht (2000) showed that effective vocabulary learning involves the analysis of the meaning and the grammatical function of the new word.

Another line of investigations is based on the effect of generative processing. Generative models (e.g., Wittrock, 1974) claim that learning and retention are improved when learners create connections between old and new knowledge by using, reformulating and elaborating the new information. Lexical studies to date have confirmed that more generative processing results in increased word gain (Joe, 1995; Joe, 1998; Zaki and Ellis, 1999). Laufer and Hulstijn (2001) integrated and further expanded on these theoretical notions by introducing the construct of "involvement load". It describes the motivational and cognitive dimensions of a task that stimulate word processing to establish and retain FMCs. A perceived *need* for a word, along with the *search* for its meaning, and subsequent *evaluation* of whether a correct meaning and syntactic function were assigned, are its central components. Tasks that stimulate all three cognitive processes are most likely to lead to the establishment and retention of FMCs.

In order to stimulate cognitive mechanisms that lead to robust FMCs, Hulstijn (1992) introduced MCGs. Unlike "normal" glosses which present an L1 translation or L2 synonym in the margin of the text, MCGs display multiple L1 word meanings from which the reader chooses. This also reduces the likelihood of establishing an incorrect FMC as compared to unenhanced reading.<sup>2</sup> At the same time, MCGs engage the reader in the cognitive process of *evaluation*, which is claimed to foster word retention (Laufer and Hulstijn, 2001). That is, the provision of MCGs in the margin of a text appears to be an intervention that triggers a higher involvement with a word than "normal" glosses. In a series of studies, Hulstijn observed that MCGs resulted in more word gain than L2 synonym glosses, but also that L1 glosses resulted in more word gain than MCGs. In addition, the study showed that a significant number of participants in the multiple-choice condition chose a wrong meaning. Hulstijn suggested that four alternatives might be too many. In a follow-up study Watanabe (1997) provided only two alternatives in the multiple-choice condition. He found no significant difference in word gain between the multiple-choice and the L2 synonym gloss condition. However, both gloss enhancement groups outperformed the incidental group immediately after the reading task and one week later. Likewise, Rott, Williams and Cameron (2002) showed that MCGs led to significantly more word gain immediately after the reading task as compared to the no-gloss control condition. The superior gain was, however, not retained over five weeks. In a qualitative investigation Rott and Williams (2003) further explored readers' processing mechanisms of TWs that were presented with MCGs at the first occurrence and un glossed during three consecutive occurrences. The study revealed that readers *searched* for concrete word meaning and *evaluated* the meaning choice in the subsequent contexts. That is, additional encounters with the TWs increased the involvement load.

To summarize, the above outlined studies have not shown consistent support for "normal" glosses and MCGs on long-term retention of FMCs. Interpretations of the results have often been speculative because the mostly quantitative investigations did not account for and elicit L2 readers' word processing behavior. Consequently, this line of research bears further investigation. Specifically, the current qualitative investigation sought to develop further insights into the motivational and cognitive factors – need, search and evaluation – which Laufer and Hulstijn (2001) describe as indicators for the retention of words. Additionally, the increased *quantity* of word processing, i.e., processing a new word repeatedly in one or multiple texts, has been found to be conducive to incidental word learning (for a review, see Horst, Cobb and Meara, 1998; Paribakht and Wesche, 1999; Rott, 1999; Waring and Takaki, 2003; Zahar, Cobb and Spada, 2001). Nevertheless, most of the above mentioned studies focused on L2 readers' word processing strategies, i.e., the *quality* of word processing, during the first encounter but did not record word processing strategies during repeated encounters with the same word. Hulstijn (2001) has emphasized that both the quantity and the quality of word processing are crucial indicators for word retention. He stressed the importance of elaborative rehearsal<sup>3</sup> of words during repeated encounters suggesting

that "[h]igh quality information processing when a word is first encountered as such is not predictive of retention outcomes" (Hulstijn, 2001: 276). Therefore, the incentive of the current study was to record not only the *quality* and *quantity* of word processing strategies as readers established FMCs during the first encounter with a new word but also during subsequent encounters. Thereby, the investigation assessed the effect of exposure frequency on strengthening of FMCs. Finally, the current study sought to determine the effect of word interventions on text comprehension. Ideally, word interventions not only promote word learning but also text comprehension, or at least they should not interfere with the comprehension process.

## Research questions

The present study addressed the following questions about word processing strategies triggered through multiple-choice glosses (MCGs) and single-translation glosses (STGs) during L2 reading:

1. What are the qualitative characteristics of word processing strategies of L2 readers who encounter MCGs as compared to readers who encounter STGs?
2. What are the qualitative characteristics of word processing strategies of these readers (multiple-choice or STG condition) during subsequent word encounters?
3. How many times (quantity) do MCG and STG readers interact with individual TWs?
4. What is the effect of the gloss condition (multiple-choice or single-translation) on the robustness of entries in the mental lexicon? Do either of the two gloss conditions result in better word retention measured four weeks later?
5. What is the effect of the gloss condition (multiple-choice or single translation) on text comprehension? Do readers in both conditions comprehend main and supporting ideas equally well?

Qualitative characteristics were determined by recording the type of cognitive processing strategies and resources (e.g., semantic, linguistic, and background knowledge) participants used to make meaning of the TW. Quantity of interaction with the TW was determined by the number of processing strategies and resources used to make meaning of the word during each encounter. For further details see the "analysis and scoring" section below.

## Method

### *Participants*

The participants were 10 native speakers of English learning German as a foreign language. Learners were enrolled in an intensive combined third and fourth semester class during the summer semester at a large, public university in the Midwest of the United States. All students had taken their first and second semester of language study during regular semesters in the same program. The regular class instructor informed the researcher that the volunteers were indeed motivated but not equally successful students. Based on their last exams, grades ranged between A and C. No standardized German language test was available to stratify participants further.

### *Materials*

The input passage was an adaptation of *Shade for Sale: A Chinese Tale* (Dresser, 1994; see [Appendix A](#)). The tale was adopted for the study for the following reasons: a) it provided a clearly developed story line which was easy to follow; b) the story was culturally neutral – text comprehension would not depend on culturally specific knowledge; and c) the text length (535 words) was appropriate for third semester learners. Some modifications were made: several passive voice instances were changed to active voice, the main characters were given names in order to clearly distinguish between them, and some words were changed to accommodate four repetitions of the TWs. To further ensure comprehension, seven words (besides the TWs) were glossed. A native speaker translated the text into German.

Each TW occurred four times in the passage.<sup>4</sup> Four encounters allowed analyzing how the intervention tasks (see below) influenced the processing of subsequent TW encounters. More occurrences would have been unnatural for the size of the input passage. The TWs were the following concrete nouns: *Kaff*<sup>5</sup> (village), *Eiche* (oak tree), *Laken* (sheet), *Vieh* (livestock). Low frequency items and colloquialisms were chosen to increase the likelihood that the TWs were completely unknown for the participants.

The TWs were part of the main ideas, and pertinent for overall text comprehension. However, not every encounter of each TW was of equal importance to the overall story line. Modifying the text so that contexts with the TWs would have been of equal importance would have disturbed the natural flow of textual propositions. While the context of the first occurrence of each TW did not provide explicit clues to its meaning, contexts two, three, and four provided contextual clues. For example the first context of the TW "Eiche" (oak tree) simply describes that the rich man built a villa next to a big oak tree. In the following three contexts the reader finds out that the rich man waters the oak tree, that it gives shade, and that people rest in the shade under the tree.

