BILINGUAL KNOWLEDGE (BIK-) MAPS: STUDY STRATEGY EFFECTS

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Abstract. The use of bilingual graphic organizers [bilingual knowledge maps (BiK-maps)] as a study strategy was investigated for the acquisition of foreign language vocabulary. Participants were assigned to one of two conditions for the task of studying 32 German-English word-pairs. Participants either used BiK-mapping as a study strategy or took notes in their own preferred style. BiK-map strategists recalled more English words during free recall. Implications for foreign language vocabulary study and future research are discussed.

1 Introduction

The prospect of memorizing lists of foreign language vocabulary (FLV), rarely elicits yelps of pleasure from students. To facilitate the daunting task of learning FLV, researchers, educators, students and entrepreneurs have invented, developed and applied methods that go beyond traditional rote-learning. The present research focuses on one of these methods called bilingual knowledge mapping or BiK-mapping. The introduction of this paper contains a presentation of the following: Connection issues in foreign language (FL) acquisition, the potential of BiK-maps to improve FL acquisition and prior BiK-research.

2 Foreign Language Acquisition: Connection Issues

The goal of rote learning in FLV study is the acquisition of translation knowledge. The type of association between the native and the FL words, necessary to accomplish this objective, is called lexical. FLV learning strategies that go beyond rote memorization are expected to facilitate acquisition, and, to enhance memory by making a variety of contexts available to the learner. Likewise, models of second language acquisition suggest several connections in addition to lexical associations that may be acquired in the process of learning FLV. For instance, Potter, So, Von Eckhardt, and Feldman (1984) propose in their concept-mediation hypothesis that FL words directly access a conceptual, non-linguistic system (1984). Here, a connection a formed directly from the FL word to its meaning. The existence of such semantic or conceptual associations is supported by current research (Altarriba & Mathis, 1997; Fox, 1996). Another possible type of connection forged by novice FL learners emerges from Paivio's dual code hypothesis (1971, 1978) which has been extended to bilingual memory (Paivio & Desrochers,1980; Paivio & Lambert, 1981). Dual coding suggests that learners do not only remember words and their meaning, but also the form, in which the vocabulary was presented. According to Paivio, novice FL learners are able to store visual images in conjunction with FL vocabulary.

If concept and imagic links can be formed during the acquisition of new FL words, one might argue that study materials that incorporate context, such as semantic and conceptual information and images, should lead to benefits by providing additional encoding and retrieval cues. While the addition of image and visuo-spatial cues to FLV appears to be a relatively simple task, the question arises as to how semantic context in the new language can be made more accessible to the novice learner. Initially, the novice learner has only a highly limited FLV and restricted, if any, knowledge of grammar. Without this knowledge, the learner lacks the capability to express and comprehend semantic relationships among new vocabulary items in the FL. The nature of BiK-maps, elucidated in the next section, suggests that they may be uniquely suited to provide context by (a) ameliorating the lack of basic FLV and FL grammar, and, (b) the addition of imagic and visuo-spatial information.

3 The Potential of BiK-maps to improve FL Acquisition

It appears reasonable to consider the degree of connectivity that novice learners are capable of when designing instructional materials and developing learning strategies. BiK-maps are multidimensional, visual representations of knowledge. (See Figure 1 for exemplar.) They resemble flow-charts and consist of *nodes* that encapsulate text or word-pairs, and, *links* (arrows) that connect the nodes. Each link is labeled based on a set of nine link-types, where each type represents a semantic relationship. For example, "P" stands for "part of". (See Figure 1.) Using the simple node-link syntax, text may be transformed into maps, by placing unitary ideas into

