ABSTRACT
              This study examined the memory-enhancing effects of
elaborative and mnemonic encoding of information presented with maps,
compared to more traditional, non-mnemonic maps, on recall of
locations of events and information associated with those events by
72 middle school students with learning disabilities. Subjects were
presented with map-like displays containing names of battles of the
American Revolution and related factual information via either: (1) a
non-mnemonic control map with realistic drawings of buildings,
soldiers, weapons, etc. found in the time period; (2) a mnemonic map
with mnemonic-keywords of verbal labels; or (3) an elaborative map
with reconstructive elaborations of the verbal labels and event
information. Findings indicated that recall of location was
significantly enhanced by mnemonic keyword encoding of verbal labels,
that mnemonic encoding of location labels produced no significant
gain in recall of related factual information, that locations were
more often recalled than events, that only elaborative encoding
resulted in a significant difference in the conditional probability
of associating events with their locations, and that mnemonic
strategy use was positively and significantly correlated with recall
measures. Battle names, associated information, keywords, and
elaborations are listed on an attachment. (DB)

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Places, Spaces and Memory Traces:
Showing Students with Learning Disabilities Ways to Remember
Locations and Events on Maps

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Running head: Elaborative Maps

Purpose

This study was designed to examine the ability of spatial displays such as maps to convey unfamiliar and abstract information to students with learning disabilities (LD). Names of battles of the American Revolution and events associated with those battles were chosen as the to-be-taught information in this study.

Learning From Maps in General Education Settings

One of the learning tasks included in many mainstream social studies classes is reading and interpreting maps. The importance of map reading is underscored by the prominence given to maps in many textbooks. For example, one commonly used American history text, Land of Liberty (Rawls & Weeks, 1985), presents six different maps requiring individuals to remember the locations and names of various natural physical features as well as the locations and names of various aspects of human activity such as territorial homes of Native American peoples in the first chapter alone. Many mainstream social studies classes require students to label maps with names of cities and events as well as associate events with their respective sites.

Previous research (e.g., Dean, 1978; Schwartz & Kulhavy, 1981) found that maps may serve as a spatial organizer enhancing both the recall of locations and related prose.

Potential Map-Learning Problems for Students with LD

Theories of perceptual difficulty and more current theories of verbal deficiencies suggest that learning and recall of information presented with maps may be particularly difficult for students with LD. Perceptual deficit theories predict the spatial characteristics of the map to be problematic. However, if verbal deficiencies are more characteristic of students with LD, one would expect the extent to which the verbal labels of the information were abstract and unfamiliar to be problematic for students recalling information portrayed on maps.

Previous Map-learning Studies with Students with LD

Mastropieri & Peters (1987) compared recall of information presented pictorially in a map-like spatial display and in a column. Significantly more items were recalled in the map condition than in the column condition. Items depicted on the map were recalled more frequently than items associated with map conditions but not depicted on the man.

Scruggs, Mastropieri, Brigham, & Sullivan (1992) employed mnemonic keyword encoding of 18th century American battle names and color-coding of the victors compared to traditional map displays using depictions of period images to mark the battles and color-coding for the victors. Recall of map locations and victors was significantly greater with mnemonic maps than with traditional maps.

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Remaining Questions

Previous studies showing the positive benefits of spatial displays of information on maps have typically employed information which is relatively concrete and familiar to the subjects. Similar outcomes with abstract and unfamiliar information for populations with learning disabilities (LD) may be less likely. This study, therefore, investigated the memory-enhancing effects of elaborative and mnemonic encoding of information presented with maps to more traditional, non-mnemonic maps on recall of locations of events and information associated with those events by students with LD.

Specific questions

1. What are the effects of symbolic, mnemonic and spatial encoding on relocation of map features?

2. What are the effects of symbolic, mnemonic and spatial encoding on recall of events associated with the locations on the map?

3. Will manipulation of encoding of information on the map result in changes in the conditional probability of association of locations and associated events?

4. What strategies will students employ in the map relocation and recall of information tasks?

Method

Map-like displays containing names of battles of the American Revolution and related factual information regarding the battle were presented to 72 middle school students enrolled in programs for students with LD.

Materials

Three map conditions were employed to examine the effects of mnemonic encoding and reconstructive elaborations relative to a non-mnemonic map (Brigham, 1992).