### *Measures*

*Independent Variables.* All participants read the same text and were randomly assigned to one of the two treatment conditions:

1. *Multiple-choice gloss (MCG) condition.*

The text was enhanced with MCGs for each of the four TWs at their first occurrence. The MCGs were bolded in the text to attract the readers' attention. Subsequent gloss appearances were not enhanced in order to assess whether readers naturally noticed the TWs after the first glossed encounter. The gloss options appeared in the margin of the input passage. Seven additional glosses were chosen for words that were considered difficult to comprehend. At the same time they served as distracters so that readers did not solely focus on the TWs. Readers had four choices: the correct meaning of the word, two additional meanings that would make sense in the present context, and a "don't know" option. For example, for the first encounter with the TW *Kaff* (village) in the input passage that read "Once a rich man lived in a small village," readers received the following choices: a) shack, b) valley, c) village, d) don't know. To ensure that students used the gloss, they were instructed to circle the option whose meaning fit best in the context.

2. *Single-translation gloss (STG) condition.*

The text was enhanced with glossed L1 translations for each of the four TWs at their first occurrence. In this condition,

the TWs and the seven additional glosses were bolded in the text and appeared in the margin of the text. The gloss appeared only for the first encounter with the TW. None of the subsequent occurrences (three more) were enhanced.

*Dependent variables.* Word gain. To assess immediate word knowledge gain and retention (four weeks later), two vocabulary tests were administered each time. Learners first completed a Vocabulary Knowledge Scale (VKS) ([Table 1](#)) adapted from Wesche and Paribakht (1996). Minor changes were made from the original wording.<sup>6</sup> "The scale ratings range from complete unfamiliarity, through recognition of the word and some idea of its meaning, to the ability to use the word with grammatical and semantic accuracy in a sentence" (Wesche and Paribakht, 1996: 29). In addition, to develop a clearer picture about receptive word knowledge gain, learners received a word recognition test (WRT) that presented the TW and multiple choices of word meanings. This included the correct TW meaning, two distracters that were semantically distinct from the TW, and a "don't know" option ([Appendix B](#)). This last option was added to minimize the chance of random correct responses. The distracters were the same as those used for the MCGs in the treatment passage.

Table 1: Adapted Version of the Vocabulary Knowledge Scale

<input type="checkbox"/>	a) I don't remember having seen this word.
<input type="checkbox"/>	b) I have seen this word but I do not know what it means.
<input type="checkbox"/>	c) I <i>think</i> it means _____ (English translation).
<input type="checkbox"/>	d) I <i>know</i> this word. It means _____ (English translation).
<input type="checkbox"/>	e) I can also use this word in a sentence in German:

Note: Adapted from Wesche and Paribakht (1996)

Text comprehension. Before starting the reading treatment, participants were informed that after completing reading the text they would have to retell, in writing, the content of the passage in as much detail as possible. This was done to ensure that the students focused on processing the text for meaning during the task. Comprehension was assessed in their L1 (English) so that their limited L2 production skills would not interfere with demonstrating text comprehension (e.g., Lee, 1986).

Strategy use. In order to assess participants' cognitive mechanisms that lead to establish FMCs and to strengthen these FMCs, the readers' use of processing strategies was recorded. Think-aloud protocols do not provide direct access to cognitive mechanisms, but the interpretation of participants' word processing strategies offers indirect insights into their mental activities. Therefore, strategy categories and criteria for analysis were established (see "analysis and scoring" below). Cognitive mechanisms and processing strategies are used interchangeably in this study.

Analysis and scoring. All think-aloud protocols were transcribed and analyzed for qualitative and quantitative processing behavior. For each reader a strategy profile was created based on the following categories:

a) Qualitative analysis: Participants' processing characteristics were recorded as they established initial FMCs during the first glossed encounter and as they (potentially) strengthened the connections during subsequent processing. For the analysis Laufer and Hulstijn's (2001) motivational and cognitive information processing mechanisms were used:

*need, search and evaluation.* "Need" referred to the L2 readers' motivation to comprehend the TW. "Search" referred to the readers' attempt to assign a meaning to the TW. "Evaluation", in turn, entailed the readers' decision process whether a chosen word meaning made sense in a given context. That is, readers confirmed or disconfirmed a meaning. As suggested by Laufer and Hulstijn (2001) it was assumed that tasks that stimulate all three cognitive processes have a higher "involvement load" and are more likely to lead to the establishment and retention of FMCs than tasks with a lower involvement load. Additionally, since the TWs were encountered in a text, knowledge sources, which readers used to process the TWs, were recorded. As a starting point, word inferencing and reading strategy categories from previous studies (e.g., Block, 1986; Carrell, 1989; Lee and Wolf, 1997; Rott, 2000; Young and Oxford, 1997) were used. Reading strategy research makes a distinction between text-based strategies which focus on reading as a decoding process (local strategies, such as breaking lexical items into parts, use of cognates, referring to gloss) and learner-based strategies which focus on reading as a meaning-getting process (global strategies, such as using background knowledge, anticipating content, recognizing text structure, integrating information, reading ahead). These categories seemed useful to determine whether and how learners dealt with the TWs.

b) Quantitative analysis: To assess the effect of frequency of interaction between the reader and each TW the number of strategies each reader used to process the TWs were tallied. This scoring procedure was based on the following position: more strategy use was related to processing multiple word aspects, thereby resulting in richer word encoding and strengthening of the FMC. Likewise, the processing of multiple word aspects potentially resulted in a higher involvement load. Unfortunately, the length of interaction with a TW could not be measured.

c) Attention to non-glossed TWs: To assess whether readers noticed the reoccurrence of the TW after the first glossed encounter, the transcripts were coded as follows: (a) for the attempt to provide an English equivalent, (b) for a comment about comprehension or miscomprehension of the TW, or (c) when learners noticed the importance of the TW for the passage by rereading it or making a comment about its reoccurrence.

*Word gain.* The individual categories (a-e) of the VKS were added up separately. A correct response received one point; an incorrect response received a score of 0. Scoring the WRT was done as follows: correct answers received a score of 1, incorrect answers received a score of 0.

*Text comprehension.* L2 readers' text comprehension was measured with an L1 recall task. The first goal was to determine whether participants had comprehended the basic event structure of the story. For that reason 20 native speakers of English were asked to retell the story in writing. The analysis of the retells resulted in a set of 14 chronologically ordered propositions ([Appendix C](#)). Interrater reliability in coding these propositions was 100%. The second goal was to determine how many supporting details readers comprehended. Therefore, the researcher established another set of eight propositions ([Appendix C](#)). A correctly recalled proposition was awarded one point, incorrectly recalled propositions 0. The scores for main ideas and supporting ideas were added up separately. Two raters scored the recall protocols gaining an interrater reliability of 96% for main ideas, and 97% for supporting ideas.

*Instrumentation.* To elicit L2 readers' processing behavior a concurrent, unobtrusive think-aloud procedure (Ericsson and Simon, 1993) was used. Participants were asked to verbalize everything that was going through their mind while making sense of the passage. Only when students paused in verbalizing their thoughts did the researcher intervene and request the participants to continue to say everything aloud. This happened only four times with two different participants. The entire session was tape-recorded. Even though introspection may interfere with learners' usual reading behavior, it is one of very few methods available for collecting data on mental processing strategies (Jourdenais, 2001). The current study followed the suggestion that a training session on how to "think aloud" may improve the reliability and validity of this method (Wesche and Paribakht, 2000).

