Journal of Experimental Psychology:
Learning, Memory, and Cognition
1994, Vol. 20, No. 6, 1471-1485

0278-7393/94/$3.00

Memory for Music: Effect of Melody on Recall of Text

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The melody of a song, in some situations, can facilitate learning and recall. The experiments in this article demonstrate that text is better recalled when it is heard as a song rather than as speech, provided the music repeats so that it is easily learned. When Ss heard 3 verses of a text sung with the same melody, they had better recall than when the same text was spoken. However, the opposite occurred when Ss heard a single verse of a text sung or when Ss heard different melodies for each verse of a song; in these instances, Ss had better recall when the text was spoken. Furthermore, the experiments indicate that the melody contributes more than just rhythmical information. Music is a rich structure that chunks words and phrases, identifies line lengths, identifies stress patterns, and adds emphasis as well as focuses listeners on surface characteristics. The musical structure can assist in learning, in retrieving, and if necessary, in reconstructing a text.

Phenomenologically, it certainly appears that hearing a melody to a well-known song can cue the text and, vice versa, hearing the text can cue the melody. For example, if you hear the opening bars or notes of the national anthem, then you probably immediately recognize the song and can recall at least the first portion of the text. Similarly, hearing the words to an old song (such as "on top of old smokey") or to an advertising jingle (such as "sometimes you feel like a nut") most likely brings the melody and the majority of the text to mind even if you have not heard that song or jingle for many years. Thus, it appears that the melody and text cue each other even over very long time delays.

Why are the text and melody effective cues for each other even after long retention intervals? Several hypotheses could explain this phenomenon. For instance, it could be that the text and melody in combination make the memory more unique or more connected and therefore more easily accessible. Or, perhaps the sheer repetition of the example songs established a strong, stable memory. Finally, songs may be stored or processed neurologically in different ways than text (e.g., Samson & Zatorre, 1991), which could facilitate retrieval.

On the other hand, it could also be the case that any textual material, so rehearsed, even with sufficient rhyme and rhythm, will be as well recalled as a song and as easily cued as a song. That is, there may be nothing unique about the melody's contribution to memory. After all, counting out rhymes such as "Eenie Meenie Minie Mo" are also quite memorable, and they are not sung (Kelly & Rubin, 1988). Furthermore, choirs occasionally learn a new song by having each member rehearse each melodic part with "la la las" until the music has been mastered, then adding the text. Learning the words and melody separately and then putting the two together would be a preferable strategy, even for an individual singer, if the melody and words do not facilitate each other's learning. From this perspective, the melody may be an additional burden on a limited capacity memory system.

The purpose of this article is to first determine whether music aids learning and recall of the text. That is, can some of the memorability of songs be attributed to having a melody, or are the words to songs memorable on their own because of the rhythmical and poetic properties that exist within the text (Wallace & Rubin, 1991)? The second purpose of this article is to begin to address when the text is more memorable with music and then to begin to address what characteristics of the melody are critical for facilitating recall.

Prior Experimental Evidence

There is experimental evidence of very long-term memory for songs, as suggested in the opening paragraph of this article. Recall of some lyrics is greater when cued with the melody than when cued with the title (Bartlett & Snelus, 1980). Similarly, Rubin (1977) found that subjects recall more of the text when provided with the melody of a well-learned song ("Star Spangled Banner") than when given no cue. Thus, for well-known songs, the melody appears to be a better retrieval cue than no melody or the title.

However, the songs studied in previous experimental literature have been well rehearsed with sufficient opportunity to learn both the melody and the text to some criterion level. Neither of these experiments shows whether the text could have been as equally well learned and recalled if it had been

Portions of this article were presented in November 1989 at the annual meeting of the Psychonomic Society in Atlanta; in October 1990 at the Association for Consumer Research, in New Orleans; and in July 1991 at the International Conference on Memory, in Lancaster, England.

This research was supported in part by National Science Foundation Grants BNS-8410124 and BNS-9010074, the Control Data Fund, and the Fuqua School of Business at Duke University.

I thank Kristin Austin, Marjorie Silverman, Lalitha Vadlamani, and Paige Weatherspoon for their assistance in collecting and scoring the data for these experiments. In addition, I thank Jim Bettman, Julie Edell, Lynn Hasher, Nancy Keeshan, Amna Kirmani, David Rubin, and Valarie Zeithaml for their comments on a version of this article. Reviewers' comments on earlier drafts and suggestions for Experiment 4 were most helpful.

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initially encoded without the melody. Thus, we still do not know whether the melody facilitates recall above and beyond other properties present in the text. We do know, however, that once encoded together, the melody serves as an effective recall cue, just as context can serve as an effective recall cue in some cases.

Previous research also documents that an unknown, short song text is better recognized when the text is presented with its original melody than when it is presented with a new melody or a melody previously presented with a different text (Crowder, Serafine, & Repp, 1990; Samson & Zatorre, 1991; Serafine, Crowder, & Repp, 1984; Serafine, Davidson, Crowder, & Repp, 1986). Thus, for novel, short melodies, the original melody and text pairing is better recognized than a mismatch or than a new-melody pairing. This finding is analogous to standard evidence from paired associate learning. Originally studied word pairs A–B and C–D are better recognized than mismatched pairs A–D or new pairings C–E. Because the word pairs co-occur they are linked in memory, but they do not necessarily form a single, integrated memory. Analogous conclusions can be drawn from the melody and text recognition experiments. When melody and text co-occur at initial presentation, then they may be more easily recognized in the original pairings simply because of the co-occurrence and because crossed pairings typically disrupt recognition performance. By this type of argument, any other item—an image for example—that co-occurs with the text could improve recognition when the original pairing is preserved.

Crowder et al. (1990) presented some evidence that the melody actually alters the encoding of the text. As with word pairs, when the semantic or imageral connections between word pairs are elaborated, recognition is strengthened. Similarly, if the melody elaborates the connection to the text through whatever mechanism, then recognition will be strengthened.

Nevertheless, the initial question raised at the beginning of this article remains unanswered: If the text is first heard out of the context of the melody, can it be equally well learned, recalled, recognized, or all of these, as when it is heard in the context of the melody? Certainly, once the text and melody are paired together at presentation, each is more easily recognized with the original pairings. However, it is not known whether either could have been better learned in isolation than as a pair.

Collectively, the data indicate that the original melody, once learned with the text, can provide a recall cue. However, these data do not address the question of whether the melody actually facilitates learning and recall of the text. That is, although the melody may cue recall or recognition, it could still distract from learning and could still make acquisition of the text more difficult simply because it is an additional piece of information to be attended to and to be learned. Thus, at learning and at recall, if the melody does not add more than a context, then it could compete with the text for recall effort rather than actually facilitate recall. Given a memorable poetic text, can subjects just as easily learn and recall the text without the melody as they can learn and recall the text and melody together? Thus, does the melody contribute anything to recall *beyond a unique context*?

Furthermore, these data do not indicate whether the melody is an effective cue simply because of the co-occurrence of the melody and text or because of other factors such as the informational cues the melody provides about the text. This article presents findings to support the latter position and suggests that the richness of information provided in the melody facilitates recall.

Theoretical Framework

The intuitive hypothesis driving this analysis is that the melody will facilitate learning and recall of the text above and beyond what is contributed by the rhythm or the rhyme present in the text. The general framework guiding this expectation evolved from work on the role of structural features in memory representations for texts and for songs. In general, memory structures such as rhyme and meaning link components of the text together, constrain textual components so that changes are unlikely, and thus preserve characteristics across recalls (Rubin & Wallace, 1990; Wallace & Rubin, 1991). The combination of music and text is expected to function in a similar manner to the combination of rhyme and meaning.

The underlying notion is that the melody provides rich information about the features of the text as well as a direct connection between components of the melody and components of the text. These connections then are access points or cues to memory. Thus, thinking about some component of the melody will cue the parallel component of the text.

When a subject recalls a melody, the subject then knows the length of the accompanying textual line, how many syllables belong on that line, and how many stressed syllables occur on that line. In addition, there is order information about phrases. This information provides both connections within memory that should strengthen the text memory as well as cues to guide text memory search or to indicate that a search is needed.

Furthermore, the melodic cue contains important sequential information, which provides an order of encoding and a comparable order of recall. Sequential recall limits the likelihood of skipping over portions of the material without being aware of the omission. Finally with verse structures, sequential information provides an access point (the opening of the next verse) from which one can pick up recall again even if a portion is omitted. For example, unlike Hamlet's soliloquy or the preamble to the U.S. Constitution in which subjects start recall, reach a stopping point, and cannot continue (Rubin, 1977), for songs, subjects have a natural prompt for picking up recall again at the beginning of the next verse.

Finally, a melody can also provide constraints for text recall, so that if a portion of the text cannot be readily recalled, then there is a high probability that the correct text can be generated or reconstructed. For example, if you try to recall a line from Appendix A, "I'd go today to my _____love," and know the melody so that you know there is an omitted word and that the word is one syllable, then you can guess the likely word choice. In fact, there are relatively few choices that fit these constraints (e.g., true, own, dear, and sweet), many of which occur in recalls. Notice, however, without knowledge from the melody, there would be no reason to insert any word in the above phrase because the lyric makes a complete

sentence without an adjective. The arguments about potential reconstruction do not imply that reconstruction is the preferred mode of recall for songs; rather, given a need for reconstruction, the melody has the potential for making reconstruction more accurate. Whether songs (or any memories) are recalled as episodes or are reconstructed probably depends on a variety of factors such as the need for accuracy and the ease of recall. The perspective in this article is that both reconstruction and episodic recall can occur in recall of texts such as ballads.