nodes, and, by connecting them through labeled links. Thus, BiK-maps can provide semantic context without requiring the knowledge of either FLV or grammar. The student with limited knowledge of FLV and grammar can access, or, create their own, semantic context. Moreover, the emergent visuo-spatial properties of maps, apparent in their graphic layouts, may allow for the perceptual organization of knowledge domains. Consequently, BiK-maps could provide encoding and retrieval cues resulting from the spatial organization of their content. The images of the clusters of related ideas, the arrangement of parallel lines of thought, feedback loops, and hierarchies may provide cues for memory storage and search.
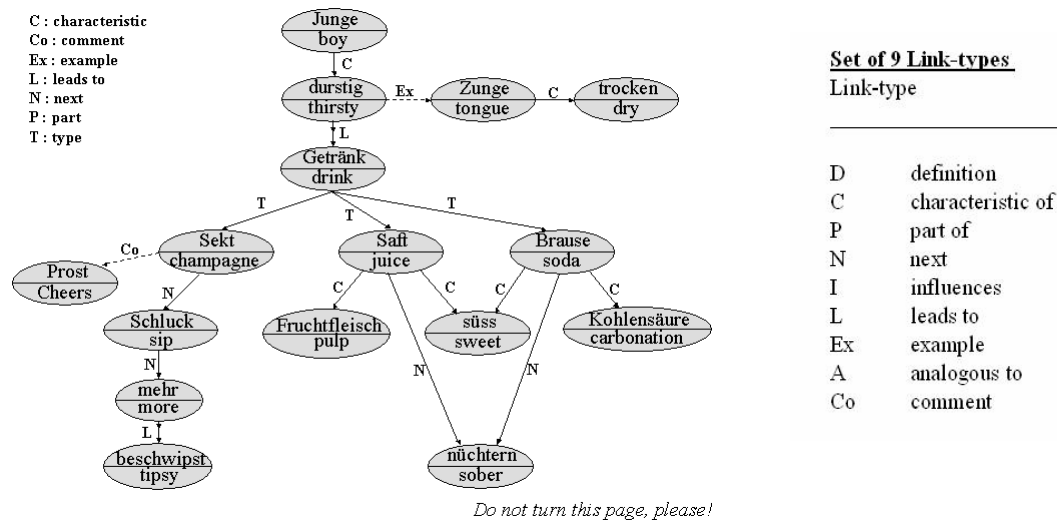

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Figure 1. BiK-map exemplar.

3.1 Background on Mapping

BiK-maps are the multi-language version of knowledge-maps (k-maps). Since BiK-maps are a relatively recent addition to the k-map family, the majority of research has been conducted with monolingual materials. For instance, in academic settings, k-maps have been shown to improve the recall of main ideas or macro-structure (e.g., Rewey, Dansereau, and Peel, 1991), to enhance the processing of technical information (Rewey, Dansereau, Skaggs, Hall, and Pitre, 1989), and to benefit individuals with low verbal abilities (Dees & Dansereau, 1993). Training individuals on k-mapping as a study strategy produces a similar pattern of outcomes, e.g., enhanced recall of macro-structure (Rewey, Dansereau, and Peel, 1991). Also, after being trained on k-mapping, trainees spontaneously generate sophisticated annotations when presented with novel study materials (Moreland, Dansereau, and Chmielewski, 1997).

In addition to the research conducted in the academic realm, the k-map approach has been investigated in the area of drug abuse counseling. According to objective measures such as urinalysis, k-maps and -mapping appear to positively impact on the outcome of treatment (Dansereau, Joe and Simpson, 1993, 1995; Dees, Dansereau and Simpson, 1997; Joe, Dansereau and Simpson, 1994). Also, counselors and clients who use k-maps and k-mapping report improved communication and rapport (Dansereau, Joe, Dees and Simpson, 1996; Pitre, Dees, Dansereau and Simpson, 1997). The utility of k-maps as communication interfaces extends to the majority of clients and counselors regardless of cultural, racial or educational differences (Dees, Dansereau, and Simpson, 1997).

In summary, three features of knowledge-maps, their propositional syntax, their visuo-spatial properties and their utility as communication interfaces in counseling, suggest that maps are uniquely suited for multi-lingual applications. The k-map structure represented by arrows and link types, offers the possibility of communicating ideas in two or more languages simultaneously. A bilingual, even multilingual, k-map is constructed by placing more than one language representation of an idea in each node (see Figure 1). The resulting multilingual map could potentially aid international meetings as a communication bridge between speakers of different languages, without the burden of decoding FL vocabulary and grammar. Prior research of relevance to the present study,

has explored bilingual k-maps in helping individuals acquire a new language by placing vocabulary to be learned into a coherent spatial and semantic context.