### *Procedure*

Phase 1: During the third week of the semester volunteers signed the participation agreement and completed the vocabulary checklist test. To ensure that the chosen TWs were unfamiliar to all participants, a vocabulary pretest was administered. Students received a list of 20 lexical items including the four TWs and 16 distracters. Students were asked to explain what each word meant, even if they had only a vague idea, and to skip only the words that they did not know at all. None of the participants claimed any knowledge of the TWs.

Phase 2: One week later participants engaged in the treatment: first, learners received the treatment passage without glosses and were asked to read the text silently. This allowed participants to focus their uninterrupted attention on the content of the passage. Next, the researcher demonstrated what it means to think aloud by thinking aloud while performing a mathematical multiplication task. This was followed by a short practice passage for the participants. Then, learners received the treatment passage with the glosses and engaged in a think-aloud procedure. To ensure that students read the text for meaning, they were informed that they would have to retell the content of the text after the think-aloud. Students did not know that they would receive two vocabulary tests (VKS and WRT) immediately after the recall. Alternating the administration of multiple-choice and translation gloss texts randomized the treatment.

Phase 3: Four weeks after the treatment the same vocabulary tests were administered unannounced.

### **Analysis and results**

A detailed summary of MCG and STG readers' word processing strategies is presented in [Table 2](#). Each participant's strategies for all 16 TW encounters were tallied. The think-aloud protocols revealed that participants used only a small variety of strategies. Especially readers who encountered the first TW with a STG used strategies only minimally. The word processing strategies fell into two categories: meta-cognitive word processing behavior (MP) and semantic elaboration (SE).

Meta-cognitive processing included strategies that indicated noticing of the occurrence of the lexical form and monitoring of word comprehension. It did not involve any meaning making or word inferencing processes. Readers used three meta-cognitive processing strategies: the glosses, monitor, and verbalization. Referring to the *glosses* in the margin of the text was counted as a meta-cognitive strategy during the first glossed TW encounter only. This was done because the need for the TW was imposed externally through the



bolded TW as compared to an intrinsically perceived need to comprehend the TW during a non-glossed encounter (see semantic-elaborative processing strategies). Readers *monitored* their comprehension of the TW by mentioning that they were unsure of its meaning saying "I am not sure", for example. Few readers *verbalized* the TW in German by inserting it in a mostly English reconstruction of the text. They did not attempt to provide an English equivalent, such as "I come from the ... a ... **Kaff** from the other side of the mountain." Both, *monitoring* and *verbalizing*, strategies required at least the processing of orthographic aspects of the TWs.

Semantic elaboration strategies included accessing and retrieving existing knowledge sources in order to assign a meaning to the TW, such as the use of the context, a synonym, and background knowledge. Likewise, referring to the gloss during the non-glossed encounters (occurrence 2, 3, and 4) was counted as semantic-elaborative processing because it showed the readers' intrinsic need and subsequent search for the meaning of the TW. When searching for meaning in the *context* of the TW, readers identified and utilized words in the immediate environment, looked at a previous sentence for semantic clues, or used clues from the subsequent TW encounter. One reader, for example, inferred the correct meaning of the TW "**Kaff**" (village) during the third encounter verbalizing "he thought about moving into a different **shack**. OK, I think this is a **village**. Oh, so can I change the gloss up here?" A few times readers accessed their existing knowledge sources retrieving a *synonym* of the English gloss. For example, one reader used blanket during the third encounter of the TW "**Laken**" instead of **sheet**, which was the translation provided in the gloss. Some readers also accessed their *background knowledge* to make meaning of the TW and the textual proposition. The following reader used context clues and her background knowledge about taking care of a tree to disambiguate between the possible meanings provided through the MCG.

This is my **Eiche**. I guess that would be **river** or **wall** oh no water so that makes sense **river**. I ... I care for it myself. I give it water. Oh **tree**, its **tree**. Ok, so I sit under it. Ok, then gehört mir auch Schatten oh shade.  
[This **oak** is mine. I take care of it. I give it water. I sit under it. Therefore the shade is mine too, said the rich man.]

Yet, in some instances the use of background knowledge led readers to misinterpret the proposition and choose the incorrect gloss option. The following reader chose relatives for the TW "**Vieh**" (livestock) because it fit into the context of family in her discourse model. She explained:

Oh, before the poor man was alone but after some time he made friends and sogar deren **Vieh**. I don't know. Well, perhaps **relatives** because he became like family. They all come in the place of the poor man and rest.  
[In the beginning, the poor man rested alone, but later, he began to bring his friends and sometimes even their **livestock**.]

From the above samples it becomes clear that the *need*, *search*, and *evaluation* strategies of semantic-elaborative processing led to more elaborative word processing and therefore a higher involvement load (Laufer and Hulstijn, 2001) than meta-cognitive processing.

Additionally, [Table 2](#) presents the number of times readers *skipped* TWs and the number of times they simply verbalized the English

equivalent of the TW without any hesitation. That is, when they *transferred* the word meaning they had gained during a previous encounter to the current context.

Table 2: Strategy use of MCG Readers and STG Readers Across the Four TW Encounters

		<b>Treatment Condition</b>	
<b>TW Encounter</b>	<b>Strategy</b>	<b>MCG</b>	<b>STG</b>
<i>Occurrence 1</i>			
(glossed)	Gloss (MP)	18 (47%) (5 incorrect)	20 (100%)
	Monitor (MP)	4 (11%)	
	Context (SE)	13 (34%) (3 incorrect)	
	Background (SE)	3 (8%) (1 incorrect)	
<b>Total Strategies</b>		38	20
<b>Words skipped</b>		(1)	
<i>Occurrence 2</i>			
	Gloss (SE)	2 (10%)	2 (33%)
	Monitor (MP)	3 (15%)	
	Verbalize (MP)	1 (5%)	3 (50%)
	Synonym (SE)	2 (10%)	1 (17%)
	Context (SE)	10 (50%)	
	Background (SE)	2 (10%)	
<b>Total Strategies</b>		20	6
<b>Words skipped</b>		(3)	(1)
<b>Words transferred</b>		(4) (1 incorrect)	(14)
<i>Occurrence 3</i>			

	Gloss (SE)	3 (33%)	
	Monitor (MP)	2 (22%)	
	Verbalize (MP)		3 (60%)
	Synonym (SE)	1 (11%)	2 (40%)
	Context (SE)	2 (22%)	
	Background (SE)	1 (11%)	
Total Strategies		9	5
Words skipped		(3)	(5)
Words transferred		(13) (3 incorrect)	(11) (1 incorrect)
<i>Occurrence 4</i>			
	Gloss (SE)		
	Monitor (MP)		1 (20%)
	Verbalize (MP)		2 (40%)
	Synonym (SE)	2 (50%)	2 (40%)
	Context (SE)	2 (50%)	
	Background (SE)		
Total Strategies		4	5
Words skipped		(1)	(6)
Words transferred		(15)	(9)
Overall Strategies (four encounters)		71	36

Note: Total number of TWs = 20; MP = meta-cognitive processing; SE = semantic elaboration

**What are the qualitative word processing characteristics triggered through multiple-choice and the single-translation glosses?**

Research question one sought to record the characteristics (quality) of readers' processing mechanisms triggered by MCGs and STGs.

This allowed further insights into the process of establishing initial FMCs through such glosses. The data analysis revealed that MCG readers processed the TWs in a qualitatively different way than STG readers in that they integrated meta-cognitive (58%) and semantic-elaborative (42%) knowledge sources ([Table 3](#)) to establish a FMC. MCGs clearly triggered readers to rigorously *evaluate* the provided gloss choices by using background knowledge, context and hypothesis-testing strategies – a notion predicted for MCGs by Hulstijn (1992). Some readers chose a gloss option after testing several meanings in the context. For example, one reader tried out two meanings of the TW provided in the MCG, used the immediate context to disconfirm and then to confirm her initial hypothesis about the TW meaning:

There lived rich man in a **village**. I think that might be **shack**. Er baut a villa so not **shack**. Yeah **village**.  
[Once upon a time there lived a rich man in a small **village**. He built a mansion next to a large **oak**.]