Nevertheless, the melody is an additional piece of information; thus, for it to be effective in aiding recall it must be easily acquired. Otherwise, the melody will place an additional burden on attention and on memory capacity. Ease of acquisition should be affected by clarity, repetition, and simplicity. In addition, gestalt principles such as proximity, similarity, and reversal should also affect ease of acquisition (Namour, 1990). For the melody to facilitate recall of the text, it is not necessary that the melody be so learned that the subject can sing the melody accurately; rather, for the purposes of text recall, the subject needs only to learn enough of the melodic form to cue the text, to provide line and syllable length information, to link or chunk the text, and to give rhythmical information. Thus, recall errors in the actual notes sung would not be disruptive for purposes of recalling the text.

The experiments that follow show that music, when repeated, simple, and easily learned, can make a text more easily learned and better recalled than when the same text is learned without any melody (Experiment 1). However, when the melody does not repeat and is therefore presumably less well learned, the melody does not always facilitate text recall (Experiments 3 and 4). Additionally, Experiment 4 also suggests that the overall form of the melodic contour, particularly simplicity and symmetry, facilitates learning of the text.

The experiments also provide some clue about which components of the music are critical for facilitating recall. In general, any single feature of the music (i.e., rhythm [Experiment 2] or the mere presence of a melodic contour [Experiments 3 and 4]) is expected to be insufficient to account for the impact of music on recall. Rather, the entire collection of information provided by the music is necessary to improve learning and recall. It is not just the mere co-occurrence of melody and text but the richness of the interaction in that co-occurrence as well as the constraints provided by that interaction that are effective for memory.

The stimuli used in these experiments are from the ballad tradition. The unique properties of this tradition are the simplicity of the melody, the regularity of the rhythm, the presence of end rhyme, and the concrete imagery provided in the text (Wallace & Rubin, 1991). These properties are fairly characteristic of many songs in our culture. Therefore, the findings reported in this article should extend to many other song genres, particularly ones with simple melodic structures.

Experiment 1

The first experiment was designed to show that music can facilitate recall of a text. Subjects heard three verses of a ballad that were either spoken or sung and were then asked to recall in writing the text that they had heard. The accuracy at each trial was expected to be greater for the sung condition than for the spoken condition.

Method

Materials. The ballads from *The Frank C. Brown Collection of North Carolina Folklore* (White, 1952; 1957) were searched for verses with clear end rhymes, consistent rhythmical patterns, accompanying melodies, no archaic language, and events or actions that were understandable when heard apart from the context of the rest of the ballad. Three verses from each of two ballads were selected. These excerpted ballads, referred to as "Sailing" and "Dressed," are listed in Appendix A. Each excerpted ballad contains 80 to 85 words.

A sung version and a spoken version of each ballad excerpt were prepared. An undergraduate with extensive choral training sang and read each excerpted ballad onto cassette tape. To assure clarity, two independent observers listened to each version and reported the words line by line to the experimenter. Neither observer misunderstood any of the words in either version.

Subjects. Sixty-four undergraduates from an introductory psychology class were subjects in this experiment. Familiarity with the ballad tradition was assessed on a 4-point scale for each of 29 popular North Carolina ballads listed by title. Among the 29 titles were the ballads from which the stimulus verses were taken. No subjects were familiar with the stimulus titles.

Before beginning the experiment, each subject indicated how many years he or she had participated in some singing activity such as a choir or chorus and how many years he or she had played a musical instrument. Most subjects had some musical training. The mean number of years of singing experience was 2.25 years, and the mean number of years playing a musical instrument was 4.79 years. Seventy-seven percent of the subjects reported being able to read music. Only 7 out of 64 subjects had neither experience singing nor experience playing a musical instrument. These 7 subjects were distributed across conditions.

Procedure. Subjects were informed that they would hear three verses of a ballad and would be asked to recall in writing the words of the ballad. Furthermore, subjects were instructed to try to recall the words as close to verbatim as possible, and if they could not recall the verses verbatim they were to recall whatever they remembered.

Subjects listened to one of the two ballads, either "Sailing" or "Dressed," five times and recalled the words of that ballad in writing after the first, second, and fifth repetitions. Words were recalled after the first and second trials because prior experiments showed that subjects experience difficulty learning verses on the first trial but become moderately accurate by the second trial. Recall was not required on Trials 3 and 4 because in pilot tests, subjects became annoyed with and tired of writing the text so many times. Trial 5 was included to ensure that any benefits found from the melody persisted.

As a planned distraction task, subjects also heard and learned the other ballad, following the same procedure. Data from this task were not scored or analyzed.

Subjects then recalled the first ballad in a delayed-recall task. The time between recalling the first ballad on the fifth trial and recalling the ballad in the delayed task was about 20 min. The delayed-recall task provided further evidence of the persistence of any improvement in recall performance.

Assignment to this condition was random as was assignment to learning "Sailing" or "Dressed."

Results

Recall performance. The percentage of words recalled verbatim was calculated for each subject; that is, the number of

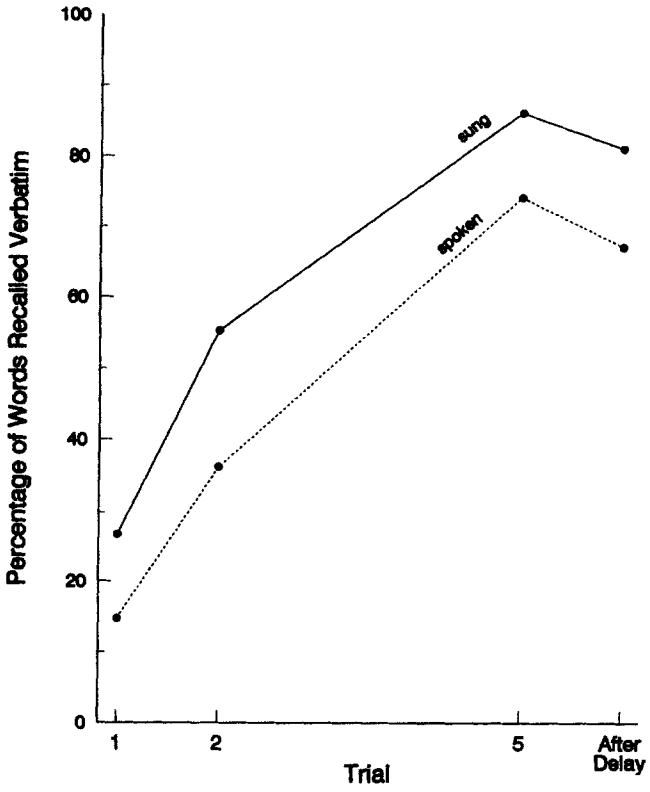

Figure 1. Recalls for three-verse segment.

words recalled exactly from the original text and in the same approximate order was counted for each subject. Substitutions and contractions were not considered correct because they do not preserve either the sound or the rhythm of the original text. A repeated measures analysis of variance (ANOVA), with condition (sung or spoken) and ballad ("Sailing" or "Dressed") as between-subjects variables and trial (1, 2, and 5) as a within-subject variable, compared verbatim recall for the sung and spoken conditions.

Verbatim recall was significantly greater for the sung condition than for the spoken condition, $F(1, 60) = 19.95, p < .0001$, $MS_e = 0.05$. Performance significantly improved across the three trials, $F(2, 120) = 598.96, p < .0001$, $MS_e = 0.009$. In addition, there was a significant interaction of trial and condition, $F(2, 120) = 3.27, p < .05$, $MS_e = 0.009$, reflecting a greater difference in verbatim recall at Trial 2 between the sung and spoken conditions than at Trial 1 or Trial 5. Finally, there was a marginal main effect of song, $F(1, 60) = 3.36, p < .08$, $MS_e = 0.05$, with "Sailing" being marginally easier to recall than "Dressed" at every trial. No interactions with song were near significance. As can be seen from Figure 1, verbatim recall was very good by the fifth trial.

To assure that musical training did not influence the results of the experiment, another repeated measures ANOVA was conducted, with trial (1, 2, and 5) as a within-subject variable, condition (sung vs. spoken) as a between-subjects variable, and years of singing experience, years playing a musical instrument, and ability to read music (yes or no) as covariates. Neither years of singing experience, years playing a musical instrument, nor ability to read music, $F(1, 59) = 0.44, 0.35, 0.01$, respectively, $MS_e = 0.05$, significantly affected recall performance. However, although subjects were by no means trained musicians, they were also not musically inexperienced. Perhaps, with a greater range of musical talent, experience, or both, some effect of musical experience on recall would be observed.

For the delayed recalls, an ANOVA with condition (sung or spoken) and ballad ("Sailing" or "Dressed") as between-subjects variables was performed using verbatim recall as the dependent measure. Even after a 20-min delay, there was still a significant difference between conditions, $F(1, 63) = 11.77$, $p < .001$, $MS_e = 0.02$, with the sung condition having better verbatim recall than the spoken condition. There was almost no forgetting over the delay interval, even though subjects heard and learned another ballad.