3.2   Prior BiK Research

In previous experiments, students received experimenter produced BiK-maps to study German vocabulary (Bahr & Dansereau, 2001a, 2001b). The initial study (Bahr & Dansereau, 2001a) compared the performance of students who studied BiK-maps to that of students who received the same vocabulary in list format. Two sets (16 word-pairs each) were presented as either maps or lists. Participants were informed that they had 10 min to study each set and that they would be expected to write down the stimuli during testing. The primary memory measures were Free and Cued Recall, which were taken 10 min after the study session had ended. For the *Free* Recall, participants wrote down everything they could remember from the study stimuli. For the *Cued* Recall, participants filled in English translations of FL stimuli. While the Free Recall mean difference approached significance in favor of map students, their Cued Recall performance was significantly higher than that of list learners. *Two essential questions arose from this study:* On a practical level, it remained unclear how durable the immediate recall differences were over time. Additional, delayed recall measures needed to be collected. On a methodological level, we realized that the instructions prior to study did not ensure that learners were attending to the semantic context provided for them in the BiK stimuli. The next study addressed these issues (Bahr & Dansereau, 2001b). Memory measures were taken after a brief delay (as in the initial study) *and* repeated 2 days later. Again, map students performed higher than list students. To address the second question, two groups were added to the original design. With one exception, these groups were identical to the list and BiK-map conditions: In addition to the bilingual stimuli, the new groups were exposed for 30 seconds of the 10 min study time to the stimuli in *English only*. It was hypothesized that initial exposure, limited to native language stimuli, would draw the attention of the participants to the study format and the provided contextual cues. Hence, participants were considered in semantic emphasis conditions. Results indicated that learners with semantic emphasis forgot more vocabulary over time than their non-emphasis counterparts. Apparently, the manipulation created an unexpected memory deficit for foreign language stimuli while the recall performance for native words remained unaffected. In summary, 2 studies investigating the intact BiK-map presentation format, indicate that individuals studying maps compared to lists remember more vocabulary.

3.3   Pertinent Issues and Questions Emerging from Prior Research

3.3.1   Recall Issues

Research on the BiK-map presentation format has reliably demonstrated that BiK-map students recall more vocabulary items than do list learners. Although this finding is encouraging, the possibility could not be ruled out that the delayed recall performance of list and map learners (Bahr & Dansereau, 2001b) was influenced differentially by the immediate recall results. To address this issue the present study employed delayed recall measures without prior immediate tests.

3.3.2   BiK-mapping as a Study Strategy

Another application based on the theoretical background that gave rise to the BiK presentation format studies, is to teach BiK-mapping to FL students as a study strategy. Here, learners create their own BiK-maps from word-pair lists. The question arises whether semantic and visually based elaborations must be produced by experts (as in the BiK-presentation format) to benefit the learner, or, whether learners trained on the production of BiK-maps are able to benefit through the same elaborative mechanisms. It seems reasonable to expect that individuals who employ BiK-mapping as a study strategy with lists of FL vocabulary will engage in deeper processing than individuals who take notes without prior BiK-training. Given the recall-facilitating nature of deep compared to shallow processing (e.g., Lockhart & Craik, 1990; Craik & Lockhart, 1972), it is likely that BiK-mapping individuals will outperform untrained list learners who may or may not attend to and deeply process the context of a vocabulary set. Thus, one might expect a higher performance level from BiK-mappers compared to list-learners unaware of BiK-maps and BiK-mapping.

4   Method

We investigated BiK-mapping as a study strategy in a two group design and evaluated delayed recall performance. Individuals either took notes in their own preferred style or in BiK-map format.

4.1   Participants

The participants were treated according to the APA guidelines. The experiment was reviewed and approved by the Human Subjects Safeguard Committee at Texas Christian University, Fort Worth, Texas. 38 undergraduates were recruited from psychology classes to participate in the study for experimental credit. They were randomly assigned to one of two cells: BiK-strategy (BiK-training and BiK-note-taking during study phase, n = 17), or, Control (Control-training and standard note-taking during study phase, n = 21).

4.2   Materials

4.2.1   Individual Difference Measures.

Participants reported any prior FL education and knowledge of German. Indication of prior knowledge of German was used to screen out overqualified participants. In addition, a processing inventory (PI) regarding textbook study in general (PI-TS) was administered. The PI-TS assesses type and frequency of study strategies used by the participants. In session 2, a multiplication test was administered prior to the study period to detect motivational differences between groups (Chmieleski & Dansereau, 1998). Progress on this test which consists of numerous multiple digit multiplications is hypothesized to be primarily a function of current motivation to perform experimenter provided tasks (Chmieleswki & Dansereau, 1998).

4.2.2   Dependent Variables

The two dependent measures were based on earlier research, which compared the memory performance of BiK-map learners to that of list learners (Bahr & Dansereau, 2001a): The measures collected were *Free* Recall and *Cued* Recall. For the Free Recall (FR), participants were instructed to write down everything they remembered from the study session. This measure yielded two scores: The total number of correct word-pairs recalled, FR-wp, based on 1 point per word-pair, and, the number of English or German words recalled in addition to word-pairs, FR-add, based on 1 point per word. For the Cued Recall (CR), participants received the FL stimuli with the English translations left blank. The student was instructed to write in the appropriate English words. Participants received 1 point for each correct translation.

