Accessing Prior Knowledge to Remember Text: A Comparison of Advance Organizers and Maps

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Two theories, schema and dual coding, and the conjoint retention model were contrasted to explain the role of geographic familiarity and prior knowledge in map-passage retention. One hundred, eighty-six college students listened to a passage taking place in either a familiar or unfamiliar geographic domain and viewed either a map or no map of either of the two geographic areas. One-third of each group received either a general or specific advance organizer of the passage topic, or no organizer at all. Results revealed that maps function to bridge what learners already know about an area and what they need to remember from a passage. However, prior knowledge of geography is activated by the geographic propositions contained in a passage, with or without a map. Thus, maps serve a mnemonic function of imagery, but learners’ prior knowledge of the geography of the map’s space mediates the value of the map. Learners are able to generate an image of the map themselves if there are locational markers in the passage, and the geography of those markers are familiar. © 1998 Academic Press

When maps and passages are combined as instructional partners, recall for passage information as well as map contents is increased (Kulhavy, Stock, & Kealy, 1993; Scevak, Moore, & Kirby, 1993; Schwartz & Kulhavy, 1981). Findings show that this facilitative relationship appears with steadfast regularity and is virtually consistent across map types and passage themes (Amund, Gaffney, & Kulhavy, 1985; Dean & Kulhavy, 1981; Winn, 1991). However, it is unclear as to whether maps will enhance passage comprehension when learners have no prior knowledge of the passage content. This investigation was designed specifically to investigate the role of prior knowledge in the comprehension and retention of a passage when the content of that passage is unfamiliar to the learner and a map is varied for familiarity.

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In all of the studies concerning maps and passages, researchers have used passages in which learners possessed at least some degree of prior knowledge of the topic area. For example, in Kulhavy, Woodard, Haygood, and Webb (1993), the text material read by learners consisted of a 500-word exposition similar to that used in many textbooks and contained information about the history, tourist sites, and economics of a county (e.g., “The people who came to the peninsula built the Old Fort that is now used as a jail for those convicted of minor crimes. Tourist visitors often walk along Seal Beach looking for the valuable precious stones that wash up on this shore”). It is apparent that regardless of the geographical location, all learners would have a schema of tourist-type activities like walks along the beach, and that their prior knowledge, or lack of it, would not be questioned. Research by Scevak, Moore, and Kirby (1993) similarly illustrate the use of text passage themes in which learners’ prior experiences and/or knowledge can be tapped. In their investigation, learners were required to examine a history text that described two battles fought by Australian soldiers on the Gallipoli Peninsula in Turkey during World War I. Again, possession of a distinctive schema, such as warfare, is essentially universal. Their subjects were also Australian.

Investigations involving the role of maps in the enhancement of passage recall have predominantly taken a position based in dual-coding theory (Paivio, 1971, 1986) to explain the retention-enhancing utility of the passage-accompanying maps. Dual coding theory states that visual and verbal information are presented as functionally distinct codes in separate memory stores. Information that is acquired visually is taken into the visual store and held there as an intact visual image. Semantic information that is acquired, either auditorily or through means of written text, is taken into the verbal store and held there as meaningful linguistic propositions. Paivio has argued that there are access links between the visual and verbal stores, so that information in one code can activate information in the other code. For example, when learners form an image of a concrete word, the word creates both visual and verbal traces. It is these multiple codings that increase the likelihood of the word being recalled, because there are two trace modalities from which the word can be retrieved. In other words, two codes are better than one.

The Model of Conjoint Retention

Kulhavy and Stock (1996) have used Paivio’s theory to explain that maps and prose are represented in memory as visually apprehended and verbally processed referents, respectively. They contend that maps are encoded as images that retain both the structural and feature information present in the stimulus map itself, whereas text information is represented in a nonimage verbal code—a coding partnership they call conjoint retention. According to conjoint retention, there are access links between the two codes, with the information from the map image being able to be used as a highly efficient
cross-code retrieval cue for passage information encoded and contained in the verbal store. Thus, maps provide image locations learners can search to retrieve semantic information contained in a related passage.

Two assumptions underlie the value of a map when a map and passage are studied together. One is that the map is stored as an intact visual image: a single imaginal unit that is represented in memory as one data chunk (see Kulhavy & Stock, 1996, p. 135). This assumption is important because it suggests that the map takes up little room in the limited space of working memory, and allows the space left over to be used for the activation and retrieval of the propositions derived from text (see Larkin & Simon, 1987 for a description of this process with diagrams). Thus, map and passage elements can be allocated attention in working memory simultaneously, rendering the two rapidly associated and efficiently stored (Nelson & Leonesio, 1988). According to Kulhavy and Stock (1996), “as subjects read or listen to a text, they retrieve the map image into working memory and form direct associations between map features and facts joined to them in the text.” (p. 135).