Recall errors. The types of recall errors observed were quite similar to recall changes and errors reported elsewhere for ballad recall (e.g., Wallace & Rubin, 1988). For example, the line "Oh if I had a sailing ship" was recalled as "I wish I had a sailing ship," in which the error preserves both the rhythm and the meaning of the line. Subjects in the sung condition tended to attempt recall of more lines in Verse 3 than did subjects in the spoken condition, most likely because the music provided a marker to pick up recall again at the beginning of each verse. Furthermore, in the sung condition, subjects indicated more awareness of the verse structure by identifying line breaks more accurately than did subjects in the spoken condition. In the sung condition, more word and line omissions were indicated than in the spoken condition. For the sung condition, subjects more clearly indicated how much was missing (a word, a full line, or several lines; even the correct number of omitted lines); whereas subjects in the spoken condition had less clear indications of the size of the omission.

To quantify the qualitative difference between the sung and spoken conditions, recalls of Trial 2 were scored for (a) the number of lines for which any recall was attempted in Verse 3, independent of percentage recalled correctly; (b) the percentage of times a line break was incorrectly indicated; and (c) the number of times an omission was not indicated and should have been (or was indicated and should not have been). For all error analyses in Experiment 1, only Trial 2 was examined. On Trial 1, recalls were so poor that accurate measures were hard to judge reliably and accurately, and on Trial 5, recalls were so high that few errors were observed. However, on Trial 2, recalls fell around the 50% mark, which was preferable for analyzing errors.

There was a significant difference between conditions on the percentage of incorrect line breaks, with the sung condition having more accurate line structure, $F(1, 59) = 5.65, p < .02$, $MS_e = 0.02$; means equal 8.2% and 15.9% for sung and spoken conditions, respectively. The sung condition also had significantly more lines in Verse 3 for which recall was attempted, $F(1, 59) = 5.61, p < .02$, $MS_e = 1.25$; means equal 2.70 and 2.08 for sung and spoken conditions, respectively. However, there was no significant difference between conditions for the number of incorrect omissions, $F(1, 59) = 1.81, p > .18$, $MS_e = 0.54$; means equal .35 and .58 for sung and spoken conditions, respectively. Although the number of omissions does not differ

significantly, the quality of the omissions did appear to vary. For example, no subjects in the spoken condition indicated how many syllables were missing in an omission; however, in the sung condition, subjects occasionally identified the number of missing syllables.

As evidence of whether rhythm information was being encoded in both the sung and spoken conditions, recalls on Trial 2 were scored for the number of syllables correctly recalled. This number was subtracted from the number of syllables in the original text to provide a measure of syllable or rhythm errors. This measure allows for distortions in the sound of the words that still preserve the correct number of syllables for the line. For example, for the line "She made the knocker ring clear," if a subject recalled "she made her knocking sound clear," then the verbatim score would be 50% correct, but there would be zero syllable errors.

There was a significant difference in the number of syllables recalled by condition, $F(1, 60) = 13.68$, $p < .0005$, $MS_e = 25.93$; controlling for song and line, such that the sung condition had fewer syllable errors than did the spoken condition (mean syllable errors per line were 2.39 for the sung condition and 3.85 for the spoken condition). Therefore, subjects in the spoken condition learned less of the rhythm, as indicated by the number of syllables recalled, than did subjects in the spoken condition.

In summary, subjects in the sung condition appeared to be more aware of structural elements of the ballad such as rhythm and line breaks than did subjects in the spoken condition.

Discussion

For both ballad excerpts, music facilitates recall in the initial learning phase as well as in the delayed-recall task; verbatim recall of the text is greater when the text is sung than when it is spoken at every trial and at a delayed-recall task. In addition, recalls of the sung text, relative to the spoken text, reveal greater knowledge of structural elements such as rhythm and lines breaks as well as more attempted recall of the last verse. The superior recall of a sung text over a spoken text occurs even when subjects know in advance that they are not required to learn or recall the melody.

The stimulus materials in this experiment repeat the same melody for each verse, offering several potential advantages. Apart from mere repetition and the increased ease of acquisition with repetition, hearing multiple verses sung to the same melody may facilitate abstraction of basic melodic properties. In ballad verses, for example, the basic beat structure is the same for each verse even though there may be slight variations across verses as additional unaccented syllables are inserted. Thus, hearing multiple verses accentuates the common beat structure. Similar results are found in the encoding-variability literature in which encoding material in different ways sometimes improves recall (see Hintzman, 1976, for a review). Identifying basic melodic structures should facilitate recall because the structures can then serve as an encoding and retrieval cue.

The melody could serve as a retrieval aid, encoding aid, or both through several mechanisms. First, the melody could assist subjects in distinguishing one verse from the others by making each verse a coherent unit. Second, the melody could act as a frame, cuing subjects to search for lines that fit the entire frame, thus reducing the chances of a subject omitting a line. Third, the structure of the music may provide cues about the nature of the text such as the number of syllables in a line, the stress pattern or number of accents in a line, the number of lines in a verse, and where verses begin and end. This information provides at least a search cue and an organizational structure. Fourth, the melodic contour sequences lines and verses as well as links lines with each other. Fifth, the structure of the music, such as the rises and falls in the melody, the accents, and the tone, may accentuate particular components of each verse thus making those components more unique and more memorable.

In addition to the overall advantage of hearing a text sung, some songs may be easier to recall than others; for example, "Sailing" is easier to recall than is "Dressed." In this instance, there are differences in the text structure and in the melodic structure. The word choices in "Sailing" seem to be more logical and typical of normal speech; whereas, for "Dressed" the word choices seem more unique to that particular story line and less typical of everyday speech. For example, the phrases "knocker ring clear" and "lily white hand" from "Dressed" are not typically found in everyday conversation; however, there are no such unusual phrases in "Sailing." In addition, the words in "Sailing" repeat slightly more often than do the words in "Dressed." For example, "sailing ship" appears in every verse of "Sailing"; however, there are no comparable repetitions in "Dressed." On the other hand, these differences could also have had the opposite effect; that is, because "Dressed" is more unique it could have been easier to recall.

Not only is the text of "Sailing" somewhat simpler, the melody is also more repetitive. For "Sailing," the melody of each line is a near repeat of the first line, which should make the melody much easier to learn. For "Dressed," each line has a different melody. On the other hand, the repetition in "Sailing" could have had the opposite effect on recall; that is, the repetition in melody lines could have provided less of a cue to the sequencing of lines within a verse.

In the foregoing discussion, music has been considered as a facilitator of verbal recall. The reverse proposition, that music can be a distractor, is also plausible. Music may facilitate recall when it is easily and sufficiently learned and understood and can therefore serve as an encoding or retrieval device. When heard only one time, music may be more of a distractor, perhaps because of its novelty or complexity. In addition, subjects may need more than one exposure to a melody to learn enough of the melody to make use of it at recall. Experiments 3 and 4 address this issue.

Experiment 2

The first experiment demonstrated that music can facilitate verbal recall. The purpose of Experiment 2 was to assess whether music contributes more than just rhythmical structure.

Wallace and Rubin (1988) have shown that recall of a text is better when the text is spoken to a background beat than when the text is merely spoken, indicating that rhythmical structure can facilitate recall of text. A background beat is necessary to

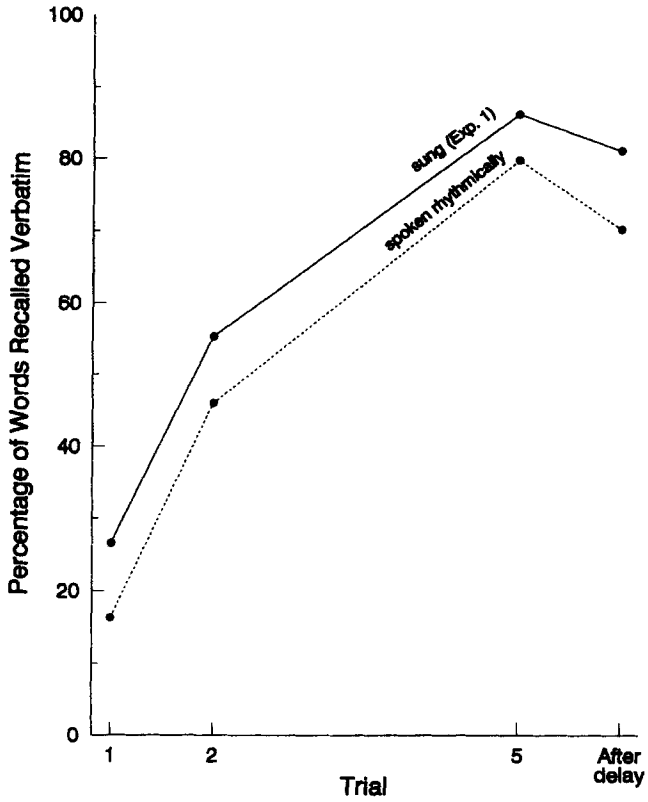

Figure 2. Recall of rhythmical presentation.

emphasize the rhythmical structure for subjects; presenting the text with rhythmical intonation but without the background beat does not facilitate recall.