4.2.3   Study materials

Bilingual lists employed in previous research served as study materials (Bahr & Dansereau, 2001a, 2001b). The number of word pairs was limited to 16 per list, based on research by Crothers and Suppes (1967) who showed that novice learners benefit from learning relatively small groups of words. The types of words chosen were determined by semantic themes reflecting tourist issues abroad (finding and selecting food and drink choices). The average number of syllables for the German words is 1.84 (1.75 in the first set and 1.98 in the second set). The average number of letters per word is 6.56 (6.69 and 6.44).

4.2.4   Training Materials

In session 2, four sets of Hindi-English word-pairs served as training stimuli. The set size was 8 word-pairs for the first two sets and 16 for the third and fourth sets. In the List-training condition all sets were presented in list format. For BiK-map training the first and third set were presented as BiK-maps while the second and fourth set appeared as lists.

4.3   Procedure

The study consisted of three sessions (45 min, 2 hours and 45 min in length, respectively) on a Monday, Wednesday, Friday schedule. The total times given in parentheses are approximations.

4.3.1   Session 1

- Random assignment of participants (15 min)
- Statement of consent administration and collection (10 min)
- Assessment of prior foreign language knowledge (10 min)
- Processing inventory of textbook study (PI-TS) administration (5 min)

4.3.2   Session 2: Training and Study phase

- Training phase (45 min). Individuals were either BiK-trained or List-trained. List-trainees engaged in the same activities and studied the same stimuli as BiK-trainees but were not exposed to BiK-maps or mapping. Prior to the commencement of training, participants received workbooks containing the training stimuli and blank sheets of paper. Stimuli were also presented on an overhead screen as slides of a PowerPoint presentation. The training consisted of two main parts: training warm-up (15 min) and main training (30 min).

- During the warm-up, participants were presented with either a brief written description (List-training), or, a monolingual knowledge map (BiK-training) of a hobby. Then they were asked to write about (List-training) or map (BiK-training) one of their hobbies on a blank sheet of paper for 5 min. Participants were informed, that they would be asked afterwards, to share and discuss their hobby notes, or hobby maps, with a partner. The cooperative activity took 3 min and concluded the warm-up

- During main training, participants continued with the workbooks. Both training conditions were presented with the first of four sets of training word-pairs (Hindi-English). The first set consisted of 8 word-pairs either in list (List-training) or BiK-map format (BiK-training). Participants had 3 min to study these stimuli without taking notes. Next, participants in both training conditions received the second set of 8 word-pairs in list format and were asked to take notes (List-training) or to make a map (BiK-training) based on these stimuli. The note-taking or mapping activities lasted for 5 min. Participants were informed that following this period, they would be asked to share and discuss their notes or maps with a partner. The cooperative activity took 3 min and was followed by the presentation of the third set of stimuli which consisted of 16 word-pairs either in list (List-training) or map format (BiK-training). Participants had 8 min to study these stimuli without taking notes. Next, all participants received the fourth and final set of 16 word-pairs and were asked to take notes (List-training) or to make a map (BiK-training) based on these stimuli. This note taking/mapping activity lasted for 10 min and concluded the training phase of session.

- Study phase (30 min). The materials were administered in the order listed. The multiplication test was timed (4 min). Likewise, exposure to the study stimuli was timed (10 min for each list in the set of two). The study stimuli were presented in list format. Participants were instructed to take notes as they had during the training phase. Map trainees took BiK-notes and Control-trainees took standard notes in their own preferred style. Furthermore, participants were informed that they were going to be tested on the word-pair stimuli in the third session (two days later). After completing the study phase, the experimenter reminded the participants of the time and day of the last session and instructed the students to turn in their folders.

4.3.3   Session 3 (35 min): Collection of dependent measures and conclusion

- Free Recall (15 min)
- Cued Recall (10 min)
- Debrief
- Experimental Credit

5   Results

5.1   Scoring and preliminary analyses

The multiplication-motivation measure from session 2 was included to detect motivational differences prior to the study phase. A one-way ANOVA on the number of problems solved revealed no differences between the groups. Consequently it was concluded that groups were approximately equal in motivation to perform experimenter provided tasks.

Performance on the PI-TS gathered in session 1 served as a covariate. The sum of PI-TS ratings (PI-TSum) served as the frequency-of-use index for a variety of study strategies. The standardized value for Cronbach's coefficient alpha was .627.