In turn, STG readers established initial FMCs using meta-cognitive strategies only. They briefly glanced at the gloss and integrated the meaning in their reconstruction of the proposition (100%).

With regard to establishing a correct FMC, STG readers were at a clear advantage as they all used the provided glosses. MCG readers were less successful with establishing correct FMCs. In five instances readers chose the wrong gloss option, one reader skipped one of the TWs altogether, and in three instances readers misinterpreted the context and inferred an incorrect word meaning ([Table 2](#)). This main drawback of MCGs has been mentioned repeatedly (e.g., Hulstijn, 1992). In fact, MCGs did not always trigger readers' *evaluation* of the provided gloss options to determine the correct word meaning. Occasionally, readers immediately perceived one particular meaning of the gloss options as plausible in a particular context, an observation also made by Frantzn (2003) and Rott and Williams (2003). One reader was instantly satisfied with her discourse model though her choices were all incorrect:

There once lived a righteous man in a small **valley**, I guess. He possessed a villa next to a big **wall**. In the summer one day in the summer he sat in this shade. On a particularly hot summer day came a man a strong man along the street and sat in a shaded place. He laid there his **bag** he laid the **bag** on the floor and laid himself next to it.  
[Once upon a time there lived a rich man in a small **village**. He built a mansion next to a large **oak**. He spent each summer day sitting in its cool shade. One hot summer day, a poor man came along the road and saw the shady spot. He lay a **sheet** on the ground and laid down on it.]

Table 3: Total Number of Strategies used by MCG and STG Readers

TW occurrence	Multiple-Choice Gloss		Single-Translation Gloss	
	MP	SE	MP	SE
1 (glossed)	22 (58 %)	16 (42 %)	20 (100%)	0
2	4 (20%)	16 (80%)	3 (50%)	3 (50%)
3	2 (22%)	7 (78%)	3 (60%)	2 (40%)

4	0	4 (100%)	3 (60%)	2 (40%)
Total:	28 (39%)	43 (61%)	29 (81%)	7 (19%)

Note: MP = meta-cognitive processing; SE = semantic-elaboration

### What are the qualitative word processing characteristics during subsequent TW encounters?

Research question two assessed whether readers noticed the reoccurrence of the TWs (three more times) and attended to the meanings. In cases where readers were not able to retrieve the TW meaning, did they perceive the *need to search* for and *evaluate* meaning? In other words, did they rehearse the TW meaning after an initial FMC was established during the first encounter and thereby strengthen the FMC?

Overall, readers in both conditions, STG and MCG, demonstrated that they noticed the reoccurrence of a majority of the TWs by retrieving its English equivalent, by verbalizing the TW in German, or by mentioning a lack of comprehension (Table 2). Thereby, readers minimally processed orthographic word aspects. Nevertheless, in some instances readers skipped a TW without verbalizing it or its meaning. While there seemed to be a decreasing trend of skipping for the MCG group across the three non-glossed encounters (3, 3, 1 respectively), the data indicated an increasing trend for the STG group (1, 5, 6 respectively). Likewise, the two conditions showed opposite tendencies regarding readers' access from memory and use (verbalization in English) of FMCs. This time, STG readers' retrieval and transfer of TW meanings decreased (14, 11, 9 respectively), while MCG readers' access and transfer increased (4, 13, 15 respectively) across the three encounters. That is, unlike the STG group, MCG readers seemed to perceive the *need to* assign a concrete meaning to the non-glossed TWs. Thereby, MCG readers allocated attentional resources to the TW and rehearsed its meaning. Accordingly, MCG readers displayed intratextual awareness of the reoccurrence of the TW by referring to the previous proposition containing the TW. One reader said aloud "Oh, what was that [up here]? Oh, these are **livestock**."

Moreover, readers in the MCG condition actively searched for TW meaning and *reevaluated* initial FMCs during consecutive encounters. Some instances indicate that readers had kept the multiple-choice options of the gloss in working memory as they processed subsequent encounters. One reader demonstrated intratextual awareness of the reoccurrence of the TW verbalizing "**Laken ... sheet, pillow, bag**. I would say **sheet** again." Participants changed incorrect FMCs or filled in partial FMCs with additional semantic information. Particularly during the second and third encounter, they established or changed their initially wrong meaning assignments for nine out of 20 TWs (Table 4). One reader's discourse model further demonstrates the process of word learning for the TW "Vieh" (livestock). She had assigned the meaning "relatives" at the previous encounter. Multiple context clues pertaining to animals, though, made her change her understanding of the word:

Bringt kein **Vieh** in meine Villa. Don't bring **relatives** into villa, since there was Schwein this might be **livestock** so now he is saying don't bring **livestock** into my house, oh maybe not. Es macht alles schmutzig und frisst meine Möbel.  
Oh yes, it makes everything dirty.  
[The rich man became angry. "Don't bring your **livestock** into my villa! It makes everything dirty and eats the furniture."]

During the fourth encounter MCG readers accessed 15 out of 20 TWs correctly ([Table 2](#)).

The think-aloud protocols of readers in the STG condition indicated the opposite word processing trend across the three additional encounters. Even though their use of semantic-elaborative strategies increased from 0 to 11% they continued using mainly meta-cognitive strategies. Their decreasing trend in access and transfer of TW meanings resulted in verbalizing only 9 out of 20 TWs during the fourth encounter ([Table 2](#)).

Table 4: Changes in TW Meaning Assignments Through Repeated Encounters

Subject	Target Words			
	Eiche	Kaff	Laken	Vieh
MCG1		Valley->village 3 <sup>rd</sup> TW		
MCG2	∅->tree 2 <sup>nd</sup> TW			∅ -> livestock 2 <sup>nd</sup> TW
MCG3			bag ->sheets 4 <sup>th</sup> TW	
MCG4	Tree->wall 2 <sup>nd</sup> TW	shack->village 3 <sup>rd</sup> TW		relatives -> livestock 2 <sup>nd</sup> TW
MCG5	Wall->tree 2 <sup>nd</sup> TW		∅ ->blanket 2 <sup>nd</sup> TW	

Note: ∅ = no meaning assigned during the first TW occurrence; 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> refers to the TW occurrence in the text; maximum occurrences = 4

### How many times do L2 readers interact with the TWs?

Research question three concerned the *quantity* of interaction with individual TWs in each gloss condition. More specifically the question assessed the number of times readers dealt with a TW and in so doing assessed the amount of time a TW remained in working memory (WM). It was assumed that the longer or more often a TW is active in WM the higher the chances for the word to become intake and be stored in the mental lexicon. To answer this question the number of strategies used by the STG or the MCG group were tallied. The baseline for this analysis was 80 instances for each group (4 TWs x 4 occurrences x 5 participants). A higher score indicated that participants used more than one strategy as they processed individual TWs, a below baseline score indicated that readers did not verbalize any interaction with some of the TWs. The protocols revealed that individual TWs were quantitatively more

often processed in the MCG than in the STG condition. Unlike STG readers, who dealt with the TWs 68 times, MCG readers dealt with them 103 times (number of strategies used plus the number of transfers) as shown in [Table 2](#). In particular, the quantity of interaction with the TWs differed during the first glossed encounter. The MCG group used almost twice as many strategies as the STG group, i.e., they used an average of two strategies to establish a FMC (38 versus 20, [Table 2](#)).