Experiment 2 extended the Wallace and Rubin (1988) results to compare the impact of rhythmical and musical structures on verbal recall. Subjects in this experiment heard the three verses from Experiment 1 spoken in a rhythmical intonation with a beat tapped in the background. Verbal recalls of the verses are compared with recalls from the sung version of Experiment 1. If music only contributes rhythmical structure to verbal recall, then there should be no differences between the recalls in this experiment and the sung verses from Experiment 1. The opposite result was predicted—the sung verses should have higher recall than the rhythmical verses.

Method

Materials. The verses used in Experiment 1 were used in this experiment (three verses of "Sailing" and three verses of "Dressed"). The performer who recorded the verses for Experiment 1 also recorded the verses for this experiment. Verses were spoken with a rhythmical intonation, emphasizing the rhythmically stressed syllables. In the background, a metronome tapped in synchrony with the verses. The metronome continued to tap through the rest at the end of Lines 2 and 4 of each verse, further emphasizing the rhythmical structure of the ballad verses. The background tap did not sound awkward and had been shown to be necessary to facilitate recall (Wallace & Rubin, 1988).

Subjects. Twenty-one undergraduates who were partially fulfilling an introductory psychology requirement served as subjects. These subjects had a mean of 4.3 years of playing a musical instrument and 1.3 years of choral experience. Eight subjects reported not being able to read music. The musical training of subjects in this experiment did not differ significantly from that of subjects in Experiment 1.

Procedure. The procedure was identical to that used in Experiment 1. Subjects heard one of the three verse ballads ("Sailing" or "Dressed") five times and recalled the text of the ballad in writing after the first, second, and fifth repetitions. Subjects then learned the other ballad, which was not scored. Finally, subjects recalled the first ballad in a delayed-recall task. The time between the fifth recall of the first ballad and the delayed recall was about 20 min.

Results and Discussion

Recall performance. Using a repeated measures ANOVA, verbatim recall was compared between the rhythmical and sung versions with condition (rhythm from Experiment 2 vs. sung version from Experiment 1) and song ("Sailing" vs. "Dressed") as between-subjects variables and trial as a within-subject variable. There was a significant difference between conditions, $F(1, 54) = 5.04, p < .03, MS_e = 0.06$, and across trials, $F(2, 108) = 463.86, p < .0001, MS_e = 0.01$. The sung condition resulted in better verbatim recall than the rhythmical condition. No other effects or interactions were significant. Figure 2 illustrates these results.

For the delayed-recall condition, there was a significant effect of condition, $F(1, 54) = 4.46, p < .04, MS_e = 0.04$, with the sung version having better recall than the rhythmically spoken version.

As in Experiment 1, an additional repeated measures ANOVA was conducted to test the effect of musical training on recall performance of subjects in the rhythmical condition. Trial (1, 2, and 5) was a within-subject variable, condition (sung vs. rhythmical) was a between-subjects variable, and years of singing experience, years playing a musical instrument, and ability to read music (yes or no) were covariates. None of the musical training variables had a significant effect on recall performance, $F(1, 17) = 0.77, 0.09, 1.60$ for singing, playing an instrument, and reading music, respectively; $MS_e = 0.08$.

Recall errors. As in Experiment 1, four types of recall errors were calculated for this experiment. First, the difference between the number of syllables recalled and the number of syllables present on each line was calculated for each subject. A repeated measures ANOVA, with condition and song as between-subjects variables and line as a within-subject variable, revealed a marginally significant difference between the rhythm condition and the sung condition, $F(1, 54) = 3.94, p < .06, MS_e = 29.30$. The sung condition resulted in slightly fewer syllable errors than did the rhythm condition (2.39 vs. 3.17, respectively).

Second, the number of lines in Verse 3 for which any recall was attempted was calculated for each subject. There was a marginally significant difference between the sung and rhythmical condition on this measure, $F(1, 54) = 3.95, p < .06, MS_e = 1.75$.

Third, the percentage of lines recalled for which a line break was incorrectly indicated was also calculated for each subject. There were no significant differences between the rhythmical and sung conditions on this measure, $F(1, 54) = 0.01, p > .83, MS_e = 0.02$.

Fourth, the number of incorrect omissions was calculated for each subject. Again, there were no significant differences between the rhythmical and sung conditions, $F(1, 54) = 2.28$, $p > .13$, $MS_e = 0.52$.

In summary, music contributed more than rhythmical information. Sung verses have better verbatim recall than do rhythmically spoken verses, even over a longer retention. Furthermore, according to the error analyses, slightly less structural information was acquired in the rhythmical condition relative to the sung condition. Even syllable information appeared to be slightly easier to acquire in the sung condition than in the rhythmical condition. Access or recall of lines in Verse 3 was slightly facilitated by the sung condition relative to the rhythmical condition.

Experiment 3

In Experiment 1, subjects had ample opportunity to learn the melody. Because each of the three verses was sung to the same melody, the melody was heard three times as often as the text. In this experiment, subjects heard only one verse and thus had equal exposures to the melody and the text.

The purpose of this experiment was to determine whether hearing one sung verse would facilitate recall in the same manner as hearing multiple verses each of which are sung in the same melody. Hearing multiple verses to the same melody could mean that the melody is better learned because it is heard more often. Thus, if the melody was not so well learned as in Experiment 1, then perhaps it would not serve as an adequate encoding or retrieval cue and might actually serve as a distraction.

Method

Materials. The first verse from each of the 2 three-verse ballads in Experiment 1 was excerpted from the tapes used in Experiment 1. Each verse made sense when heard out of context and depicted a miniscene from the ballad.

Subjects. Thirty-nine undergraduates participated in this experiment in partial fulfillment of an introductory psychology course credit. They averaged 4.7 years of playing a musical instrument and 1.8 years of choral experience. Fourteen subjects reported not being able to read music; these subjects were randomly distributed between conditions. There were no significant differences in musical training between subjects in this experiment and those in Experiment 1.

Procedure. The procedure was identical to that in Experiment 1. Subjects were informed that they would first hear one verse (either "Dressed" or "Sailing") and then recall that verse in writing. They were instructed to try to recall the verse as close to verbatim as possible. Subjects recalled the text in writing on the first, second, and fifth trials. As a planned distractor task, subjects heard and recalled the remaining verse following the same procedure. The second verse was not scored. Subjects then recalled the initial verse in a delayed-recall task.

The time between the fifth trial and the delayed task was about 10 min. Subjects were randomly assigned to the sung or spoken conditions and randomly learned "Sailing" or "Dressed."

Results

Recall performance. As in Experiment 1, a repeated measures ANOVA, with trial as a within-subject variable and song ("Sailing" and "Dressed") and condition (sung vs. spoken) as between-subjects variables, examined the effect on percentage of words recalled verbatim.

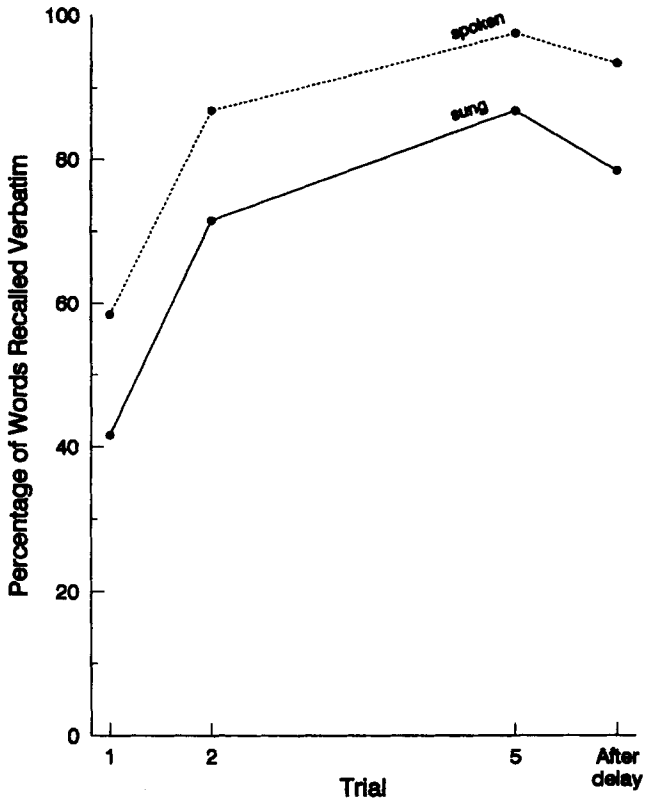

Figure 3. Recalls for one-verse segment.

The advantage of hearing the ballad sung, found in Experiment 1, reversed in this experiment. There was a significant effect of condition (spoken vs. sung) on verbatim recall, $F(1, 35) = 4.29$, $p < .05$, $MS_e = 0.10$, with the spoken condition having better recall than the sung condition, the opposite of the findings in Experiment 1. In addition, there was a significant main effect of trial on verbatim recall, $F(2, 70) = 71.50$, $p > .0001$, $MS_e = 0.02$. No other effects or interactions were significant. As shown in Figure 3, verbatim recall was good by the fifth trial. Thus, for a single verse, music appeared to disrupt more than to facilitate learning and recall of the text.