The second assumption relates to the map as a retrieval guide in terms of the map’s influence over the way passage propositions are organized in memory. As a guide, the map is assumed to be used by learners to search for passage propositions during the retrieval process. The map is believed to serve as a second-stratum cue for passage information that may not have been remembered during an initial retrieval round. Thus, during a second retrieval search learners pull up the image of the map and search it to retrieve the text-based propositions that were stored with it. The important point implicit in this assumption is that the map image is the organizing framework from which text-derived verbal codes are activated and retrieved. Indeed, Kulhavy and Stock (1996) state that “. . . the intact nature of the map image is responsible for imposing a degree of integration of this network of verbal/nonverbal associations” (p. 135). Thus, Kulhavy and his colleagues (Dickson, Schrankel, & Kulhavy, 1988; Kulhavy, Lee, & Caterino, 1985; Kulhavy & Stock, 1996; Kulhavy, Stock, Verdi, Rittschoff, & Savenye, 1993; Peterson, Kulhavy, Stock, & Pridemore, 1991; Winn, 1991) believe that it is the map image that not only cues retrieval of associated verbal content, but guides the retrieval of text-based propositions and organizes them in memory as well.

Although the conjoint retention model has parsimoniously explained many data sets of map-passage retention, it has never been used to account for the role of a learner’s prior knowledge of passage material. Also, the model has never been applied to systematic variations of the familiarity of a map. Instead, support for the conjoint retention hypothesis has been drawn only from research involving conditions in which learners have had a least some degree of background knowledge or experience involving the passage material and
no prior knowledge of the geographic area depicted on the accompanying experimental map. If it is the case that it is the image learners construct of a map that facilitates passage comprehension—as the conjoint retention hypothesis would suggest—and not the map’s capacity to engage learner’s prior knowledge (either of the subject matter of a passage or the geographic domain on a map), then there should be no difference between familiar and unfamiliar map conditions with regard to successful map-passage recall.

Prior Knowledge and Schema Theory

The role of prior knowledge in passage comprehension has been extensively discussed using concepts borne from schema theory (cf. Bartlett, 1932; Bransford & Johnson, 1972; Brewer & Treyens, 1981; Schwartz & Reisberg, 1991). The schema view differs significantly from conjoint retention in that rather than encoding information into a particular memory store, only information that fits with a learner’s expectations and prior knowledge is recorded. In other words, learners informationally catalog the gist of their experiences based on what they already know and expect from that knowledge, rather than simply developing an image of locations or events and attaching semantic units to those images. Thus, during recall, information is not retrieved from a specific visual or verbal store per se, but instead, is guided by a learner’s present beliefs and prejudices, and reconstructed in ways that are consistent with the schematic structures that contain those prejudices and beliefs.

In accordance with schema theory, information that does not fit in with these structures is thought to be ignored and distorted to make it fit: information that is not present in the experience, but which, according to schema should not be present, will be assumed to have been perceived (Spiro, 1977; Zangwill, 1972).

Thus, a position based on schema theory would suggest that what a learner sees in a map and hears in a passage is supplemented by the learner’s interpretations and expectations. In turn, these expectations are guided by the learner’s prior knowledge. Indeed, Schwartz & Reisberg (1991) assert that “the world as we experience it and understand it is not merely a function of the objective events in the world, of the physical stimuli that reach us. Instead, the world as we experience it represents the joint contributions of information from the world and information we supply” (p. 330). There are a number of investigations where this interpretation is relevant (cf. Schwartz & Kulhavy, 1981; Peterson, Kulhavy, Stock, & Pridemore, 1991). Consider the two sample studies below.

Reconsidering Previous Research

In a study considering the effects of semantic organization where the hierarchy of familiar passage topics (e.g., geographic content, weather event con-
tent) were manipulated, Schwartz and Wilkinson (1992) found that the content of a passage’s structural hierarchy, in light of importance, is better remembered when corresponding map features are also high in the visual hierarchy of the map. Visual hierarchy is defined by the salience with which shapes, marks, and colors appear on a map (Jenks, 1973). However, passage retention in the Schwartz and Wilkinson study may have been enhanced under hierarchical consistency because learners had prior knowledge of the material contained in the passage. If learners had no passage prior knowledge, it would not matter at all whether the information was high or low in the passage structure. Thus, the Schwartz and Wilkinson results can be generalized to the nature of the materials they used because prior knowledge of the passage content was never manipulated. Thus, a positive learning outcome, based on content consistency between the two referents may not have been found if the information was unfamiliar to the learner. This is because the hierarchical importance of that information would be indistinguishable.

In addition to the prior knowledge effect on distinguishing the importance of passage content, prior knowledge of a passage probably also exerts an effect on the inferences learners can draw from a passage when it is accompanied by a map. Rittschoff, Stock, Kulhavy, Verdi, and Doran (1994) examined the effects of stimulus presentation order of a map or a passage on learner’s ability to understand by reason of inference. A sample inference item and its correct answer are presented below.

“Mr. Icondi owns a company that makes such things as erasers, raincoats, and racquetballs. He plans to build a factory on Ceylon for manufacturing his products. Where should he build his factory and why? (Answer: Near the rubber plantations in the south in order to be close to his source of materials).”

The researchers found that the comparative judgments necessary for inferences to be made were superior for learners who saw a map prior to text, as opposed to learners who received the text material first. However, we propose that the improved performance by the map-text group, as opposed to the text-map group, may not have been the singular result of the order in which learners received the stimuli. If learners who had no prior knowledge of the passage had been tested, the effect of stimulus order may have been weaker because inferences would have to be made only on the basis of the learners’ ability to reason. In that case, a superior performance in the map-text group may not have been found. Essentially, it may have been more difficult for learners to make inferential judgments about an unfamiliar passage without at least some degree of prior knowledge.