The free and cued recall measures were scored with a relaxed spelling criterion. If a word was comprehensible it was considered correct. Inter-rater reliability was established based on a 15% sample ($r = 1.0$). To reduce skewedness, the Cued Recall was capped at 18. The Free Recall of word-pairs, FR-wp, and, the

FR of additional words, FR-add, were each capped at 9. Analyses were conducted with capped and uncapped measures. Capping did not change the results but suppressed univariate interactions that did not reach significance at the multivariate level (Barnett & Lewis, 1984; Keselman, Othman, Wilcox, & Fradette, 2004).

5.2   *Primary analyses*

The primary analyses were conducted with the following measures. The first set consisted of the memory measures, which included the Free Recall scores (word-pairs recalled, FR-wp; words in addition to FR-wp, FR-add), and Cued Recall scores (CR). A 1-way (strategy) MANCOVA on the memory measures revealed a significant effect for strategy $F(3,33) = 3.93$, $p < .016$. A main univariate effect was found for Free Recall of individual words in addition to word-pairs, FR-add, $F(1,35) = 7.31$, $p < .010$. BiK-mappers recalled significantly more English words than control note-takers. Adjusted means and standard deviations in parentheses were: FR-add $_{BiK-mapping} = 5.92$ (3.96), FR-add $_{Control} = 3.06$ (2.54), $d = .858$; FR-wp $_{BiK-mapping} = 2.77$ (3.52), FR-wp $_{Control} = 2.18$ (2.63), and CR $_{BiK-mapping} = 8.08$ (5.40); CR $_{Control} = 8.24$ (5.68).

6   Discussion

The results discussed in this section account for self-reported differences in study strategies.

6.1   *Performance levels*

Research in FL acquisition has been notorious for large standard deviations and relatively low recall scores (e.g., McDaniel & Pressley, 1984; Service & Craik, 1993; Skegan, 1989) Recall percentiles ranged 6.8% to 25.2% for control note-takers and 8.6% to 25.7% for map note-takers. These scores are comparable to performance in other FL vocabulary acquisition studies (e.g., Hogben & Lawson, 1994; Lawson & Hogben, 1998). Still, performance in the current study was lower than the scores in earlier BiK research (Bahr & Dansereau, 2001b). The difference is likely a due to the fact the delayed recall in previous experiments was preceded by immediate recall, which apparently caused a rehearsal effect. The object of the current studies was to eliminate the possibility of differential rehearsal effects. Without rehearsal a consequent suppression of memory in general was unavoidable when testing for BiK-map effects.

6.2   *Primary Findings*

The use of BiK-mapping as a study strategy in the current experiment did not enhance or depress the recall of word-pairs (FR-wp). However, the analyses revealed that BiK-strategists recalled significantly more additional, single words during Free Recall (FR-add) than control note-takers. The majority of the FR-add scores consisted of single native English rather than German, i.e., foreign language, words. Obviously, from a foreign language learner perspective, an increase in additional English words is less desirable than an increase in word pairs consisting of native and foreign language words. However, the availability of additional native words in memory may prove valuable during subsequent study sessions. In the present experiment studying was limited to 20 min total (10 min per set). This constraint is somewhat unrealistic, since foreign language vocabulary words are usually acquired over multiple sessions. In such a scenario the recall of context and fragmented information may very well be advantageous. An experiment that mimics this naturalistic scenario needs to be conducted. It should also be noted that the participants learned and applied the BiK-map strategy in the same session. The novelty of mapping and the inexperience with its application, may have suppressed the learning of word-pairs for mappers compared to their control. Additional practice on mapping may be needed before students can fully realize its potential.

7   Summary

The results from the investigation of BiK-mapping as a study strategy are encouraging but require follow-up. Overall, BiK-mapping appears to facilitate recall, but the type of recall does not indicate an immediate advantage of BiK-mapping over general note-taking. The additional information recalled from the stimuli by BiK-mappers consists of individual words, most of them in English. The recall of such contextual and fragmented information may possibly provide an advantage in subsequent study session when material is being refreshed. Ergo, before concluding on the usefulness of the BiK-strategy, it should be studied in a design that mimics the actual process of vocabulary acquisition (including multiple study sessions) more closely than the current study. An increase in the number of study sessions also ameliorates the lack of familiarity with the

mapping technique per se. Continued practice with the opportunity to further annotate and edit self-produced maps is likely to reduce any novelty effects that may affect acquisition and memory.

A continued investigation to fully explore the potential of BiK-maps as connective tissue between the foreign and native language lexica, and, within the FL lexicon, is desirable. So far BiK-maps have performed well as presentation format vocabulary study tools. Empirical research should forge ahead, and (a), examine the utility of the BiK-strategy in reality-based experimental designs, and (b), explore the processing and connection building relevant to BiK-map study by manipulating map parameters.

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