1. Non-mnemonic control map with realistic drawings of buildings, soldiers, weapons, etc. found in the time period,

2. Mnemonic map with mnemonic-keywords of verbal labels, and

3. Elaborative map with reconstructive elaborations of the verbal labels and event information.

Procedure

One of three maps and an accompanying oral passage naming each location and describing a factual event related to the location were presented to the subjects individually. Next a brief distractor task, designed to prevent rehearsal was provided. Finally, subjects were asked to indicate the location of each battle by name and to recall any information they could relative to that battle on a test map with an empty box at each location. A 3 organization by 2 recall measure (location vs. event information) Analysis of Variance was conducted on the resulting data.

Results

<u>Descriptive Data</u>

Means and standard deviations calculated for each of the primary variables, recall of location and recall of event information are presented on Table 1. There were 24 subjects in each group.

Inspection of the mean and standard deviations for the groups reveals that the mnemonic and elaborative group attained higher mean scores for both variables compared to the control group. Evidence of a floor effect is present in the control and mnemonic groups for the variable, Event Recall. Due to the constrained variance indicated by the floor effects, nonparametric statistics were employed to confirm parametric statistics.

Table 1
Mean Scores and Standard Deviations for Recall of Location and Event Information

Variable		Group		
		Control	Mnemonic	Elaborative
Location	Mean	2.88	6.03	5.58
	(SD)	(2.15)	(2.83)	(2.92)
Event	Mean	0.42	1.29	3.71
	(SD)	(0.58)	(1.46)	(2.58)

<u>Map Relocation</u>

Significant differences were found between the means of the experimental groups for location (p.= .0001). Multiple comparisons for recall of location indicated that the mnemonic and elaborative groups did not differ from each other but were both significantly greater than the control group. Figure 1 presents a plot of the means for correct recall of location by group.

<u>Recall of Event Information</u>

Significant differences were found between the means of the experimental groups for location (p.< .0005). Multiple comparisons indicated that recall of event information was significantly greater for the elaborative group than the mnemonic or control groups which did not differ significantly from each other. Figure 2 presents a plot of the means for correct recall of event information by group.

Figure 1: Locations
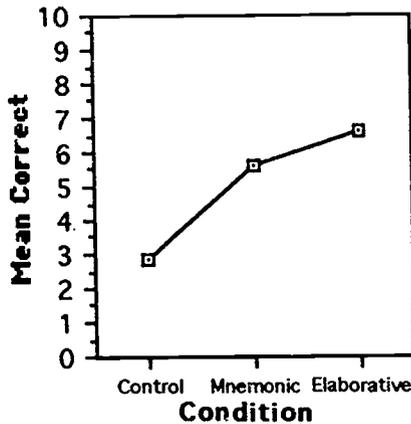
Figure 2: Events
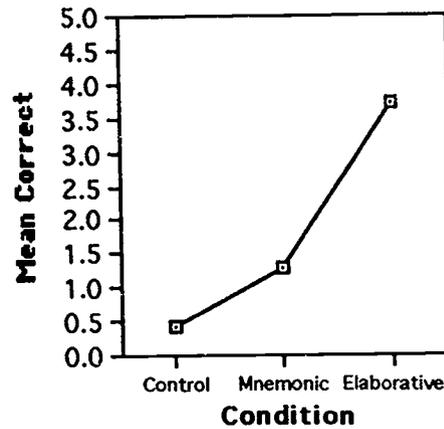
Association of Location and Event-Information

Significant differences between location and event recall were found in each group. Figure 3 presents a plot of the means for recall of location and event information by group.

The strength of association for the elaborative group was significantly greater than either the mnemonic or control groups which did not differ significantly from each other. Mnemonic and elaborative subjects recalled event information correctly more often after a correct than incorrect location. Conditional probabilities were virtually the same for control subjects. Table 2 presents mean conditional probabilities and standard deviations.

Strategy Reports

Subjects reported using prior knowledge, verbal rehearsal, visual reconstruction, mnemonics, and no strategy. The mnemonic strategy (reported only by mnemonic and elaborative subjects) was significantly and positively correlated with recall ($r = .44$ for location, $.36$ for events). Reports of "no strategy" were significantly and negatively correlated with recall ($r = -.26$ for locations, $-.26$ for events). Other strategies were nonsignificantly though negatively correlated with recall.

