

Music and word recall: The strength of familiar melodies as mnemonic devices

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Abstract

It is a commonly held belief that a familiar melody can increase memory for information. The effects of presentation rate (fast versus slow) and presentation mode (spoken versus sung) on word recall were examined. First, a pilot experiment was conducted in order to test words for comprehensibility and frequency. In the central experiment, undergraduate volunteers were tested for word recall after listening to sentences presented in one of four between-subject conditions: fast tempo-spoken, fast tempo-sung, slow tempo-spoken, and slow tempo-sung. On a paper and pencil test, participants were asked to fill in each missing noun with the word they believed to be correct. Results show that spoken sentences were remembered better than sung sentences, but there was no difference in recall for sentences due to presentation rate. In addition, word error analyses demonstrated memory for semantically similar items across all conditions. Despite the common belief that familiar melodies can be used as mnemonic devices, the current study found that in certain situations, familiar melodies actually decrease recall.

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It is a commonly held belief that a familiar melody can work as a good mnemonic device. Children are often taught important information using familiar melodies. For example, children are taught the ABC's set to the melody of "Twinkle, Twinkle Little Star". Melodies have been found to cue memories for new information in preschoolers and young adults (Wolfe & Hom, 1993; Calvert, 2001). However, children are not the only ones to use familiar melodies as memory aids. Many teenagers and adults are taught to set lists of items to familiar melodies in order to help them remember the items better. Since many people use familiar melodies to help them remember information, it is important to measure the strength of familiar melodies as mnemonic devices.

One explanation for the hypothesis that music enhances learning and recall is that music may act as a mnemonic device (Yalch, 1991; McElhinney & Annett, 1996; Rainey & Larsen, 2002). There are two types of mnemonic devices, formal and informal (Ashcraft, 2006). Formal mnemonic devices rely on a well-known set of memory aids as well as repetition of the information using these memory aids. Informal mnemonics are not as complex and are usually personalized (Ashcraft, 2006). Ashcraft (2006) states that a strong mnemonic has three principles: first, it provides a structure for incorporating information into an existing memory framework, second, it incorporates the information into the existing framework, and third, the mnemonic device provides cues for retrieval of the information. An example of a commonly used mnemonic device is the anagram for the Great Lakes, HOMES: H stands for Lake Huron, O stands for Lake Ontario, M stands for Lake Michigan, E stands for Lake Erie, and S stands for Lake Superior. Rainey and Larsen (2002) point out that music appears to meet the requirements of a good mnemonic device. The rhythm and melody of a familiar song provide a structure for

learning new information, a distinctive memory record, and effective retrieval cues (Wallace, 1994; Rainey & Larson, 2002).

There has been a large amount of research conducted on the use of music as a mnemonic device. Wallace (1994) conducted four experiments and found evidence that supports the hypothesis that music facilitates the learning and recall of text. Familiar melodies can provide a great deal of information about the features of text. These features include the length of the text, the number of syllables, how many syllables are stressed, and the order of the words and phrases. In addition, familiar melodies provide a framework for reconstruction of the text (Wallace, 1994). Music also provides sequential information and an order of encoding and recalling so that the likelihood of skipping or misplacing a portion of the text is decreased (Wallace, 1994). Wallace (1994) found that a repeating, simple melody can act as a better recall aid than when text is heard alone. Also, subjects who heard the text set to a melody appeared to be more aware of structural components, such as rhythm and line breaks. In addition, melodies with simple symmetrical melodic contours showed better facilitation of text recall, because they were easy to learn (Wallace, 1994).