When considering map familiarity, learners who possess some prior knowledge of an area would be able to use the mental image of a map to pack in bits of factual semantic information for later retrieval, while learners without the benefit of prior knowledge would merely have a tool with which
to catalog or organize the information from the passage. Hence, although learners, with or without prior knowledge of the topic matter, would be capable of making inferential judgments, the nature of their inferences would be expected to change because of differences in their prior knowledge level. In short, prior knowledge is important as a variable to consider because, according to schema theory, it provides learners with a relevant, searchable context in which to interpret, comprehend, make inferences from, and remember information presented in a passage and a map.

**Prior Knowledge and Dual Coding**

Although schema is a viable conceptual framework in which to explain the potential role of prior knowledge in map-passage retention, schema theory does not necessarily have to be invoked as the only theoretical context in which to explain the prior knowledge role. Sadoski and his colleagues (e.g., Sadoski, Goetz, & Avila, 1995; Sadoski, Goetz, & Fritz, 1993; Sadoski et al., 1991) argue that the role or prior knowledge in learning and remembering is eminently well-explained by dual coding theory. In fact, Sadoski, Paivio, and Goetz (1991) make the point that “. . . schemata are, by most accounts, abstractions derived from experience that exist in a potential, nonspecific state, awaiting input. The epistemological question is how conceptual or schematic knowledge can exist in the abstract, isolated from any of the examples that give rise to it” (p. 467).

Thus, Sadoski and his colleagues believe that prior knowledge is represented in memory as dual codes: interconnected images and propositions organized into an associative structure of two subsystems (nonverbal and verbal) that can function independently, in parallel, or in an integrated manner during processing. Thus, a dual coding perspective of the role of prior knowledge does not include or require a separate abstracted structure such as schema. Instead, Sadoski believes that processing occurs by the “. . . probabilistic activation of particular verbal and/or nonverbal mental representations by external stimuli” (e.g., text) along with “previously activated representations” (e.g., prior knowledge) (Sadoski et al., 1991, p. 475). In other words, verbal and imaginal codes already linked together in memory (e.g., prior knowledge) are activated by the propositions encountered in text, and are used to encode, store, and retrieve textual elements.

**Prior Knowledge in the Present Investigation**

In the present investigation, we sought to account for the role of prior knowledge in the performance of learners’ retention of a passage and a map when the content of the passage was unfamiliar. We reasoned that controlling prior knowledge of the experimental passage would allow us to observe the role of prior knowledge of maps. Thus, maps were varied in this investigation.
by progressively manipulating levels of map familiarity in order to determine the maps’ effect upon learners’ comprehension and retention of the passage when the content of the passage was unfamiliar.

Levels of map familiarity were manipulated to differentiate between whether it is the image of a map per se that enables learners to comprehend unfamiliar information or rather a map’s capacity to bridge a learner’s schematic structure. If the conjoint retention hypothesis works the way Kulhavy and his colleagues believe, there should be no differential effect in a learner’s memory of a passage composed of unfamiliar content whether an accompanying map is familiar or unfamiliar.

At one end of the map familiarity continuum a familiar map was used comprised of familiar locations; at the other was an unfamiliar map comprised of unfamiliar locations. Two other map-passage familiarity manipulations fell in between: a no map condition paired with the unfamiliar passage and a no map condition paired with the same unfamiliar passage, except that unfamiliar locations where passage events occurred were replaced with familiar ones.

Learners were given a passage about a group of young children traveling around a country competing in matches of the game of cricket—a sport about which the learners (all of them American) had no prior knowledge. In one condition, a map of the United States accompanied the passage in order to determine whether the map would facilitate learners’ comprehension of the unfamiliar passage content.

In the second map condition, the events of the passage took place at geographic locations in the U.S., but learners did not have the benefit of viewing the map. It is possible that familiar locations are all that is necessary to stimulate a learner’s prior knowledge of the U.S., and that this knowledge is all that is necessary to help one to remember unfamiliar passage contents. Thus, in this condition, learners could conceivably access their knowledge of the U.S. based on their personal experience with it and use this knowledge to embed events and occurrences from the story. However, their use of a freshly encoded image of a map and its location of the events would be unavailable to them.

If conjoint retention operates as Kulhavy and his colleagues believe, learners in both the familiar and unfamiliar map conditions would demonstrate high passage recall because of their opportunity to conjointly encode the map and passage. That is, if a map provides a second stratum cue for learners to use in accessing newly encoded semantic information, the learners would need only to pull up their image of the map and unpack the semantic passage units linked with the map image in memory. The theory of conjoint retention does not predict a familiar map will yield higher recall than a map that is unfamiliar. Therefore, if it is just the image of a map and not the map’s
ability to connect prior knowledge, there should be no difference in learners’ retention when either an unfamiliar map of unfamiliar geography or a familiar map with familiar geography is used.