### **What is the effect of the gloss condition (multiple-choice or single-translation) on the robustness of entries in the mental lexicon?**

[Table 5](#) presents the individual MCG and STG readers' word acquisition and retention scores that were collected immediately after the reading treatment and four weeks later. Three levels of word gain are reported from the VKS: Category (b) responses indicated that readers recognized the word form but not its meaning; and Categories (c) and (d) indicated that the reader had gained receptive knowledge and could provide an English equivalent. Responses on these two categories were combined because most of the participants' answers were alike on both items. They did not make a distinction between their levels of certainty of word knowledge ("I think" versus "I know"). Responses on category (e) indicated that participants had gained additional syntactic knowledge about the TW by using it in a sentence in German. None of the participants checked category (a) indicating that they had not seen the word before. The second measure (WRT) further assessed receptive word gain providing retrieval cues in the form of multiple choices. In that way it demanded more word knowledge than category (b) on the VKS but less than category (c/d).

Regarding establishing initial FMCs, findings demonstrate that readers in both conditions performed very much alike on the immediate posttest ([Table 5](#)). For the majority of the TWs, readers had gained receptive word knowledge by producing a translation of the TW in English (VKS level c/d; 60% in the MCG and 55% in the STG condition) and demonstrated syntactic knowledge by using the word in a sentence (VKS level e; 55% in the MCG and 45% in the STG condition). With the additional provision of multiple meaning options readers reached a ceiling effect of 90% (MCG) and 95% (STG) of correct answers (WRT).

Retention scores, however, suggest a different effect of the two gloss conditions on developing robust entries in the mental lexicon. Those readers who had processed the TWs in the MCG condition retained more and more complete FMCs than those in the STG condition. A "more complete" FMC was operationalized as a higher score in categories (c/d) and (e) on the VKS. The VKS scores indicate that the FMCs established while processing STGs were less robust than those of the MCG group. STG participants' level of word knowledge decreased over four weeks: their ability to provide an English translation of the TW decreased notably (category c/d; from 55% to 20%) and they retained minimal syntactic knowledge (category e; a decrease from 45% to 10%). For most of the TWs STG readers were only able to indicate that they had seen that word before. Therefore, category (b) scores increased over four weeks. The decrease in word knowledge was less drastic in the MCG condition. The knowledge of syntactic word aspects dropped from 55 to 45%. Receptive abilities to produce a L1 translation of the TW dropped from 60% to 55%.

A similar trend of word knowledge retention was noticeable on the WRT measure, where multiple meaning options were available. While MCG readers' WRT scores were robust over four weeks (90%), STG readers' FMCs were weaker and dropped notably from 95% to 70%.

Table 5: Vocabulary Acquisition and Retention Scores for MCG and STG Readers

Group	Acquisition				Retention			
	VKS		WRT		VKS		WRT	
	b	c/d	e		b	c/d	e	
MCG								
Mean	1.6	2.4	2.2	3.6	1.8	2	1.8	3.6
SD	(0.55)	(0.55)	(0.89)	(0.55)	(1.6)	(1.6)	(1.3)	(0.89)
Percent	40%	60%	55%	90%	45%	55%	45%	90%
STG								
Mean	1.8	2.2	1.8	3.8	3.2	0.8	0.4	2.8
SD	(0.84)	(0.84)	(1.1)	(0.45)	(0.84)	(0.84)	(0.56)	(0.84)
Percent	45%	55%	45%	95%	80%	20%	10%	70%

Note: VKS = Vocabulary Knowledge Scale; number of TWs = 4; VKS category (b) I have seen this word but I do not know what it means; (c) I *think* it means (English translation); (d) I *know* it means (English translation); (e) I can use this word in a sentence in German; Categories b and c/d are mutually exclusive and add up to 100%, while category e presents additional knowledge; WRT = Word Recognition Test, maximum score = 4

### What is the effect of the gloss condition (multiple-choice or single translation) on text comprehension?

Research question five assessed the effect of the two word-focused interventions (STG and MCG) on text comprehension to determine whether either one of the glosses fostered or interfered with the comprehension process. [Table 6](#) reports STG and MCG readers' comprehension scores of main ideas as well as supporting ideas. Overall, text comprehension was low for both groups. Participants in both conditions comprehended the main ideas of the input passage at around the same level (63% versus 57%). Regarding comprehension of supporting ideas, MCG readers clearly outperformed STG readers (70% versus 33% respectively).

Table 6: L1 Retell Scores for MCG and STG Readers

Group	L1 Retell	
	Main Ideas	Supporting Ideas
MCG		
Mean	8.8	5.6
SD	(3.3)	(0.7)
Percent	63%	70%
STG		
Mean	8	2.6
	(4.5)	(1.7)



SD Percent	57%	33%
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Note: Maximum score of main ideas = 14; maximum score of supporting ideas = 8

This differential effect of gloss type on readers' text processing behavior can be explained by analyzing case-study data. The following excerpts from the readers' text reconstructions further illustrate the relationship between the processing of the text and the type of gloss enhancement. Although each STG reader's approach to reconstructing the passage showed individual differences, one thing that emerged from the data is that readers applied minimal processing resources to comprehend the text and the TWs. These readers engaged in largely linear reading behavior and were satisfied with comprehending chunks of the text, in particular, the immediate context of the TWs. Participants frequently omitted details, such as the exact meaning of other verbs in the propositions containing the TWs (e.g., lived, built, sat), and information that did not pertain to the gloss, (e.g., sitting in the sun every day and seeing a shady place). The following STG reader was satisfied with understanding chunks:

In a small **village**. The **village** is by a large **tree**. In the summer one day em Schatten ok when summertime came a man in the street er legt dort sein **sheet** and lays it on the floor.

[Once upon a time there lived a rich man in a small **village**. He built a mansion next to a large **oak**. He spent each summer day sitting in its cool shade. One hot summer day, a poor man came along the road and saw the shady spot. He lay a **sheet** on the ground and laid down on it.]

A salient characteristic of MCG readers' discourse models was that they consistently monitored their text comprehension by verbalizing "maybe" and "don't know". Monitoring and the uncertainty of correct gloss choice led these readers to interact more with the text than the STG group. MCG readers did not reconstruct the text in a linear word for word, sentence for sentence fashion. Instead, their discourse models show that they revisited propositions and changed their initial understanding of a proposition. One MCG reader focused first on the local context of the TW, vocalized that she expected to gain additional information by reading further, and then reconstructed the passage:

I am not sure about **Kaff** and **Eiche** yet. So, I will read a little further and see whether I can figure out what they mean. ok **Laken** perhaps **sheet**? A rich man ... oh once upon a time a rich man lived in a small **village**, maybe. Er baute eine Villa neben eine grosse **Eiche**. Maybe he lived in a small maybe **village** so maybe that was **Kaff** or **valley** next to a large river, maybe. In summer every day I am not sure about Schatten. Every day in summer he does something. And on one particularly hot summer day he comes up to a poor man in the street along ... I am not sure about that part. He is laying by the ground ein **Laken** maybe **sheet**.