Rainey and Larsen (2002) also conducted two experiments testing the general hypotheses that music can act as a successful mnemonic device. The first experiment looked at the specific hypothesis that participants would learn a list of unconnected text in fewer trials when the text was set to a familiar melody compared to when they learned the list as prose. Rainey and Larsen (2002) found that there was no difference between the two conditions; the participants in both the sung and the prose group learned the list in the same amount of time. The second experiment considered how much of the text was retained in long-term memory when the text was learned as a song versus when learned as prose. Participants who initially learned the list set to a familiar

melody took fewer trials to re-learn the list than those who learned the list as prose. In fact, there were twelve participants (6.6%) in the sung conditions who recalled the list perfectly after one week while there were only five (2.8%) in the prose condition who could recall the entire list. Rainey and Larson (2002) concluded that the musical presentation of the text resulted in better long-term memory than the prose presentation and that familiar melodies may serve as a retrieval cue. Rainey and Larson (2002) did point out that it is possible that the use of unconnected text might have been a factor in why the two conditions for initial learning did not differ. They suggested that the use of more meaningful connected text could create a difference in the initial learning.

Another reason that might explain why music increases the learning and recall of text is that memories for music and lyrics may be partially integrated. Research has shown that melody and text are integrated in memory, even when nonsense syllables are used (Serafine, Crowder, & Repp, 1984; Serafine, Davidson, Crowder, & Repp, 1986). Other research has shown that music and text may cue each other, which could be due to physical interactions or association by contiguity (Crowder, Serafine, & Repp, 1990). Samson and Zatorre (1991) examined dual encoding for songs in participants with lesions in the right or left temporal lobe. Specifically, they investigated the neural mechanisms underlying multiple encoding of songs. They found that the left temporal lobe is mostly involved in the recognition of text whereas both the right and left temporal lobes are involved in the recognition of melodies (Samson & Zatorre, 1991). The different role for each lobe provides evidence for the use of dual memory codes and suggests that songs can be encoded in different ways (Samson & Zatorre, 1991). This dual-coding facilitates easier recall because the text can cue the melody and vice versa. However, there is also evidence that tunes and text are processed independently. Some studies have shown that participants

divide their attention between lyrics and tunes, but the processes do not compete for the same pool of resources (Bonnell, Faida, Peretz, & Besson, 2001). This suggests that songs do not form a single memory representation that has two dimensions (Bonnell et al., 2001). Instead, songs are composed of two separate memory representations that have one dimension each (Bonnell et al., 2001).

It has also been suggested that the increase in memory when text is set to melodies may actually be due to presentation rate (Kilgour, Jakobson, & Cuddy, 2000). Kilgour et al. (2000) addressed the effect of musical training and presentation rate on recall when text was set to melody in three experiments. In the first experiment, they found that recall was better for the sung condition than the spoken condition. However, the level of music training did not affect recall. Kilgour et al. (2000) proposed that the differences in recall between spoken and sung presentations might actually be due to presentation rate. When singing, the rate of presentation may have been slower than when spoken. In the second and third experiments, they tested the effect of presentation rate on recall. In the second experiment, the duration of the sung and spoken conditions was equated. The results showed the opposite of their first experiment; the participants in the spoken condition recalled more of the material than the participants in the sung condition. This supported the hypothesis that it is the slower tempo when the material was sung that facilitated recall. The third experiment examined the effect of presentation rate more closely by adding a slow tempo condition, 30 beats per minute, and a fast tempo condition, 70 beats per minute. Once again, there was an advantage, though small, for the spoken materials. These results suggest that the advantage of sung over spoken presentations reported in previous studies (e.g., Wallace, 1994) may actually reflect an artifact of different presentation rates for sung and spoken conditions because the sung condition may be presented at a slower tempo than

the spoken conditions (Kilgour et al., 2000). This slower tempo allows more time to process the presented material, leading to better memory.

Though many studies have looked at the effect of music on word recall, not many studies have been conducted on the actual accuracy of word recall when the text is set to a familiar melody. The majority of past research has either tested recall for whole verses (Wallace, 1994) or recall of lists (Rainey & Larsen, 2002). The current study tests the accuracy of word recall when subjects are given a written cue. It is predicted that participants will have better recall for words when set to a familiar melody than when the text is just read. The effect of tempo on the accuracy of word recall will also be tested. It is predicted that a faster tempo will decrease the accuracy of recall.

Pilot Experiment

Methods

Participants. 53 undergraduate introductory psychology students participated in this experiment for class credit.