Schema theory, on the other hand, would predict higher passage recall in the familiar group, with or without the accompaniment of the map, because learners would have the benefit of accessing their knowledge of the area. A map, according to schema theory, is not so much important because it can provide an image for retrieving the passage propositions that are stored, but because it can access the appropriate schema for instantiating and relating passage propositions in memory. Therefore, extrapolating from schema theory, if learners get access to a relevant framework of prior knowledge, it does not matter whether a map is present or not. Schema theory would also suggest that an unfamiliar geographic area, whether it is mapped or not, would result in the lowest recall scores of the four map conditions, since an unfamiliar geographic domain provides learners no relevant schema in which to embed passage content. Conjoint retention and schema theory would predict that learners in the no map unfamiliar condition would have the most inadequate passage recall of all, because neither an image, or a relevant prior knowledge structure would be available for retaining passage elements.

Advance Organizers and Maps

Appending the notion of maps as bridges, advance organizers were manipulated to examine their relationships with maps. Advance organizers are materials presented prior to difficult or unfamiliar information that serve to bridge a learners’ prior knowledge and the material to be learned (Petersen, Glover, & Ronning, 1980; Stone, 1983). These introductory materials can be paragraphs, brief passages, outlines, or graphic displays that are supposed to link learners’ existing schemata with the novel ideas of a passage (cf. Corkill, Glover, & Bruning, 1988; Royer & Cable, 1976). Theoretically, advance organizers help mobilize relevant schema and provide a means of organizing new materials thereby increasing learners’ comprehension and recall. According to Ausubel (1968), certain qualities consisting of abstractness, inclusiveness, and generality are needed in order for advance organizers to be effective and function appropriately.

Advance organizers were combined with maps in this investigation in order to determine whether the two function independently or interactively to enhance the retention of a related passage. If, as intended, advance organizers do facilitate the learning of targeted material, it would be expected that they should function quite as successfully as a map, but for different reasons depending upon the theoretical context used to make the predictions.

Thus, two kinds of organizers were used in this investigation. One was a brief general paragraph about sports; the other was a short paragraph specifically describing the game of cricket. McDaniel and Einstein’s (1989) concep-
tion is a useful way to think of the difference between the general and specific organizers used in this investigation. They suggest that there are two types of processing learners do in the presence of texts: proposition-specific and relational. Proposition-specific processing is presumably conducted on the specific information contained in text and is useful for specifying the details and specific information contained in a passage. Relational processing, on the other hand, is thought to be useful in deriving a bigger picture on a story and necessary for supplying a story’s general theme. Relational processing refers to the encoding of similarities among items, whereas proposition-specific processing leads to the encoding of item-specific or distinctive information. “Relational processing focuses attention on the sequential, conceptual, and/or causal relationships among the ideas in the text and focuses on information that organizes and fits the constituent ideas together” (p. 121). They suggest that some types of texts will normally invite one or the other type of processing. The general organizer used in this investigation was written to invite relational processing; the specific advance organizer was designed to evoke processing that is proposition-specific.

Sadoski et al. (1993) make the point that both “. . . dual coding theory, as well as schema theory, suggest a theoretical explanation of familiarity effects (Paivio, 1986), so familiarity effects do not automatically favor a schema theory interpretation. Schema theory would predict better passage recall when a story is preceded by the general organizer because more generalized ideas of sports is all that is necessary to fill the variable slots of appropriate schema. Dual coding theory, however, would make the same prediction—the difference between the two principally in the explicitness and the form with which the two theories assume representations are stored in memory. An advance organizer specifically about cricket would be expected to offer little help for passage retention if learners have no knowledge of the sport at all. Thus, we expected no difference between the specific advance organizer and the absence of one.

However, when a map is involved, retention should be greatest when a learner is given a map with familiar geographic locations as well as an advance organizer. If it is the case that both maps and advance organizers are competent in pulling up and linking prior knowledge, the advance organizer should enhance a map’s ability to access or locate the appropriate semantic structure associated with prior knowledge of the mapped area, and therefore, a familiar map, advance organizer additive recall effect would be expected. That is, if we are correct in our prediction that a map accesses a learner’s prior knowledge of an area, then passage recall should be highest when a passage in presented with a general organizer of sports and a map of the area in which the story takes place. Under this condition, retention would be best because both the map and the general sports advance organizer would have the capacity to link new (passage-based) propositions with learners’
preexisting knowledge associated with the geographic area and preexisting knowledge of sports.

If the conjoint retention model operates as Kulhavy and his colleagues suggest, then the map would prove itself necessary, not only to organize and guide retrieval of new passage information, but also to link learners’ existing knowledge with information that is new. If, on the other hand, schema theory explains the data better, passage recall would be expected to be enhanced when learners have access to a generalized well-developed schema concerning events taking place in an area learners know a good deal about. However, schema theory would not predict differential retrieval gains simply because of the presence of a map. Instead, it would suggest that it is only important that learners access prior knowledge in order for learning to occur. In other words, combining a familiar schema of sports with a familiar schema of the United States would result in the highest recall of all the map familiarity-advance organizer conditions, because both stores of prior knowledge would be accessible to learners.