## Discussion and conclusion

The current study focused on the observable word learning characteristics of ten L2 readers who encountered unfamiliar words in a text that was either enhanced with STGs or MCGs. The think-aloud data recorded the quality as well as the quantity of learning mechanisms induced through the two lexical input enhancements as participants established an initial FMC. In particular, the study

sought to identify the type of knowledge sources participants drew on to assign meaning to the same word during repeated encounters. That is, the aim of the qualitative data analysis was to develop further insights into the nature of processing mechanisms that fostered the strengthening of lexical FMCs and the assimilation into the mental lexicon. The starting point for the qualitative analysis was the motivational and cognitive factors, need, search, and evaluation, which Laufer and Hulstijn (2001) have described as indicators for long-term word learning. The quantitative analysis further explored the L2 readers' frequency of interaction with a word during individual encounters. Furthermore, the data analysis shed light on the intricate relationship between the processes and products of reading a text for meaning and word acquisition.

One main goal of the current investigation was to assess the effect of the two gloss interventions on word acquisition and retention and to link the results to the participants' word processing behavior. Both types of glosses triggered essential learning mechanisms. Readers' *need* for word meaning was triggered externally through the bolded TW in the text. As a result readers noticed (Schmidt, 2001) the orthographic representation of the word and selectively attended (Gass and Selinker, 2001) to its semantic meaning provided in the form of a gloss in the margin. Consequently, in both conditions participants established initial FMCs as measured immediately after the reading treatment – a finding also reported in Watanabe (1997) and Hulstijn (1992). However, unlike in Watanabe's study, results from the delayed posttest corroborated predictions based on the involvement load hypothesis (Laufer and Hulstijn, 2001). Readers who read the text enhanced with MCGs retained (four weeks after the treatment) notably more word knowledge than readers in the STG condition. That is, FMCs triggered through MCGs not only resulted in more robust entries in the mental lexicon but also in the encoding of more word aspects (the ability to use the word in a sentence, translate it into English, and recognize its meaning). In contrast, after processing a word in the STG condition, readers' ability to use the word in a sentence, supply the English equivalent, or recognize the meaning from multiple options decreased considerably over four weeks. This suggests that even though both gloss interventions triggered noticing and attention to meaning, MCGs triggered additional learning mechanisms that fostered word retention. The think-aloud data provided considerable evidence for distinct processing patterns in the two gloss conditions not only while readers processed the TWs during the glossed encounter but also during subsequent unenhanced encounters. These findings corroborate Laufer and Hulstijn's (2001) claim that different intervention tasks induce a different involvement with a new word.

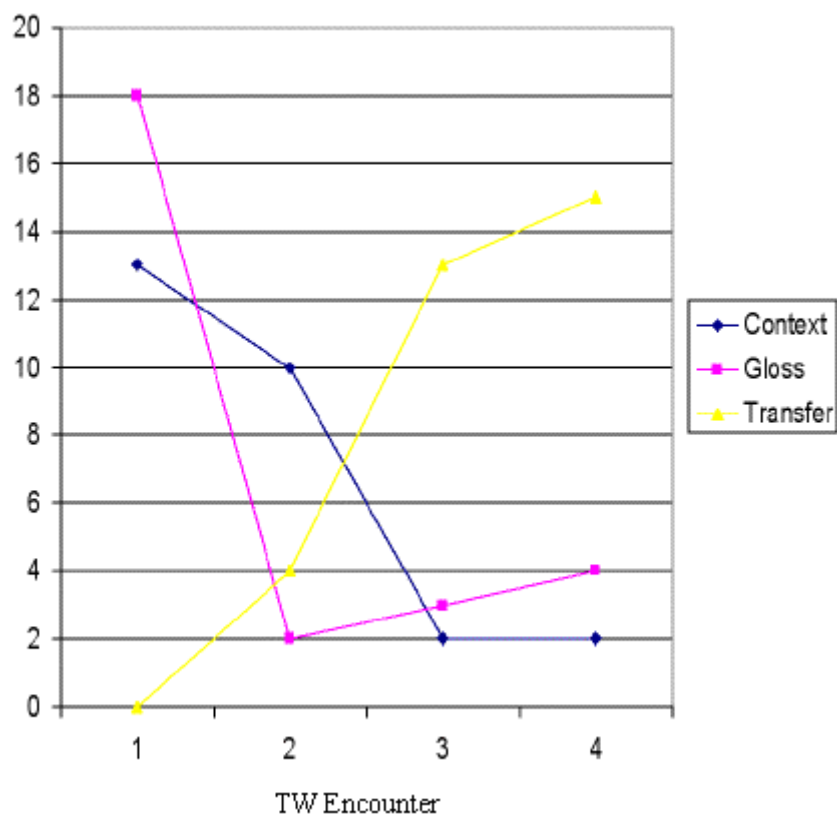
The current data analysis exemplified how MCGs stimulated elaborative processing behavior, and expands our understanding of the *evaluation* function of the involvement load hypothesis. MCG readers engaged in inferencing and hypothesis-testing strategies referring to the gloss, using familiar words in the context of the TW and their background knowledge. This process of evaluating different meaning options strongly suggests that readers rigorously processed multiple word aspects, shifting attentional resources between the TW (orthographic and syntactic properties), the gloss (semantic meaning) and textual clues (comparing the semantic clues of other words and the TW). That means that words were processed elaboratively (Hulstijn, 2001). It seems likely that this process led readers to access and retrieve existing meanings from their German lexicon and related the new word to familiar words. Such a creation of associative links between existing knowledge sources and the form to be learned is generally considered conducive to the consolidation of a new lexical form in memory (e.g., Baddeley, 1997; Ellis, 2001; Wittrock, 1974). It can be said that this process constituted greater mental effort (Hulstijn, 1992) and a higher involvement load (Laufer and Hulstijn, (2001) than processing STGs. In addition, similarly as in Rott (2000), word retention may be linked to the integration of a variety of knowledge sources to establish associative links. The data-analysis revealed that MCG readers, who established more robust FMCs that were

retained over four weeks, integrated meta-cognitive and semantic-elaborative processing strategies as they established a connection between the lexical form and its meaning. In contrast, readers in the STG condition, who established weaker connections that decreased over time, mainly used meta-cognitive strategies to process the glossed word.

The two gloss interventions seemed to induce different word processing behavior. Nevertheless, in order to better understand the differences in word retention the effect of frequency of word occurrences needs to be taken into consideration. In fact, the current findings suggest that the quality and quantity of word processing stimulated by a word intervention task may influence subsequent word processing. Thereby, these interventions may be a predictor for word retention. Three additional occurrences of each TW in the text allowed to further develop insights into how lexical FMCs were strengthened. Repeatedly allocating attentional resources to the TWs provided opportunities for strengthening the initial FMC and filling in additional semantic and syntactic word aspects. The data contained ample evidence that, unlike the STG readers, MCG readers continued to actively *evaluate* the initial meaning assignment and furthermore *search* for additional meaning clues. That way they rehearsed the TWs elaboratively. It seems this group of readers strongly benefited from the repeated hypothesis-testing effort in that FMCs developed from a weak, tentative meaning assignment to a more stable connection within four encounters. A similar search and evaluation process was reported by Rott and Williams (2003). Additionally, the *evaluation* of multiple meaning options seemed to stimulate the use of memory capabilities by keeping multiple word meanings in working memory. Several readers in the MCG condition recalled all three meaning options during non-glossed encounters. This rehearsal of word meaning plus an explicit decision on the most logical correct meaning may constitute processing strategies that further contributed to more robust FMCs.