Materials. The stimuli consisted of 60 sentences that were set to three different familiar melodies. The 60 sentences were presented in one of four conditions; slow tempo sung, slow tempo spoken, fast tempo sung, and fast tempo spoken. The three familiar melodies that were chosen were “Twinkle, Twinkle Little Star” (McAuley, Stevens, & Humphreys, 2004), “Old MacDonald Had a Farm”, and “Mary Had a Little Lamb” (Wolfe & Hom, 1993) and there were 20 sentences per melody. An example of a sentence that was used is “The children followed the turtle to the riverside.” An experienced musician recorded both the sung and spoken sentences. A metronome was used to ensure that the sung and spoken versions were the same length. In

addition, there were six randomized sentence orders to control for sentence order. Audio timing was controlled by using a Microsoft PowerPoint slide show.

Procedure. The design was a between-subject design, which means that subjects heard sentences from all the conditions. Participants heard each sentence repeated twice. They were asked to write each sentence immediately after hearing it.

Results. The sentences were scored for errors. Sentences were counted as having an error if there was a word missing or if the participant wrote the wrong word. A total of 10 sentences with six or more errors were excluded from the main experiment. To even the number of sentences per melody, an additional two sentences with five errors were excluded. An initial experiment was conducted that resulted in a floor effect. To make the task less demanding, 24 stimuli were removed from the experiment, leaving eight sentences per melody.

Conclusion. The remaining sentences that were chosen based on the pilot test were equal across comprehensibility and including the same number in each melody. By making sure that sentences were equally comprehensible across spoken and sung as well as fast and slow, this ensured that there was no pre-existing differences between the groups.

Central Experiment

Methods

Participants. 128 undergraduate introductory psychology students who had not participated in the pilot test or the initial experiment participated in this study for course credit. Participants were native speakers of American English (with English in the home before the age of 3) and they had little to no private musical instruction ($M = 1.58$ years, $SD = 2.78$ years).

Materials. The stimuli consisted of 24 sentences that were found to be comprehensible in the pilot test (see Appendix for a complete list of stimuli). There were eight sentences in each of

the three melodies. The nouns and verbs in each sentence were controlled for frequency by using the Kučera and Francis word frequency list (Kučera, 1967). The verbs were between 50 and 450 occurrences per 100,000 American English words and the nouns were rated between 5 and 10 occurrences. This was to control for word frequency effects and Von Restorff effects. The Von Restorff effect is when an event is remembered better because it is distinctive or unusual (Ashcraft, 2006). Again, audio timing was controlled by using a Microsoft PowerPoint slide show.

Procedure. Participants heard the 24 sentences repeated twice. Pilot testing showed that repeating each sentence helped in encoding and the number of sentences prevented floor (very poor) and ceiling (nearly perfect) results. Participants were told that they would complete a recall task at the end of the experiment. After hearing all the sentences, participants completed the cued recall task. This task consisted of half of the sentences heard earlier with blanks where the last two nouns were supposed to be. An example of one of the sentences on the cued recall task is “The children followed the ____ to the ____.” Participants were asked to fill in each missing noun with the word they believed to be correct. If they did not know what noun was supposed to be inserted, they were asked to make their best guess. Once participants had finished the cued recall task, they were asked to fill out a simple music and language background survey. The information collected from this survey was used to control for musicianship and language.

Design. The design of this experiment was a between-subject design, each subject heard sentences in one of the four conditions. The between-subject factors included presentation type: sung or spoken and fast or slow. The dependent variable was the number of correct words each subject recalled.

Results. An analysis of variance (ANOVA) was used to compare the number of words correct by condition. A significant difference was found across the conditions ($F(3, 124)= 3.34$, $p<.05$). Tukey's *HSD* was used to determine the nature of the differences between the conditions. This analysis revealed that the subjects in the slow-spoken condition ($M=9.44$, $SD= 3.70$) recalled more words correctly than the subjects in the slow-sung condition ($M=6.9$, $SD=3.21$), the fast-sung condition ($M=7.31$, $SD=3.60$), and the fast-spoken condition ($M=7.94$, $SD=3.08$). An additional analysis grouped the two spoken and two sung conditions together and found that the spoken conditions were significantly better than the sung conditions ($F(1,126)= 6.67$, $p<.05$). However, there were no significant differences in recall when the two fast conditions and two slow conditions were grouped together ($F(1, 126)= .83$, $n.s.$). These results are shown in Figure 1.