METHOD

Design

Two factors, map familiarity and type of advance organizer, were combined as between-subjects factors to yield 12 experimental cells. The resulting design was a 4 Map Familiarity (Familiar vs. Unfamiliar vs. No Map with Familiar Geographic Passage Locations [NMF] vs. No Map with Unfamiliar Geographic Locations [NMU]) × 3 Advance Organizer (General Sports vs. Specific Sports vs. None) analysis of variance.

Two additional within-subjects factors were crossed with map familiarity and advance organizer type in separate analyses. The factors were: (a) Map Feature Elaboration (elaborated vs. Not Elaborated), and (b) Type of Passage Fact Recalled (Familiar vs. Unfamiliar).

Subjects

One Hundred, Eighty-six undergraduate students volunteered for participation. They were enrolled in psychology courses at a mid-sized western university in the United States. Subjects were randomly assigned (N = 15 or 16) to between-subjects conditions based on the order in which they appeared for the experiment. There were 44 males and 142 females; males were equivalently represented across all experimental groups. Subjects ranged in age between 17 and 55, mean age = 23.56, and SD = 5.88. All participants were predominantly white, middle-class students with no apparent sensory, physical, or learning disabilities.

Materials

Experimental passage. The experimental passage was an 800-word descriptive narrative about a group of children who travel around a country competing in a sports competition. The story tells about the episodes that take place at each competition of the tour. The competitions were matches of the game of cricket. The passage contained 24 facts, with two located in each of twelve paragraphs of the story. Facts were statements describing a significant occurrence in the story and were of two types: either an event related to the game of cricket, or a noncricket related event. A cricket related event was defined as a specific activity performed in the game of cricket (e.g., ‘‘Zach fielded on the boundary all day . . . ‘’) and was designated
an unfamiliar passage fact, while a noncricket related event was defined as a condition or activity that could occur in any sporting event (That night he practiced for an extra two hours’). Noncricket related passage facts were designated as familiar.

Each cricket and noncricket pair occurred at each of the 12 geographical sites in the country where the story took place. Each site was named once in each of 12 passage paragraphs. In order to better articulate the passage facts with corresponding features on the map, 6 of the 12 paragraphs contained an elaborative statement about the location at which the passage fact occurred. The elaborative statement consisted of a brief sentence describing either the geography or climate of the location. Locations receiving elaboration in the passage were randomly selected.

All paragraphs were approximately equivalent in length and were of the same general format. In the paragraph below, a sample of the passage is presented.
``From here the kids were off to Dover. This town is nestled between the mountains and the ocean. What a match Daniel had there. He scored ducks in both innings. That night he practiced for an extra two hours.''

Finally, the experimental passage was written in two versions in order to be presented with two different experimental country maps. One version identified locations in the United States, since a map of the United States was used to accompany that version. The second named fictitious locations in the story since a fictitious country map was used. The map was named ‘‘Novadocia.’’

The experimental passage was audio tape-recorded at a medium rate of 160 words/min. by an American adult male and ran 5 minutes, 9 seconds. It contained 42 idea units—defined as a single sentence, clause, or phrase containing a single complete idea. Idea units were the basic elements of the passage and were the units forming: (a) familiar and unfamiliar facts, (b) elaborative statements of six selected locations, and (c) connecting sentences providing setting information or continuity to the narrative.

**Experimental advance organizer.** The experimental advance organizer (AO) was designed to link learners’ prior knowledge with information contained in the experimental passage. Thus, the AO was an introductory passage presented before exposure to the experimental passage. Construction of the AO was made in accordance with Mayer’s (1979) characteristics of an AO. Specifically, Mayer characterized an AO as ‘‘(a) a short set of verbal or visual information, (b) presented prior to learning a larger body of to-be-learned information, (c) containing no specific content from the to-be-learned information, (d) providing a means of generating the logical relationships among the elements in the to-be-learned information, and (e) influencing the learners’ encoding process.’’

The advance organizer was written in two versions to represent two levels of specificity. One version, the general sports AO, was devised as an expository organizer and conveyed information about the basic gist of sports and sporting competitions. It was intended to incur relational processing of the passage. The other version, a specific sports AO, was devised as a comparative organizer and conveyed information specifically regarding the game of cricket, as it is likened to the game of baseball. It was written to invite proposition-specific processing of the experimental passage. Both versions were of the same length (N = 165 words) and consisted of the same number of idea units (N = 20).

**Experimental map.** The experimental map was a black and white two-dimensional drawing of a county containing twelve feature locations, a country label, and a compass rose. The map was produced in two versions in order to vary familiarity. In the familiar version, the perimeter of the continental United States served as the country boundary and contained drawings and labels of familiar cities (e.g., Mobile, Pismo Beach, Spokane). In the unfamiliar version, a fictitious country outline was designed. This country, named ‘‘Novadocia,’’ contained drawings and labels of fictitious cities with common names (e.g., Granite Springs, Oakridge, Sandy Bluff).

The maps were the same size and contained no internal state or territorial boundaries. A copy of the familiar and unfamiliar maps are contained in Figures 1 and 2, respectively.
United States of America

FIG. 1. Familiar experimental map.
FIG. 2. Unfamiliar experimental map.
Recall protocols. Recall protocols consisted of: (a) lined paper for free recall of the passage, and (b) map outline for reconstruction of the experimental map. Passage recall instructions directed learners to write everything they could remember about the story they heard. The map reconstruction task directed learners to complete the map by replacing map contents and labeling all entries.