To examine the effect of musical training on recall performance, another repeated measures ANOVA was conducted, with trial (1, 2, and 5) as a within-subject variable and condition (sung vs. spoken) as a between-subjects variable, and years of singing experience, years playing a musical instrument, and ability to read music (yes or no) as covariates. All three measures of musical training showed no significant effect on recall performance, $F(1, 34) = 0.31, 0.18, 0.01$ for years singing, years playing an instrument, and ability to read music, respectively, $MS_e = 0.11$.

Finally, for delayed recalls, an ANOVA, with condition (sung vs. spoken) and song ("Sailing" vs. "Dressed") as between-subjects variables, was conducted. There was a significant difference between conditions, with the spoken condition

having better verbatim recall, $F(1, 38) = 4.75, p < .04, MS_e = 0.04$. There was no significant difference between songs and no significant interaction of song and condition.

Recall errors. In general, as in Experiment 1, recall errors were characterized more by omission than by gross distortion. Although there were several distortions of the text, these distortions did not tend to alter the number of syllables recalled per phrase. For example, the line "I'd go today" was frequently recalled as "I'd sail today." This type of distortion was typical of ballad recall error patterns reported elsewhere (Wallace & Rubin, 1988).

To capture the qualitative aspects of recall errors, three error measures (syllable, line break, and omission errors) were scored for each subject and compared across conditions with an ANOVA, controlling for song. For each of these measures, recalls on Trial 1 were scored because Trials 2 and 5 had such high levels of recall that few errors were observed.

The number of syllables recalled on each line in Trial 1 was counted for each subject and subtracted from the number of syllables occurring in the original text. An ANOVA, with song and condition as between-subjects variables, revealed that there was a marginally significant difference between conditions on Trial 1, $F(1, 35) = 3.86, p < .06, MS_e = 15.10$; controlling for song and line, with the sung condition slightly having more errors than the spoken condition (mean number of syllable errors per line was 3.58 and 2.05 for the sung and spoken conditions, respectively).

The percentage of line breaks that were incorrectly indicated and the number of omissions that were incorrectly indicated were counted for each subject on Trial 1. There were no differences between the sung and spoken conditions on either of these measures, $F(1, 33) = 2.79, p > .10, MS_e = 0.02$, for percentage of line break errors, and $F(1, 33) = 0.80, p > .37, MS_e = 0.18$, for omission errors; mean percentage of line break errors was 2.9 and 10.8 for the sung and spoken conditions, respectively; mean omission errors were .29 and .15 for the sung and spoken conditions, respectively.

Discussion

When hearing only a single verse of a song, subjects have better verbatim recall for the spoken version than for the sung version at every trial and at delayed recall. These results are the opposite of those found in Experiment 1.

In addition, the amount of structural information—as captured by syllable errors, line break errors, and omission errors—acquired in the sung and spoken conditions is relatively comparable. Thus for the sung condition when a single repetition of the melody is heard with a single text verse, acquisition of structural information is not improved relative to the spoken condition. Without repetition of the melody, the melody and the information it contains should be more difficult to learn and should be an additional piece of information for the memory system to process, learn, filter out, or all of these. Without sufficient or easy learning, the melody does not provide a recall cue or an organizational device and thus cannot facilitate recall and may actually distract from recall.

Subjects were not required to learn or recall the melody in either Experiment 1 or Experiment 3 and were informed in advance that they would be required to recall only the words. Therefore, subjects could have chosen to ignore the melody, especially because the music did not facilitate learning in this experiment. However, apparently subjects did not or could not ignore the melody.

In summary, for initial learning, music may not always facilitate recall of text. Hearing multiple verses with the same melody facilitates acquisition, accentuates the basic melodic structure, and ensures that the melody is sufficiently learned to facilitate recall.

Experiment 4

Experiments 1 and 3 provide evidence that hearing a text sung can facilitate recall relative to hearing the text spoken, perhaps only when the melody is easily and sufficiently learned, is repeated across verses, or both. In addition, Experiment 2 indicates that the melody contributes more than rhythmical information. The purposes of this final experiment were (a) to replicate the findings of Experiments 1 and 3, (b) to show that melodic repetition between verses is necessary to facilitate learning and recall, and (c) to further substantiate the finding that music contributes more than rhythmic repetition. To ensure some generalizability, a new ballad was selected and a different singer performed the versions used in this experiment.

In Experiment 1, the melody repeated three times and occurred in the three different contexts of each unique verse. The repetition and the contextual differences should have facilitated acquisition of the melody just as repetition of any information facilitates acquisition. In these experiments, repetition may be particularly important because subjects should not be intentionally learning the melody but rather should be acquiring information about the melody from incidental efforts. In Experiment 4, additional insights into the necessity of repeating the melody are added.

Apart from the repetition of the melody, there is one other difference between the stimuli in Experiments 1 and 3; the story lines in Experiment 3 are shortened relative to those in Experiment 1. The shortened story line should have an equal impact on both the sung and the spoken conditions because both the sung and the spoken conditions are either equally simpler to recall or equally less filled out in detail. However, the shortened story line should not reverse the effects of music, but should at most dampen those differences. Instead, music actually distracts in the one-verse experiment. The length of the story line does not seem to account for the pattern of results found thus far; however, this problem is addressed in Experiment 4.

In Experiment 4, verbatim recall of three verses that are either spoken, sung to the same melody, or sung to three different melodies are compared. If melodic repetition is necessary to facilitate recall, then verses sung to three different melodies will have poorer performance than verses sung to the same melody. Furthermore, the three different melodies preserve the same rhythm. Therefore if recall of the three melody condition is worse than recall of the one melody condition, then there will be further evidence that recall is facilitated by more than just the rhythmical information

contained in the music. Finally, if melodic repetition is necessary to facilitate recall, and the lack of melodic repetition accounts for the results of Experiment 3, then the three-melody condition should have worse recall than the spoken condition.

Method

Materials. A new three-verse ballad excerpt was selected from the ballads from *The Frank C. Brown Collection of North Carolina Folklore* (White, 1952; 1957), which met the same requirements of Experiment 1; namely, end rhyme was clear, language was not archaic, and the three verses were coherent when heard in isolation. The excerpt came from "Lord Bateman" (White, 1952, Vol. II, pp. 54–55) and contained 84 words.

A melody was selected from among the variations for "Lord Bateman" (White, 1957, Vol. IV, p. 28) so that the rhythm was consistent throughout the melody. In addition, two other melodies were selected from two entirely different songs so that each of the three melodic contours were unique (White, 1957, Vol. IV, p. 43 & p. 51). These two new melodic contours were slightly altered so that the meter, rhythm, timing, notes, and tonal center of the original melody were preserved across all three melodies. Appendix B provides the three-verse text and the three melodies.

All three melodies were selected so that there were intentionally few differences between the melodies except in contour. All melodies used the same five notes (G, A, B, D, and E) around the same tonal center (G). Rhythm, meter, and timing were identical across all three melodies. The number of times the notes varied between ascending and descending cadences was not very different across the three melodies (14 such changes for the original melody, 11 for Melody 1, and 13 for Melody 2). The size of the step differences between notes was also not very different across the melodies (average step size for the original melody was 1.53; for Melody 1, 1.19; and for Melody 2, 1.34, in which one step equaled one note in the major scale). Finally the number of notes on the tonal center was not very different across the three melodies (8, 10, and 11 for the original melody, Melody 1 and Melody 2, respectively).

A local amateur singer tape-recorded the three-verse text sung to each of the three melodies and read the text in a normal speaking voice.

From this recording, five stimulus tapes were composed: (a) the text spoken, (b) the text sung to the original melody, (c) the text sung to a new Melody 1, (d) the text sung to a new Melody 2, and (e) Verse 1 sung to the original melody, Verse 2 sung to Melody 1, and Verse 3 sung to Melody 2. Comparing the three sung versions ensured that all three melodies were equally beneficial for recall. The critical comparison then involved (a) three verses spoken, (b) three verses sung to one melody, and (c) three verses each sung to a different melody.

Subjects. Forty-eight masters students at the business school served as subjects. Each was paid for participation. Before listening to the tapes, subjects were asked whether they recognized eight ballads by title to ensure that no subject knew the ballad that would be tested. No subjects were familiar with the stimulus ballad. In addition, subjects were asked for years of singing experience and years of playing a musical instrument. Mean number of years singing was 2.19 years, and mean number of years playing a musical instrument was 4.22 years.

Procedure. Subjects heard one of the five stimulus tapes. The three verses were heard by the subjects once and recalled in writing under explicit verbatim recall instructions, heard a second time and recalled in writing, heard three additional times and recalled in writing after the last repetition. Recall instructions and presentation method were the same as in Experiments 1, 2, and 3. However, unlike the first 3 experiments, no delayed-recall task was included.