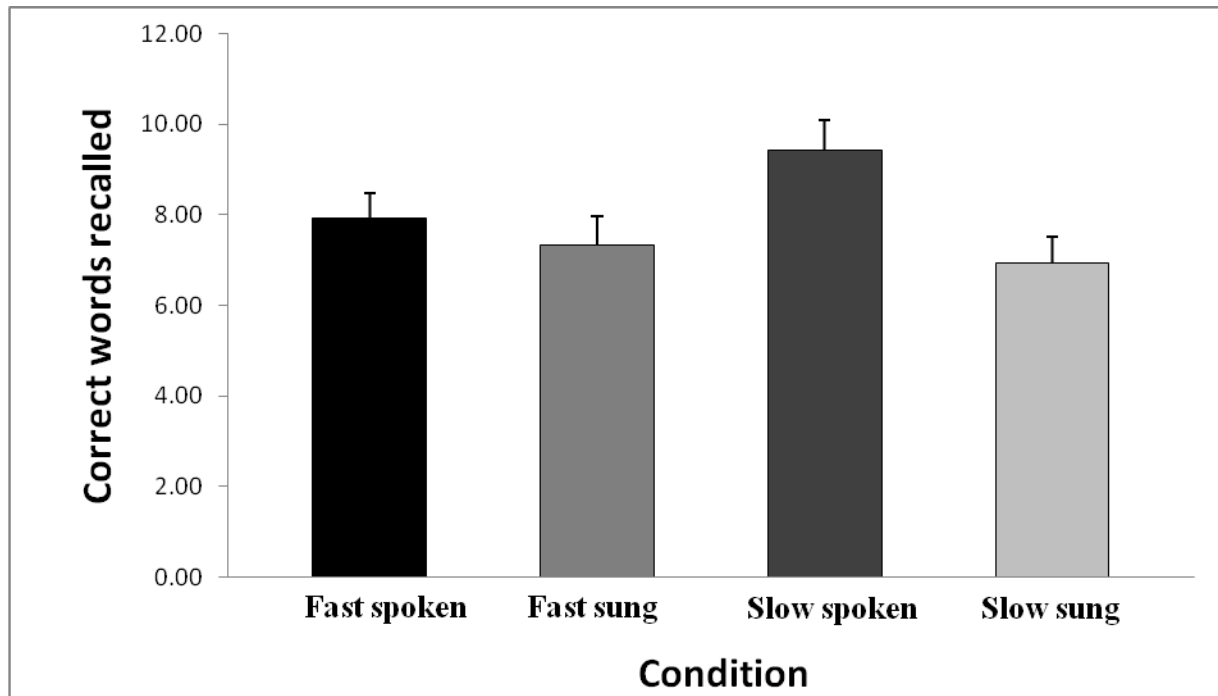


Figure 1. Correct words recalled on cued recall task per condition

The total errors across participants were also analyzed. Six specific types of errors were examined; semantically related new words, semantically related words that has been previously

heard during the experiment, words that were in the right sentence but the wrong blank, words that were previously heard but not semantically related, novel words, and no responses. Figure 2 shows the percentage of errors in each condition. Error patterns were similar in the four conditions. However, one-third to one-fourth of errors were semantically related or previously heard.

	Total Errors:	% Semantically Related New words:	% Semantically Related Previously Heard:	% Switched position within sentence:	% Previously Heard:	% Novel Words:	% Blank:
Fast-spoken	514	15%	4%	2%	9%	55%	14%
Fast-sung	535	15%	3%	2%	9%	59%	13%
Slow-spoken	465	14%	6%	2%	11%	58%	9%
Slow-sung	547	11%	3%	2%	9%	50%	24%

Figure 2. Word error analyses

Discussion. The central experiment showed that presentation mode affected recall of words, but there were no differences for presentation rate. Error patterns suggest some evidence for content accuracy over technical accuracy, which means that participants were getting the gist of the sentences.