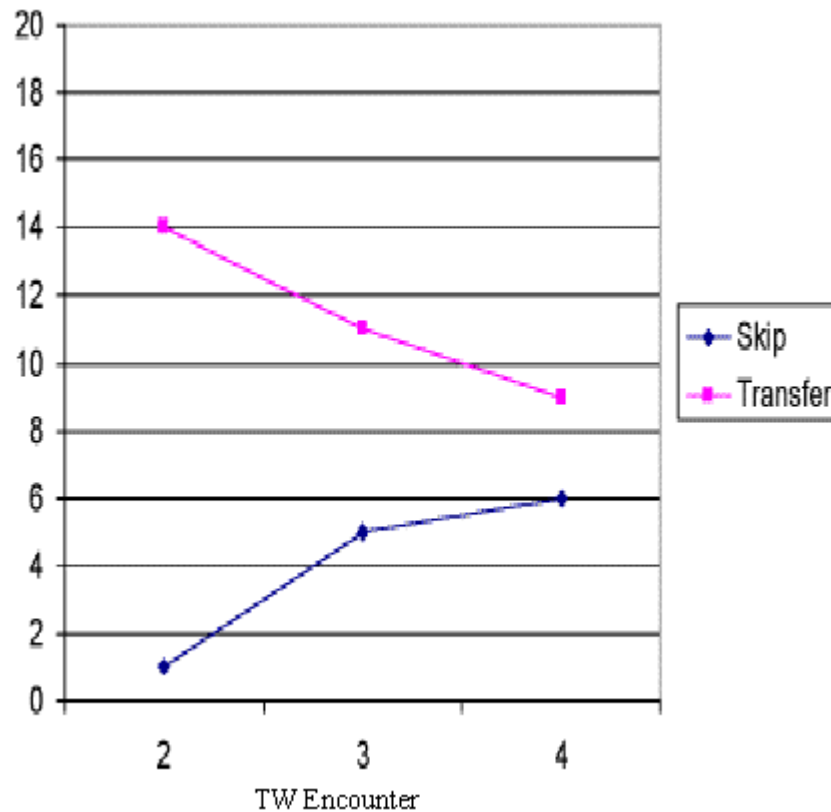
Using context clues as a primary strategy to *evaluate* the FMC during subsequent encounters, MCG readers were to a large extent able to establish a correct FMC for the majority of the TWs. Interestingly, as in Frantzn (2003), context clues were not equally helpful for each reader. Some readers were able to assign the correct meaning during the second, others during the third or even fourth encounter. Excerpts from the think-alouds revealed that repeated encounters were essential to readers' understanding of the meaning of the TWs. The accumulation of additional textual clues allowed readers to disambiguate between the different MCG options, refine their word knowledge, or change the initial wrong meaning assignment. Nevertheless, in some instances some readers could not make use of the context clues for some TWs at all. They transferred and strengthened an incorrect word meaning especially when it appeared plausible in their discourse model. When readers were satisfied with their meaning assignment, they started transferring the gained meaning to the next encounter(s). At the same time, strategy use decreased because there was no further need to evaluate the meaning assignment. The inverse relationship between strategy use and transfer of word meanings indicates how filling in semantic information and strengthening FMCs happened across the four TW encounters ([Figure 1](#)).

Figure 1: Context, Gloss, and Transfer Strategy Use by MCG Readers



In contrast, readers in the STG condition did not experience this same search and evaluation process. It seems that STGs did not stimulate an active engagement with the TWs during non-glossed encounters. [Figure 2](#) shows that the skipping of TWs increased as the transfer of the initial FMC decreased. This observation strongly suggests that the memory trace of the initial FMC did not strengthen across the three additional occurrences. Yet, it cannot be concluded from the transcripts that these readers did not notice the TW or that they were not able to retrieve the meaning in these instances. Nonetheless, an increase in verbalizing the TWs in German without attempting to infer the meaning indicates a lack of perceived *need* to assign the TWs a concrete meaning. As a result, these readers missed the opportunity to fill in additional semantic and syntactic word aspects and consolidate these aspects in the mental lexicon.

Figure 2: Skip and Transfer Strategies by STG Readers Across TW Encounters 2, 3, and 4.



This study also sought to gain further insights into the effect of frequency. SLA research, to date, has only assessed the effect of the frequency of word occurrence in a text. None of the previous lexical intervention studies have looked at the frequency of processing and interaction with an unfamiliar word in *one* context. Logically, if L2 readers interact with one word repeatedly in the same context, they potentially process the same range of word aspects as during word encounters in different contexts. Processing multiple word aspects in the same context has the advantage that learning may happen with fewer encounters. On the other hand, the possible disadvantage is that readers may not be able to make use of clues in one specific context. The present data revealed that readers who processed the TWs more often through *search* and *evaluation* strategies, developed more robust word encodings. Another processing feature that clearly distinguished readers in the two gloss conditions was the total number of strategies applied when dealing with the TWs. MCGs triggered the use of noticeably more strategies than the STGs. This finding further corroborates findings from Lawson and Hogben (1996). They found a strong tendency for students using more word learning strategies to recall more words than those students employing fewer strategies. Accordingly, findings suggest that the type of word intervention had a strong impact on how many times participants processed and interacted with the TWs.

Finally, the current investigation expanded our understanding of the effect of word interventions on text comprehension. This

relationship has been neglected in lexical studies. A particular concern in this line of research is whether text comprehension and word learning involve complementary or conflicting cognitive mechanisms. Numerous researchers have proposed that the working memory capacity of L2 learners is limited (e.g., Barcroft, 2001; Ellis, 2001; VanPatten, 1996). Therefore, constraints may exist in the maximum amount of activation a L2 reader has available for comprehending a text and encoding new words. To the contrary, the current investigation found that participants who comprehended more details of the text also retained more words; i.e., hypothesis-testing triggered through MCGs contributed positively to both, text comprehension and word learning. In turn, STGs fostered less word gain and less comprehension of propositional details. Moreover, overall protocols of both gloss conditions showed that readers focused on reconstructing propositions containing a gloss or an initially glossed TW. That is, glossed propositions received more attention and may therefore be useful in directing readers' attention to key ideas of a text.

### *Summary of findings*

Even though the data analysis revealed strong patterns of processing behavior, the following list of findings is merely tentative because results are based on only 10 participants.

1. A word intervention task may induce specific word processing strategies and may effect how consecutive encounters with the same word are processed.
2. Readers' perceived need to assign a concrete meaning to a new word, their search for meaning by using context and background information and the evaluation of semantic fit in the textual proposition seem to be linked to retaining more words and more word aspects. These processes may be induced by a specific lexical intervention task.
3. Search and evaluation processes seem to trigger elaborative rehearsal of multiple information sources (word, text, and learner) that may be linked to more robust word encoding in the mental lexicon.
4. Search and evaluation processes seem to also trigger the use of multiple word processing strategies during one encounter with an unfamiliar word, which, in turn, may again be linked to more robust word encoding in the mental lexicon.
5. Lexical intervention tasks may direct readers' processing of main and supporting ideas and thereby affect text comprehension. Better text comprehension may be linked to recursive reading behavior as compared to linear text processing.

### **Limitations and future research**

The current study has also a number of limitations. First of all, regarding word processing behavior, it lacks generalizable power and only provides trends because of the small pool of participants. Second, participants read only one text and word acquisition of only four nouns was assessed. Therefore, findings cannot be extrapolated to other text types and other word classes. Third, more refined word knowledge measures need to be developed in order to gain a better understanding of partial and cumulative word gain through

reading. In addition, future research needs to assess the effect of *search* and *evaluation* mechanisms on productive word knowledge gain. Likewise, more refined tests may provide further insights into the acquisition of lexical form versus the acquisition of meaning. Fourth, the study did not isolate the potential effect of exposure frequency from the effect of gloss type. Future research needs to isolate these variables and extend the subject pool to gain further insights into the effect of mental effort for word learning and retention. In particular, future research needs to compare the use of processing strategies of readers of different proficiency levels. Qian (2005), for example, found that advanced L2 readers behaved differently in their lexical inferencing task from less advanced learners. Fifth, future research needs to engage in a word item analysis to further understand the intricate relationship between the reader, the text and individual unfamiliar words. Finally, the study did not account for time on task. Participants in the multiple-choice condition spent overall more time on reading the text than participants in the STG condition. The question that arises is whether the time spend on using multiple strategies to assign a correct meaning to unknown words would be better spend by reading a unenhanced text and subsequently completing specific exercises to rehearse targeted words (Mondria, 2003).