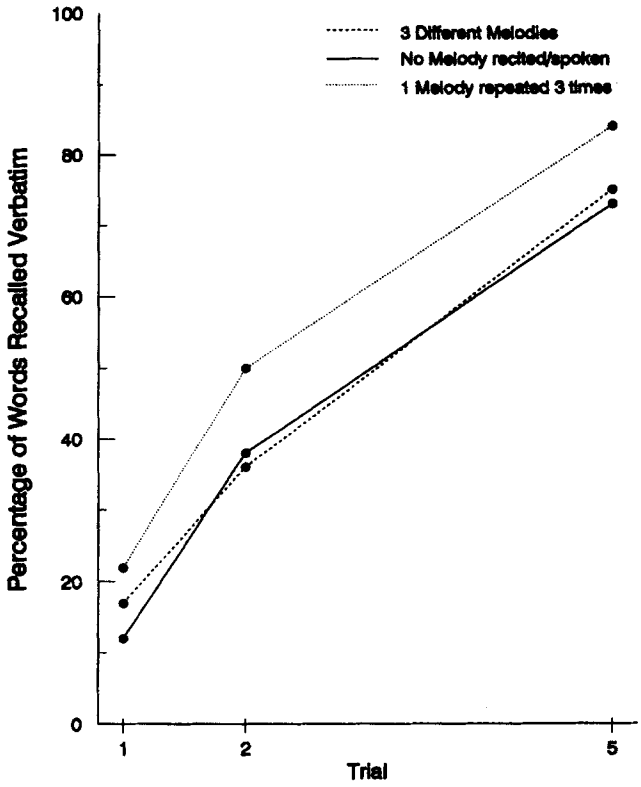

Figure 4. Recalls of three verses in Experiment 4.

Subjects were tested in groups and were randomly assigned to conditions.

Results

Recall performance. Percentage of verbatim recall was calculated for each subject. Recalls of text sung to the original melody, Melody 1, or Melody 2 were combined into the one-melody condition. A repeated measures ANOVA compared the within-subject effect of trial (1, 2, and 5) and the between-subjects effect of condition (spoken, sung to one melody, and sung to three different melodies) on percentage of verbatim recall. There was a significant effect of trial, $F(2, 90) = 556.70, p < .0001, MS_e = 0.007$, and a significant effect of condition $F(2, 43) = 4.93, p < .02, MS_e = 0.04$, but no significant interaction of trial and condition.

Hearing the same melody three times resulted in greater recall than hearing a different melody for each verse or than hearing the words spoken. Figure 4 depicts these results.

As with Experiments 1, 2, and 3, an additional repeated measures ANOVA was conducted to test the effects of musical training on recall performance by using trial (1, 2, and 5) as a within-subject variable, condition (sung to one melody, sung to three melodies, and spoken) as a between-subjects variable, and years of singing experience and years playing a musical instrument as covariates. Unlike the results of Experiments 1, 2, and 3, this analysis revealed a significant effect of years of singing experience, $F(1, 43) = 7.01, p < .02, MS_e = 0.03$, but not of years playing an instrument, $F(1, 43) = 0.04, MS_e =$

0.03. The effect of years of singing experience did not account for the effect of condition because with years of singing experience included in the ANOVA model, condition still had a significant main effect, $F(1, 43) = 7.08, p < .003, MS_e = 0.03$. As years of singing experience increased, recall improved.

Recall errors. Verbatim recall captures recall of the original words but does not capture synonym substitutions that preserve both the meaning and the rhythm of a line. Therefore, as in Experiments 1 and 3, a new analysis was conducted in which the number of syllables recalled in each line was counted and the deviation from the original number of syllables was calculated. Because recalls were low on Trials 1 and 2, only Trial 5 was considered. The advantage of this scoring technique is that it corrects for changes in the original such as from "Lord Bateman sailed on the mighty sea" to "Lord Bateman sailed upon the sea." Another common example was a change from "caught and placed in jail" to "caught and put in jail." Both examples preserve the meaning, rhythm, and poetics of the original. On the negative side, however, a subject can recall a completely different idea and still have a perfect score; although, this rarely happened.

For each subject the number of syllables per line above or below the original number of syllables was calculated. A repeated measures ANOVA examined the between-subjects effects of condition (sung to one melody, sung to three different melodies, and spoken) and the within-subject effects of line (1–12) on syllable accuracy. There was a significant effect of condition, $F(2, 45) = 3.85, p < .03, MS_e = 8.11$, a significant effect of line, $F(11, 495) = 5.36, p < .0001, MS_e = 2.56$, and a significant interaction of line and condition, $F(11, 495) = 1.76, p < .02, MS_e = 2.56$. When three verses were sung to the same melody, the number of syllable errors was significantly reduced relative to both the three-melody condition and the spoken condition (mean number of syllable errors per line was .64 for one-melody condition, 1.41 for three-melody condition, and 1.14 for spoken condition). In addition, there was a clear primacy and recency effect in the number of syllable errors across lines, with the first and last lines having fewer deviations than the remaining lines. Furthermore, for the three-melody and one-melody conditions, there were fewer errors at Lines 5 and 9, each of which begin a verse.

As an additional check on the acquisition of structural information, the number of line break errors and the number of omission errors per subject were calculated, as in Experiments 1 and 3. A line break error occurred when a subject either failed to indicate or incorrectly indicated a line break in written recalls; thus this measure roughly captured knowledge about verse and line structure. An omission error occurred when subjects indicated a word or phrase was missing and nothing had actually been omitted or when subjects failed to indicate a text omission. Using only Trial 5, an ANOVA examined the percentage of line break errors each by condition (sung to one melody, sung to three melodies, and spoken). A similar analysis was conducted for omission errors. There was no difference between conditions in the percentage of line break errors, $F(2, 45) = 1.65, p > .20, MS_e = 3.98$; means equal 8.6% for the one-melody condition, 18.9% for the three-melody condition, and 8.3% for the spoken condition. There was only a marginal difference between conditions for omission errors, $F(2, 45) = 2.59, p < .09, MS_e = 1.10$; means equal .31 for the one-melody condition, and 1.0 for both the three-melody condition and the spoken condition.

These analyses indicated that some additional structural information was acquired in the one-melody condition and not in the other conditions. Hearing verses sung to the same melody tended to preserve the number of syllables in the line as well as the rhythm of the line and the length of the line. Also, music appeared to mark the beginning of a new verse and thus chunked the text.

Effect of different melodies on recall. To check for differences in recall between the three different melodies, percentage of verbatim recall for the three verses sung to the same melody was compared by an ad hoc contrast of the original with Melody 1 and the original with Melody 2, controlling for condition and for trial. There was no difference in recall between the original melody and Melody 1, $F(1, 43) = 0.89$, $MS_e = 0.04$, but there was a significant difference between the original melody and Melody 2, $F(1, 43) = 5.12, p < .03, MS_e = 0.04$, with Melody 2 having lower recall than either the original melody or Melody 1.

The differences between the original melody and Melody 2 do not refute the overall recall results reported above. First, these differences biased the initial analysis in a direction opposite of that predicted. That is, combining all three versions into a single condition decreased the effect of hearing verses sung to one melody because one of the versions was inferior. This choice biased in the direction of not finding any advantage for the sung condition.

Second, to ensure that differences between the one-melody condition and the three-melody condition are not due to problems with Melody 2, an additional analysis was conducted that excluded Melody 2. For this analysis, only recalls of the original melody and Melody 1 were included in the one-melody condition. In addition, because Melody 2 occurred in Verse 3 of the three-melody condition, only recalls of Verses 1 and 2 were tabulated across all conditions. Thus, any effect of Melody 2 was removed from the analysis. A repeated measures ANOVA examined the effects of condition (one melody with only original melody, two melodies, and spoken) and trial (1, 2, and 5) on verbatim recall of Verses 1 and 2. Ignoring Verse 3, the same pattern of results emerged as was found for all three verses in combination. There was a significant effect of trial, $F(2, 56) = 321.84, p < .0001, MS_e = 0.01$, and of condition, $F(2, 28) = 5.36, p < .01, MS_e = 0.04$, the one-melody condition had better recall than the other two conditions at every trial. Therefore, these results cannot be attributed to any differences in the three melodies selected.

Analysis of differences between the three melodies. There were intentionally few differences between the three melodies in this experiment, such that many of the traditional measures that might account for recall differences between the melodies did not vary. For example, the melodies did not differ in rhythm, meter, timing, tonal center, notes sung, number of notes sung on the tonal center, average step size, or number of ascending and descending cadences.

The only observed difference between the melodies was that for Melody 2: The stressed notes (Beats 1 and 3 of each measure) did not form a symmetrical or simple contour.

Stressed notes in ballads tend to carry the gist of the melody such that playing the stressed notes can identify the melody (Bronson, 1969; Wallace & Rubin, 1991). Furthermore, alterations in nonstressed notes do not appear to be as noticeable to the average listener as changes in the stressed notes.

A symmetrical pattern, for example in Line 4 of Melody 2, would result in the stressed syllables of "never" and "travel," both being sung on a B note rather than on G and E, notes, respectively. That is, the last line would have had an ascending contour followed by a descending one rather than the other way around. This concept of symmetrical pattern is similar to Namour's (1990) principle of reversal in his implications–realization model, such that a movement in one direction tends to imply a countermovement in the opposite direction, thus creating symmetry. Therefore, a symmetrical contour should be easier to learn because the tendency toward reversal is satisfied in much the same way as closure is implied in perceptual patterns.

The two songs in Experiment 1 also differed in the ease of learning and recalling each text. Therefore, as a check on the generalizability of the above observations, similar analyses of the "Sailing" and "Dressed" melodies of Experiment 1 were conducted. As with "Lord Bateman," the number of variations between ascending and descending contours was comparable; "Sailing" had nine alternations and "Dressed" had seven. Both melodies had a similar number of notes on the tonal center (eight for both "Sailing" and "Dressed").