Procedure

Learners were run in intact classrooms, with an average of approximately 25 in each group. The procedural sequence began with the distribution of a large manila envelope containing two packets of stapled materials. One packet contained: (a) a set of instructions, (b) either an advance organizer or directions for the students to “consider what the story may be about,” and (c) either an experimental map or directions for the subjects to “listen carefully” to the story. The other packet contained the retrieval materials, consisting of: (a) a brief math task interpolated to circumvent rehearsal in short-term memory, (b) lined paper for free recall, and (c) the blank map outline.

Learners were directed to read carefully either the AO, or in the case of the control group, to consider what the story may be about. AO exposure time was 2 minutes. Next, as the passage was read aloud, learners were directed to study the map, or in the case of the control group, to listen carefully to the passage. The map-passage exposure time was 5 minutes, 9 seconds.

When the story was over, learners were given 1 minute to complete the math task. All learners, in all experimental groups, were required first to recall the experimental passage and next to replace map contents in the blank map reconstruction task. Ten minutes were allowed for each of these two exercises. The entire procedural sequence was completed within 35 minutes.

RESULTS

Learners’ protocols were scored for: (a) the number of map features recalled from the map reconstruction, and (b) the number of idea units and passage facts recalled from the experimental passage. Ten percent of the passage-recall protocols were scored by an additional rater naive to the experimental hypotheses. The interrater scorer reliability was $r = .89$ and $r = .96$ for idea units and passage facts, respectively. Each dependent measure was entered into a separate design and accepted as statistically significant at an alpha level exceeding .05.

Main Analyses

As a preliminary measure of passage retention overall, the number of idea units recalled was entered into a 4 Map Familiarity $\times$ 3 Advance Organizer fixed analysis of variance. The analysis yielded a main effect for Map Familiarity $F(3, 174) = 2.65, p < .05$. The Advance Organizer factor and the Map Familiarity $\times$ Advance Organizer interaction failed to reach an acceptable level of statistical significance.

A post hoc Fisher’s Protected Least Significant Difference Test on the map familiarity main effect revealed that learners seeing the familiar map while listening to the passage remembered significantly more idea units from
the passage than learners who listened to the passage taking place in an unfamiliar geographic domain, with \( p < .01 \) and without benefit of a map \( p < .02 \). All other pair-wise comparisons of treatment means failed to reach an acceptable level of statistical significance. Table 1 contains the means and standard deviations for this analysis.

Next, the number of passage facts recalled were entered into the same basic 2 factor design. However, this time, the map familiarity and the advance organizer factors were crossed with two levels of Passage Fact Type (familiar vs. unfamiliar). The Passage Fact type variable was manipulated as a within subjects factor in order to determine whether the map familiarity and advance organizer factors would differentially interact with learners’ retention of familiar and unfamiliar passage facts. The analysis yielded only a significant effect for the type of passage fact recalled \( F(1, 174) = 188.46, p < .05 \), and the Map Familiarity \( \times \) Advance Organizer interaction \( F(6, 174) = 2.14, p < .05 \). The facts with high familiarity \( (M = 2.12; SD = 1.54) \) were significantly better remembered than facts with low familiarity \( (M = .61; SD = .91) \).

Simple effects tests on the interaction revealed that there was no significant difference between levels of Advance Organizer at either of three levels of Map Familiarity, specifically the familiar, unfamiliar, and the no map unfamiliar conditions (all \( ps > .05 \)). Instead, the interaction was accounted for by significantly greater passage fact recall by learners who received a general advance organizer relative to both the specific advance organizer \( (p < .02) \) and no advance organizer \( (p < .001) \) in the no map, familiar geography passage condition. However, in the no map, familiar geography passage condition, there was no differential benefit between the specific advance organizer and the absence of one. The Map Familiarity \( \times \) Advance Organizer interaction is contained in Figure 3. Table 2 contains the means and standard deviations for this analysis.

In order to determine whether learners used their cognitive representation
of the map to recall passage facts, conditional probabilities were calculated and entered into the same design as above. The conditional probabilities were the probability of recalling a passage fact given that the fact’s corresponding map feature was recalled. The analysis yielded a significant interaction between Map Familiarity and Passage Fact type, \( F(3, 174) = 5.64, p < .05 \). (See Figure 4); simple effects tests revealed that the map familiarity factor affected the conditional probabilities of only familiar passage facts. The probability of recalling unfamiliar passage facts if their corresponding map features were recalled was undifferentiated by the geographic familiarity in which the passage took place, with or without the presence of a map. Learners viewing a map of a familiar geographic domain used their cognitive rep-
TABLE 2
Passage Fact Recall: Map Familiarity × Advance Organizer × Type of Passage Fact

<table>
<thead>
<tr>
<th>Map Familiarity</th>
<th>Advance Organizer</th>
<th>General</th>
<th>Specific</th>
<th>None</th>
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Note. N = 15–16 for each group.

representation of that domain to recall familiar passage facts (M = .49; SD = .42) significantly more than both groups of learners who did (M = .22; SD = .34) and did not (M = .08; SD = .17) view a map of unfamiliar geographic domain (p < .05). Learners listening to the story in a familiar geographic domain, but without the benefit of a map (M = .32; SD = .35) used their memory of map locations to remember passage facts significantly more than their map-absent counterparts who listened to the passage in an unfamiliar domain (p < .05).