### Acknowledgements

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### Notes

1. Prince's (1996) claim refers to a learning stage in which a specific meaning is assigned to a particular word form as opposed to processing a word for text comprehension only. This is how he explains superior word learning of the group who learned words in isolation as compared to L2 learners who encountered the words in context. This finding though does not diminish the importance of processing words in context for developing a functional L2 lexicon.
2. Nevertheless, there is a possibility that L2 readers choose the wrong meaning, which is a major criticism of this task for word learning.
3. Elaborative rehearsal involves the formation of connections between new and already known information. This claim is based on Baddeley's (1997) research (Hulstijn, 2001: 278).
4. Only a few studies that investigated lexical interventions during reading have accounted for the frequency of TW occurrence. In general, processing a new word repeatedly in one or multiple texts has been found to be conducive to incidental word learning (for a review, see Horst, Cobb and Meara, 1998; Paribakht and Wesche, 1999; Rott, 1999; Waring and Takaki, 2003; Zahar, Cobb and Spada, 2001). Studies found a relationship between frequency of exposure and acquisition, in particular for beginning learners (Zahar et al., 2001), with sizable learning gains for words that appeared at least eight (Horst et al., 1998) or more times in a text. Four TW occurrences were chosen for this study because four naturally fit the text.
5. The TW *Kaff* has a negative connotation (very small village whose inhabitants are small-minded). This was neither clear from the passage nor were participants expected to gain this aspect of the meaning.

6. To adapt the VKS for the current student population category 'e' asked participants to write a sentence in their L2, which was German. The original version by Wesche and Paribakht (1996) asked participants to write a sentence in English.

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## Appendix A

TWs were bolded only during the first glossed occurrence.

Einst lebte ein reicher Mann, Hans, in einem kleinen **Kaff**. Er baute eine Villa neben eine große **Eiche**. Im Sommer saß er jeden Tag in ihrem Schatten. An einem besonders heißen Sommertag, kam ein armer Mann, Klaus, die Straße entlang und sah den schattigen Platz. Er legte sich in den Schatten und war fast eingeschlafen, als der reiche Hans rief: "Hey, hau ab! Du kannst hier nicht schlafen. Geh weiter!"

"Warum kann ich hier nicht schlafen? Ich bin sehr müde und will mich nur im Schatten ausruhen. Ich komme aus dem **Kaff** auf der anderen Seite des Berges und es ist zu weit, um zurückzulaufen", antwortete der arme Klaus.

"Dies ist meine **Eiche**. Ich *kümmere mich* um sie. Ich gebe ihr Wasser. Ich sitze unter ihr. Deshalb *gehört* mir auch ihr Schatten", antwortete der reiche Hans.

"Also gut. Warum verkaufst du mir nicht den Schatten und behälst die **Eiche**", sagte der arme Klaus. "Ich habe Geld bei mir."

Als der reiche Hans das Wort "Geld" hörte, wurde er neugierig. Die beiden Männer sprachen über den Preis und **einigten sich**. Am Ende waren beide glücklich. Der arme Klaus wollte den ganzen Sommer im **Kaff** bleiben.

Jeden Tag kam der arme Klaus und ruhte sich in dem Schatten, der ihm gehörte, aus. Manchmal fiel der Schatten in den Garten des reichen Hans, und so ruhte sich der arme Klaus dort aus. Manchmal fiel der Schatten in die **Stube** des reichen Hans, und so ruhte sich der arme Klaus dort aus.

Anfänglich war der arme Klaus alleine, aber nach einiger *Zeit* *brachte* er Freunde und sogar deren **Vieh** mit. Oft kamen sie in die **Stube** des reichen Hans, um sich im Schatten des armen Klaus auszuruhen. Die Freunde legten sich auf das Sofa und schliefen. Die Hühner saßen unter dem Tisch, die Kühe standen in einer Ecke und die Schweine saßen vor dem Sofa. Der reiche Hans wurde sehr *wütend*: "Du darfst deine Freunde nicht in meine **Stube** mitbringen. Und bringt auch kein **Vieh** in meine Villa. Es macht alles schmutzig und frißt meine Möbel. Dies ist meine Villa, und ihr habt kein Recht hier zu sein!"

Der arme Klaus hörte höflich zu. Aber er erinnerte den reichen Hans daran, daß der Schatten ihm gehöre. "Ich folge meinem Schatten wo auch immer er hinfällt, sogar in deine Villa", sagte der arme Klaus.

Was sollte der reiche Hans machen? Er hatte den Schatten verkauft ohne an die Konsequenzen zu denken.

Bald darauf, als der reiche Hans mit guten Freunden zu Mittag aß, kam der arme Klaus mit zwei Freunden und deren **Vieh** in die Villa. Sie legten sich hin und schliefen. Die Freunde des reichen Hans waren überrascht **Vieh** in der **Stube** zu sehen. Der reiche Hans erklärte seinen Freunden, daß der arme Klaus den Schatten gekauft hatte. Die Freunde lachten über den reichen Hans und sagten, daß er dumm sei. Der reiche Hans *schämte sich* sehr vor seinen Freunden und dachte daran in ein anderes **Kaff** zu ziehen.

Nachdem der reiche Hans weggezogen war, zog der arme Klaus in die Villa. Er lebte dort viele Jahre. Alle Leute durften sich im Schatten unter der **Eiche** ausruhen.

## Appendix B

Main propositions in the input passage

1. Rich man owns a tree.
2. Poor man tries to rest in shade of tree.
3. Rich man shoos poor man away.
4. Situation is resolved with sale of shade.
5. The poor man follows shade into the house.
6. The poor man brings friends into house.
7. The poor man brings animals into the house.
8. The rich man becomes angry.
9. The rich man has guests.
10. The poor man's entourage interrupts dinner.
11. Friends ridicule the rich man.
12. The rich man is ashamed.
13. The rich man moves away.
14. The poor man moves in.

Supporting ideas

1. Rich man lives in a village next to a tree.
2. Poor man wants to sit in the shade of the tree.
3. The rich man and the poor man discuss the situation.
4. The rich man explains why the shade belongs to him.
5. The poor man explains that he has money.
6. The poor man insists on his right to rest in the shade of the tree.
7. The rich man does not know what to do.
8. Everybody is allowed to rest in the shade.

## Appendix C

Word Recognition Test (WRT)

Please choose the correct meaning of the following words in boldface:

**1) Kaff**

- a. village
- b. shack
- c. valley
- d. don't know

**2) Eiche**

- a. river
- b. wall
- c. kind of tree
- d. don't know

**3) Laken**

- a. pillow
- b. bag
- c. sheet
- d. don't know

**4) Vieh**

- a. relatives
- b. livestock
- c. lice
- d. don't know

**About the Author**

Susanne Rott teaches courses in applied linguistics and teacher education at the University of Illinois at Chicago. She has published studies on lexical development through reading and German grammar acquisition.

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