However, as with "Lord Bateman," the contour pattern for notes on stressed beats varied substantially between the two melodies. For "Sailing," each line had a similar, symmetric pattern—an ascent followed by a descent. Only the last line deviated from this pattern by having no ascent, only a descent. However, for "Dressed," the pattern of each line was substantially different from all others. Furthermore, only the pattern for Line 2 was symmetrical. Thus, these two songs, which differ in recall, showed the same pattern in melodic difference as for "Lord Bateman." A symmetrical melodic pattern tended to make learning the text easier, less distracting, or both.

Discussion

Hearing the melody repeat across verses facilitates recall. When the melody does not repeat across verses (three-melody condition), the differences between hearing the verses spoken and hearing the verses sung are negligible, even when the three melodies preserve rhythm across the verses. Finally, hearing the verses sung to the same melody facilitates acquisition of structural information such as the number of syllables within the line and the breaks between verses. This pattern of results cannot be accounted for by differences in cognitive load or in extent of story line because both cognitive load and story line are identical across conditions.

Some melodic contours are better retrieval and encoding mechanisms than others. There are differences in recall between the three different melodies even when all three verses are sung to the same melody. These differences cannot be attributed to an easier rhythm or to more natural notes because all three melodies use the same rhythm and the same notes of the scale. Rather, these differences can be attributed to the simplicity and symmetry of the melodic contour, such that contours with simple, symmetric patterns tend to better facilitate learning of the text and presumably of the melodic structure.

Consistent with the findings of Experiment 2, when the melody facilitates recall in the one-melody condition, it contributes more than rhythmical information. Repetition of rhythmical information is identical in the one-melody condition and in the three-melody condition because rhythm is identical across all three melodies. Thus, in the three-melody condition, contour but not rhythm varies across the three verses. Nevertheless, recall performance is better when the rhythm and the contour repeat (one melody) than when just the rhythm repeats (three melodies).

In contrast to Experiment 3, three different melodies do not appear to be as disruptive as hearing a single melody for only one verse. With three different melodies, recall performance is roughly equivalent to the spoken condition. There are two potential explanations. First, the three melodies do at least repeat rhythmical information, which may thus facilitate recall above where it would have been in the absence of repetition. Second, the three different melodies do share other common properties such as scale so that the novelty of the melody and therefore the distraction of that novelty may have been reduced across the three melodies relative to the one-melody condition.

General Discussion

The melody of a song can indeed make a text more memorable as compared with hearing the text out of the context of the melody, at least as long as the melody is simple and easy to learn. The experiments presented in this article demonstrate that at initial learning and at subsequent delayed recall, the melody can facilitate recall of the text when the melody repeats across verses but not when a single verse is heard (Experiment 3) or when the melody does not repeat across verses (Experiment 4: three-melody condition). Thus, a repeating, simple melody can provide a recall aid above and beyond what is provided in the text alone or in the poetic properties of the text such as rhyme.

So why does the melody not facilitate learning and recall when it does not repeat in its entirety? The most obvious benefit offered by melodic repetition across verses arises from increased familiarity with and learning of the melody, so that when the melody is sufficiently or easily learned, it does not provide a distraction but rather facilitates recall. That is, the chances of learning enough about the melodic structures to provide the necessary cues and connections to the text increase as the melody repeats, as do the chances of acquiring any knowledge when the information repeats. As shown in Experiment 3, when the melody does not repeat, there are practically no differences in the amount of structural information, such as the number of syllables and lines, acquired in spoken and sung conditions. However, for the one-melody condition in Experiment 1 and Experiment 4, the acquisition of structural information is improved when the melody repeats in its entirety.

Furthermore, some melodies are better than others, as discussed in Experiment 4. Melodies with simple, symmetrical

melodic contours show better facilitation of text recall, presumably because they are easier to learn.

The contribution of the melody to learning the text encompasses more than simply providing a rhythmical framework. A sung text is more accurately recalled during initial learning and at delayed recall than is a text spoken rhythmically (Experiment 2). Additionally, when verses are sung to different melodies but with the same rhythm, recall is not as good as when verses are sung to the exact same melody (Experiment 4). Thus, abstraction of the rhythm across verses does not facilitate recall as much as hearing the exact melody repeat across verses.

Mechanisms for Melodic Facilitation of Recall

Melodies provide more than just a context, they provide an information-rich context that is critically connected to the text. In addition to rhythmical information, the melody can provide information about the lengths of lines and intonation patterns within the line. Furthermore, the melody can chunk the text into melodic phrases and link textual phrases with similar melodic contours. For example, a melody usually starts and ends on the tonic note, thus linking the beginning and ending of the text. In addition, if the text falls on, for example, a descending contour at the end of the melody, then the text is marked to belong uniquely at the end. The melody can assist in positioning and sequencing textual units and thus decrease the likelihood that units will be misplaced and disrupt memory for succeeding units. Therefore, when enough of the information provided by the music is acquired, the music can facilitate recall of the text.

There are two underlying notions that explain how music facilitates learning and recall. First, music most likely focuses listeners on the surface characteristics of the music and of the text. For example, listeners can attend to the rhythmical properties of the text because those are accentuated by the music, the phrasing, and perhaps even the poetic properties. Often, focusing on the deep-meaning structures of a text facilitates recall more than focusing on the surface properties. However, when the surface properties are well structured, abundant, and interconnected, and when music or some other mechanism draws attention to the surface properties, then those same properties may facilitate recall. The transfer-appropriate literature has shown that under some tasks, surface properties are recalled better than deep-meaning structures (Morris, Bransford, & Franks, 1977). In addition, the characteristics of the stimuli, such as the presence or absence of music, may also determine whether the surface properties are attended to, facilitate learning and recall, or both.

Furthermore, music, unlike text, may be one stimulus for which listeners are particularly adept at identifying and recognizing surface characteristics. Krumhansl (1991) has shown that for melodic excerpts listeners can identify the general surface characteristics, such as contour, sufficiently to judge whether a new excerpt comes from the same song, even on the first trial. Such abstraction of surface characteristics may account for the Serafine et al. (1984, 1986) findings regarding superior recognition of original text and melody pairings. This finding is consistent with the Crowder et al. (1990) suggestion that textual elements are slightly altered by the melody. That is, the particular surface characteristics of the music match the text in unique ways, and listeners attend to those characteristics.

The second notion about why music facilitates recall involves music acting as a framework for both encoding a text and retrieving a text. At encoding, the melody connects and chunks lines and phrases, which assists in learning. At retrieval, the melody provides a framework that indicates how much information must be recalled, where information has been omitted, as well as the order of segments. In a memory representation that stores both textual components and melodic components, the links between the two are valuable retrieval devices. As a melodic component is accessed, such as a particular melodic phrase, it provides information about the length of the text that matches that phrase, the sequence of that text in verse, the intonation pattern of the text, and the rhythm of the text. This information exists even if the exact melodic contour is not accurately recalled; thus, slightly altering the contour at retrieval should not affect the power of the recalled melody to access the appropriate text. Finally, with such a memory representation, when a component of the text—a word or phrase—is forgotten, the chances of recreating or guessing that textual component are greatly increased. Given the meaning provided by the surrounding text that has been recalled, the cue from the melody that something has been omitted, and the information about how long the omitted text is, the chances of correct guesses should be greatly improved.

Memory Structures and Processes

As the text enters memory, there are two forms of information stored about that text. First, some exact strings of words will be stored. Which strings are stored and are retrievable at a later time probably depends on chance, attention, novelty of the language, appeal of the phrase, and perhaps other structural elements within the string such as rhyme. Second, information is abstracted from the text (such as line length, number of syllables, beat patterns, rhymes, and rhyme patterns) to the extent that these characteristics are obvious, easily observed, and relevant to the task. Which characteristics are abstracted depend on the text itself and the salience of those characteristics. Often in cognitive psychology, texts with few such characteristics are used so that their potential role is often underemphasized.

Wallace and Rubin (1991) argued that the power for memory lies in the interconnection between these two types of information about the text—the text strings and the characteristics. For example, locations in the text with phrases that fit the rhythmical pattern and contain rhyme are far more likely to be correctly recalled over and over than are other phrases that have few such characteristics.

There are three primary reasons for this improved recall. First, the interconnections strengthen the memory by tying portions of the text together, by increasing elaboration of the text even though that elaboration is more of a surface type than a depth type. Second, the interconnections increase memory

access by providing another cue to the memory. Third, the interconnections increase the probability of correctly guessing in the event that the text cannot be easily recalled. Thus, knowing the length of the line and the number of syllables in a line decreases the number of potential word substitutes that will be reconstructed in the line.

Whether a subject will access a text memory directly or will attempt a reconstruction probably depends on the task being required, the relative ease of recall versus reconstruction, and the degree of elaboration around any particular text. For example, having pondered why a particular phrase occurred as it did increases the elaboration around that phrase and increases the likelihood of recalling it directly rather than reconstructing it.

Just as with text, there are also two forms of information stored about music. One is the actual note sequence, and the other is the abstraction of characteristics such as rhythm, number of syllables, verse structure, and so forth. Again, just as with text, music's power in aiding text recall is in the interconnections from the musical characteristics to the text. Thus, what the music can do is accentuate the abstracted characteristics of the text and strongly link the abstractions to the text strings.