Subsequent Analyses

Map feature recall was tested in a 4 Map Familiarity × 3 Advance Organizer × 2 Map Feature elaboration fixed analysis of variance, with Map Feature Elaboration varied as a within subjects factor. The analysis revealed a Map Familiarity × Feature Elaboration interaction F(3, 174) = 8.93, p < .0001. Simple effects tests revealed that the interaction was due to the Effects of Map Feature Elaboration only under conditions when learners were given an Unfamiliar Map (p < .05). No other differences were apparent between Map Feature Elaboration at any other level of Map Familiarity. The advance organizer factor and all other first-order and second-order interactions failed to reach an acceptable level of statistical significance. Table 3 contains the means and standard deviations for this analysis. The Map Familiarity × Feature Elaboration interaction is contained in Figure 5.
DISCUSSION

The results of this investigation support the prediction that maps function in part to bridge learner's prior knowledge between what learners already know and what they need to remember from an unfamiliar passage. Learners who saw the familiar map remembered more idea units from the passage than the learners studying the unfamiliar map. If maps serve simply a mnemonic function in which semantic passage elements are linked with visually coded map images, there should have been no difference in passage recall due to manipulations of the familiarity of the map (Dickson, Schrankel, & Kulhavy, 1988; Kulhavy, Caterino & Melchiori, 1989).

Using idea units as an overall index of passage recall, a difference was found between the familiar and unfamiliar map groups. Since it can be assumed that learners in the familiar map condition possessed prior knowledge of the mapped area and a greater degree of declarative knowledge about the locations in which specific story incidents took place, these geographic elements were apparently able to activate the relevant propositions already in memory to be used to relate new passage elements to preexisting knowl-
edge and free up the space needed in working memory to process the new story ideas. By contrast, learners in the unfamiliar map group were apparently unsuccessful in their attempt to process an overabundance of unfamiliar information from the map and the passage in the limited capacity of working memory.

However, no difference was found between learners hearing the familiar version of the passage whether a map was viewed or not. We suggested that schema theory would predict higher passage recall in the familiar group, with or without the accompaniment of a map, because learners would have the benefit of accessing their knowledge of the area. We reasoned that a map, according to schema theory, is not so much important because it can provide an image for retrieving passage propositions that are stored, but because it can access the appropriate schema for instantiating and relating passage propositions in memory. Extrapolating from schema theory, we reasoned that as long as learners got access to a relevant framework of prior knowledge it would not matter whether a map was present or not.

On the other hand, we also suggested that if the conjoint retention model operates as Kulhavy and his colleagues contend, then learners in both the familiar and unfamiliar map conditions would demonstrate high passage recall because of their opportunity to conjointly encode the map and the passage. That is, since a map provides a second stratum cue for learners to use in accessing newly encoded semantic information, the learners would need only pull up their image of the map and use the image to access semantic...
passage units linked with the map image in memory. The model of conjoint retention would predict no difference in passage recall between a familiar map and a map that was unfamiliar, because it is the image of the map and not the map's ability to connect prior knowledge that explains the utilitarian affects of maps in passage recall.

Yet, learners hearing the passage taking place in a familiar geographic region, without the benefit of a map, failed to show a significant difference from learners hearing the passage in an unfamiliar region, with or without a map. This finding revealed that while familiarity with a geographic location yielded higher overall passage recall, the overall retention level, as indexed
This finding fails to support definitively either a schema theoretical perspective or the model of conjoint retention. However, the data do not discount either theory. As Sadoski et al. (1993) point out, schema theory and dual coding theory (and by extension, conjoint retention) both suggest a theoretical explanation of familiarity effects. That is, familiarity effects do not automatically preclude dual coding theory in favor of schema theory.

Thus, as Kulhavy and his colleagues suggest, what seems to happen is that a map does serve as a second stratum cue to retrieve semantic elements of a passage. However, the map also appears to serve to link learners’ previously stored semantic units of prior knowledge with the to-be-remembered semantic elements of the passage. This linking effect may function, as schema theory would suggest, to encourage the instantiation of an unfamiliar passage by permitting learners to activate a relevant schema of declarative knowledge that facilitates interpretation of that passage. Or, as dual coding theory would suggest, maps may serve as “targets” of prior knowledge, delimiting probabilistically the relevant verbal and/or imaginal codes in memory necessary for linking new information from a passage. As Sadoski et al. (1991) point out, a dual coding perspective of the role of prior knowledge does not include or require a separate abstracted structure such as schema. Verbal and imaginal codes already linked together in memory (e.g., prior knowledge) can be activated by the propositions encountered in text and used to encode, store, and retrieve textual elements.