Figure 3:
Association of Variables
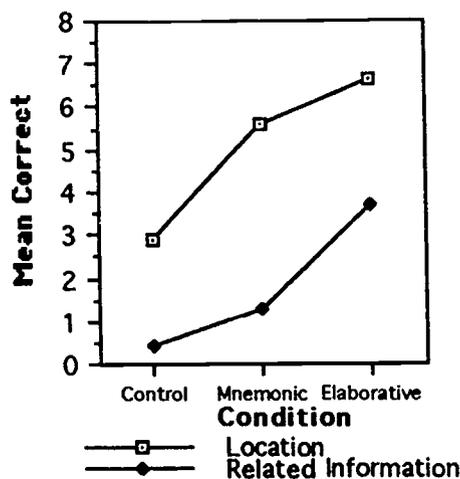
Table 2:
Conditional Probabilities

	Condition		
Probability	Control	Mnemonic	Elaborative
$P(C_r|C_f)$	.1584	.1665	.6229
SD	.2537	.1658	.2798
$P(C_r|W_f)$	.0494	.0957	.2868
SD	.0640	.2106	.2236

Conclusions

1. Recall of location was significantly enhanced by mnemonic keyword encoding of their verbal labels.
2. Mnemonic encoding of location labels produced no significant gain in recall of information regarding the events at the various locations.
3. Locations were more often recalled than events.
4. Only elaborative encoding resulted in a significant difference in the conditional probability of associating events with their locations.
5. Mnemonic strategy use was positively and significantly correlated with recall measures. Using no strategy was negatively and significantly correlated with recall measures.

Instructional Implications

Maps and spatial displays containing abstract and unfamiliar information do not appear as likely to promote recall as those in previous studies. The features on this map were all the same kind of thing (battles) and thus did not lend themselves to encoding of locations and events. Therefore, inclusion of a content-dependent strategy such as elaborative encoding in spatial displays may be expected to enhance recall of features and feature-related information.

References

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Battle Names, Associated Information Taught, Keywords, and Elaborations

Battle	Associated Information	Keyword	Elaboration
Ticonderoga	They captured canon which would be used later.	Tiger	Tiger firing a cannon
Saratoga	After Saratoga, the French helped them.	Sarah, wearing toga	Sarah, wearing a toga and eating french fries.
Cowpens	They hid behind a hill for an ambush.	Cow	Cow hiding behind a hill (peeking over).
Dorchester	They made the enemy ships leave the harbor.	Door	Ship sailing out a door.
Trenton	They attacked on Christmas night.	Tent	Tents with a decorated Christmas Tree
Brandywine	They stopped an attack on the capitol.	Brandy	Colonist hitting a brandy jug on a stop sign.
Princeton	They kept fires burning so the enemy would think they were still in camp.	Prince	A prince sitting beside a campfire
Vincennes	They waded through a flood to get to the battle.	Fence	Fence surrounded by flood waters
Kakaskia	The enemy ran out of supplies.	Basket	Soldier looking in an empty supply basket.
Cahokia	Fought at the site of a large Indian mound.	Choke.	Person sitting on an Indian mound and choking
Yorktown	Last major battle of the war.	Fork	Fork flying a white flag of surrender.
Camden	They were sick because of bad food.	Camel	Sick looking camel eating at a cook pot with a skull and crossbones rising from it.
Paoli	They were attacked while they were sleeping.	Pay check	Sleeping soldier dreaming of a paycheck.
Germantown	They started shooting at each other in the fog.	Worms	Two worms surrounded by a cloud of fog pointing rifles at each other.

Examples of Map Illustrations

Non-mnemonic Representation

The non-mnemonic control maps contained realistic drawings of buildings, soldiers, weapons, etc. found in the time period. The symbols used on the map were selected in order to be more distinctive than many maps used in textbooks which use the same symbol (e.g., an explosion or fire) to represent the locations of the battles.

Ticonderoga

Paoli

Keyword Mnemonic Representations

The mnemonic map contained illustrations of the mnemonic-keywords for the names of the battles. Each keyword reconstructed the to-be-learned information into an acoustically simialr term (the keyword) already known by the learner. At the time of retrieval, the student thinks of the keyword, recalls the keyword illustration and rellocates the illustration on the map.

Ticonderoga (Tiger)
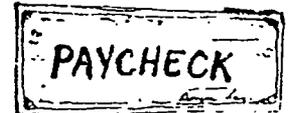
PAYCHECK

Paoli (Paycheck)

Reconstructive Elaborations

The elaborative map cantained reconstructive elaborations of the battle names and information about an event associated with that battle or an outcome of the battle. The reconstructive elaboration depicted the illustration of the battle name keyword interacting with the event information. At the time of retrieval, the student thinks of the keyword, recalls the elaborative illustration and uses the interaction as a cue to recall the associated information. Map rellocations are done using the image as in the mnemonic condition.

Ticonderoga (Tiger)

Paoli (Paycheck)