Perhaps there is nothing very unique about music. As long as any other stimulus material highlights a number of additional properties of a text and links those properties to the text, then it may also improve recall. For example, to the extent that an image highlights relationships within the text and adds additional information such as spatial locations, then the image should enhance recall of the text just as music can enhance text recall by highlighting structural characteristics of the text. However, a stimulus that highlights a single characteristic, such as rhythm, will not be as powerful as a stimulus that highlights multiple characteristics.

Thus, the overall conclusions from this article about memory processes and structures are that the presences of structural characteristics within the to be remembered material, the ease of observing and acquiring those characteristics, and the contributions of those characteristics in terms of organizing, constraining, or cuing recall will all affect the memorability of material. Music accomplishes all three of these conditions and therefore can facilitate learning and recall of a text.

Music and Imagery Parallels

The arguments made in this article about melody and text combinations are parallel to arguments that have been made about image and text combinations. Like imagery, sung lyrics may produce a dual code in memory: one code for the text and one code for the melody (Samson & Zatorre, 1991). Additionally, as has been argued about imagery, music may provide an information rich context that orders and organizes text information and adds additional information to the text. For example, when an image provides an overall organizational theme (Bransford & Johnson, 1973) or additional relative spatial information, then the image seems to aid text recall. Similarly, music can facilitate recall of the accompanying text when it provides additional information about the structure of the text and when it organizes or orders the text. Finally the stronger the interaction between a word to be recalled and the associated image, such as in the mnemonic techniques, the better recall becomes. If applied to music, the stronger the connection between the melody and the text, the better the facilitation provided by the music.

Eliminating Alternative Explanations

One question raised at the beginning of this article can now be answered: Does music provide more than just a context for cuing recognition and recall over long retention intervals? The evidence presented here suggests that the answer is yes. Neither context, simple co-occurrence of melody and text, the presence of a continuous melodic context, nor the uniqueness of a melodic context can explain the facilitating effects of music. Otherwise, the one-verse case in Experiment 3 and the three-melody case in Experiment 4 would also show melodic facilitation of text recall. These cases contain a melody that accompanies the text, but the melody does not increase learning and recall.

A single feature of the melody such as the rhythm, although very salient and rich in information, cannot account for the facilitating effects of music. Thus the entire collection of cues and connections provided by the melody are necessary to facilitate learning and recall, such as, for example, the sequencing provided by the contour along with the rhythmical information.

Increased attention or interest generated by the presence of music cannot explain the facilitating effects of music. Again, the one-verse case in Experiment 3 and the three-melody case in Experiment 4 should provide comparable attention and interest to the other sung conditions; yet, they do not have improved learning and recall.

Removing the Effects of Music

The facilitating effect of music can be destroyed. The experiments reported in this article have undergone a fair amount of pilot testing. As a result of those pilots, some observations concerning what may eliminate these effects have emerged. With singing, a clear stimulus tape must be generated, which is not always easy. If the words are not as easily understood or as clearly understood in the sung condition as in the spoken condition, there will be no facilitation in the sung condition. Subjects do not appear to be willing to reconstruct or guess the contents of a text if it is not well understood. If one assumes that musical information must be simple and easy to acquire, then sound distortions or lack of clarity will decrease ease of acquisition, increase the amount of attention required to acquire musical information, and will result in no recall facilitation.

Although the music used in these experiments did facilitate recall of the text when the music was repeated or well learned, there should be cases in which music does not facilitate recall. For example, if the music is complex, such as containing an elaborate contour, a complex rhythm, or large interval sizes, then it might be difficult to learn and retain enough about the melody to assist in recall. In such cases, there should be no advantage for the sung condition over the spoken condition,

and even perhaps a disadvantage as the music could detract attention from the text. Such situations are most likely the ones for which choirs find an advantage to rehearsing the melody independently of the text. Fortunately, ballads have the advantage of having rather simple, straightforward melodies and are therefore good stimuli for initial investigations of this type.

Additionally, music should also not facilitate recall if the match between the text and the melody is a poor one. That is, when the number of notes does not closely match the number of syllables, or when the intonation of the melodic contour does not match the intonation of the spoken text in both rising and falling patterns and in accent structure, then the melody may not facilitate recall. In such situations, the melody is not providing accurate information relevant to the text.

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Appendix A

Ballad Texts for Experiments 1, 2, and 3

Sailing

Excerpted from "Lass of Rock Royal" (p. 89) 1952, in N. I. White (Ed.), *The Frank C. Brown Collection of North Carolina Folklore* (Vol. 2). Durham NC: Duke University Press. Copyright 1952 by Duke University Press. Reprinted by permission.

Oh if I had a sailing ship
And men who would sail with me
I'd go today to my true love
Who will not come to me

Her father gave her a sailing ship
And sent her to the sand
She took her baby on her lap
And turned her back on land

She had not been at sea three months
I'm sure it was not four
Till she had landed her sailing ship
Right at her true love's door

Dressed

Excerpted from "Lord Thomas and Fair Annette" (p. 78), 1952, in N. I. White (Ed.), *The Frank C. Brown Collection of North Carolina Folklore* (Vol. 2), Durham, NC: Duke University Press. Copyright 1952 by Duke University Press. Reprinted by permission.

She dressed herself in satin fine
Her maidens all in green
And every town that she passed through
They took her to be some queen

She rode and she rode till she came to the hall
She made the knocker ring clear
There was none so ready as Lord Thomas himself
To rise and bid her good cheer

He took her by the lily white hand
And led her in the hall
He sat her at the head of the table
Among the ladies all

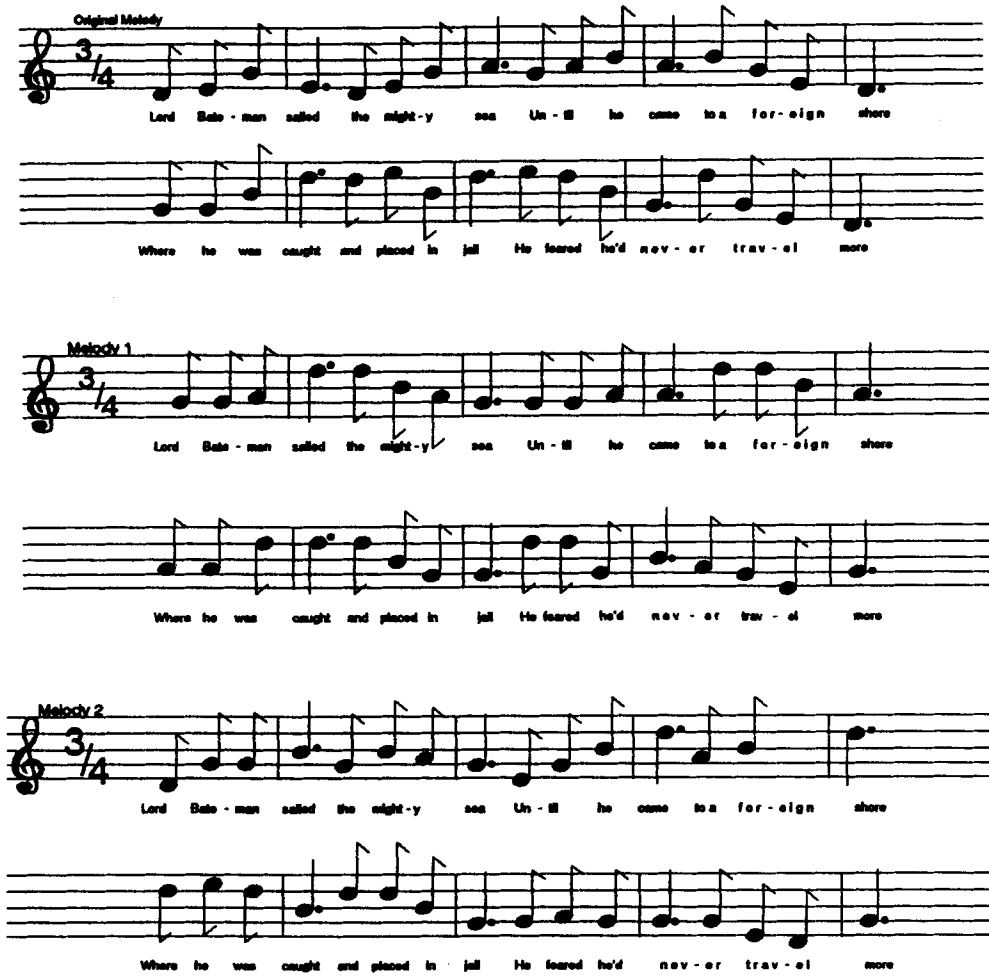
Appendix B

Ballad Text and Melodies for Experiment 4

Lord Bateman sailed the mighty sea
Until he came to a foreign shore
Where he was caught and placed in jail
He feared he'd never travel more

The jailer had one only child
She was as fair as she could be
She stole the keys to the prison dark
And then she set Lord Bateman free

She led him down to the ocean wide
And said go haste to your country
Before seven years have come and gone
You will come back and marry me



Received January 25, 1991
Revision received December 20, 1993
Accepted January 14, 1994 ■