The data borne from the idea-unit recall in the present investigation suggest that learners’ prior knowledge of geography (whether it is represented as schema or as dual codes) is activated by the geographic propositions contained in a passage, with or without a map, and is used by learners to remember newly encoded passage content. However, if the geographic context of the text is familiar, the presence of a map facilitates the level of passage retention overall—presumably because of the availability of a freshly encoded map image, rather than an image derived from the locations mentioned in the text.

As for passage fact recall, learners did differentially recall passage facts according to the degree to which they had the prior knowledge to interpret passage fact content. Specifically, learners remembered significantly more facts from the experimental passage when the facts were related to information they already knew. Indeed, learners remembered nearly three times the number of passage facts for which they had prior knowledge than facts for which they had little or no prior knowledge at all.

On the other hand, recall of passage facts seems to have been influenced most dramatically by the advance organizers rather than the maps. In fact, the map familiarity × advance organizer interaction had a significantly facili-
tating effect on learners’ memory of passage facts when learners listened to the passage occurring in a familiar place, but without the benefit of a map. By contrast, no other treatment mean in the interaction differed significantly from one another. The finding reveals that the advance organizers in this investigation were effective in bridging learners’ prior knowledge with the new and unfamiliar information, at least for those learners having knowledge of the locations where the events occurred. And again, as in the idea-unit recall, geographic knowledge was important for remembering passage facts, but this time, only when prior knowledge of sports was primed by a general organizer. However, the presence of the map was not instrumental in the provision of that geographic knowledge, either when it was familiar or unfamiliar.

As for the specific advance organizer, it did not exert an effect on passage fact recall under any of the map familiarity conditions. Moreover, the specific advance organizer exerted no facilitating effect on any outcome measure in the entire investigation. Thus, it is not enough simply to give subjects specific information that explains an unfamiliar game, in this case cricket, in hopes that the information will enhance learners’ recall of unfamiliar passage content. Instead, advance organizers must be of a higher level of generality and abstractness than the material to follow and be able to be relatable to information learners already know (Mayer, 1979; Royer & Cable, 1975; Townsend & Clarihew, 1989). Thus, according to McDaniel and Einstein’s (1989) model of processing, the general advance organizer probably invited more relational processing of the text, which the specific organizer did not.

We hypothesized that when a map was involved, retention would be greatest when a learner is given a map with familiar geographic locations as well as an advance organizer. We reasoned that if both maps and advance organizers are competent in pulling up and linking prior knowledge, the advance organizer would enhance the map’s ability to access or locate the appropriate semantic structure associated with prior knowledge of the mapped area, and, therefore, a familiar map-advance organizer additive recall effect would occur. The results of this investigation support this hypothesis. However, only the general advance organizer had the predicted effect and only in the presence of familiar geographic knowledge when the map was absent. The finding suggests that advance organizers function to enhance recall of passage facts because they provide a context into which learners can embed new passage information. However, while locational information is valuable for the retention of a related passage, the mapping of those locations is of no apparent value in its effect on specific fact recall.

One of the questions that emerges from the data above is whether learners used their knowledge of geography and/or the map to process facts from the passage. The findings from the analysis on conditional probabilities suggest that learners did both—but only on facts of which they had prior knowledge. The probability of recalling an unfamiliar cricket-related passage fact, if the
Earlier we made the point that the conjoint retention model has parsimoniously explained many data sets of map-passage retention, but that it has never been used to account for the role of prior knowledge of passage material. The conditional probability data revealed that, indeed, learners used an image of the map to remember familiar facts from the passage, but only when the learners had knowledge of the geographic domain. In fact, even in the absence of the map, learners apparently constructed an image of the geography of the area to help them remember familiar passage facts when the geography was familiar. The presence of a map was of no value for familiar passage fact recall when the geographic context of the passage was unfamiliar. Thus, maps apparently do serve a mnemonic function of imagery as Kulhavy and his colleagues suggest. But, the findings reported here suggest that learners’ prior knowledge of the geography of a map’s space may mediate the utilitarian value of the map, and learners may be able to generate an image of the map space themselves—if there are locational markers in the passage, and the geography of those markers are familiar.

Finally, with regard to map feature memory, learners who saw either a familiar or an unfamiliar map remembered significantly more map features than learners who listened to the passage without a map. While at one level, the finding is obvious, at another level of interpretation the finding reveals that learners processed more feature locations where passage events took place (familiar or unfamiliar) than learners not having the benefit of a map.

However, the map familiarity main effect was moderated by the degree to which map features were elaborated semantically in the passage. That is, learners retention of map features was influenced by the semantic elaboration of the features in the passage. Results for map feature elaboration showed that learners remembered more semantically elaborated map features than nonelaborated ones. It is apparent that a reciprocal relation does exist between passages and maps, as dual coding theory would suggest, where the elaboration of feature locations produces a more elaborated verbal code during map-passage processing. This code apparently affects the degree to which images of map features are embedded in memory—with the net effect leading to enhanced learner retention of map features. This notion of elaborative processing maintains the view that the “richer” or more elaborate the semantic material, the deeper the processing (Craik & Tulving, 1975). Thus, map features are amenable to an enhanced retention effect when they are elaborated by the semantic elements of an accompanying passage.

REFERENCES