General Discussion

Contrary to popular belief and much of the previous research, the current study found that participants recalled words better in the spoken condition than in the sung condition. This suggests that familiar melodies are not a strong mnemonic device in all situations.

One possible explanation for the results is that a mnemonic device must be repeated many times in order to encode information correctly. In this experiment, participants only heard the stimuli two times. In a majority of the previous research, participants heard the stimuli at least four times (e.g., Wallace, 1994; Kilgour et al., 2000). Future research may consider the effect of repetition on stimuli recall.

Another reason for the current results could be that there is dual-encoding of the melodies and lyrics, which means that they compete for attention. If music is not relatively simple and easily learned, it will be useless as a memory aid and will detract attention from the text and hinder recall (Wallace, 1994). Since the stimuli included only the beginning of the melody, participants might have paid more attention to the melody in order to identify it. Focusing on the melody may have distracted participants from the presented text. Future research could include a larger portion of the melody to facilitate recognition, allowing participants to better attend to the presented text.

In the current study, presentation rate did not affect the amount of words recalled. The results of the present experiment did not agree with the Kilgour et al. (2000) study. One reason for this could be that in the present study, the slow version was 60 beats per minute and the fast was 138 beats per minute whereas in Kilgour et al. (2000), the slow was 30 beats per minute and fast was 70 beats per minute. The difference in tempo may explain why the presentation rate did not have an effect in the current study. Future research may look at the effects of different tempos on recall.

The results of the word error analysis suggest that the participants were getting the gist of the sentences. Even though the sentences were only repeated twice, there was some encoding of

the general sentence themes. More repetition of the sentences could result in better encoding and accuracy.

Familiar melodies as mnemonic devices could also help intellectually disabled, older, and younger populations. It is important that future research consider the effectiveness of familiar melodies as mnemonic devices in these populations.

Despite previous work and the commonly held belief that music aids memory, the current study did not find an advantage for memory of sung over spoken sentences. This means that when using familiar melodies to teach children or to remember a list, one must be conscious of the fact that familiar melodies do not work as strong mnemonic devices automatically.

References

- Ashcraft, M. H. (2006). Learning and Remembering. In J. Mosher, & M. Richardson (Eds.), *Cognition* (pp.211-257). New Jersey:Pearson Prentice Hall.
- Bonnel, A., Faita, F., Peretz, I., & Besson, M. (2001). Divided attention between lyrics and tunes of operatic songs: Evidence for independent processing. *Perception & Psychophysics*, 63, 1201-1213.
- Calvert, S. L. (2001). Impact of televised songs on children's and young adults' memory of educational content. *Media Psychology*, 3, 325-342.
- Crowder, R. G., Serafine, M. L., & Repp, B. H. (1990). Physical interaction and association by contiguity in memory for the words and melodies of songs. *Memory & Cognition*, 18, 469-476.
- Kilgour, A. R., Jakobson, L. S., & Cuddy, L. L. (2000). Music training and rate of presentation as mediators of text and song recall. *Memory & Cognition*, 28(5), 700-710.
- Kučera, H. (1967). Computational analysis of present-day American English, by Henry Kučera and W. Nelson Francis. With a foreword by W. F. Twaddell, a study by Mary Lois Marckworth and Laura M. Bell, and an analytical essay by John B. Carroll. Providence: Browns University Press.
- McAuley, J. D., Stevens, C., & Humphreys, M. S. (2004). Play it again: did this melody occur more frequently or was it heard more recently? The role of stimulus familiarity in episodic recognition of music. *Acta Psychologica*, 116, 93-108.
- McElhinney, M. & Annett, J. M. (1996). Pattern of efficacy of a musical mnemonic on recall of familiar words over several presentations. *Perceptual and Motor Skills*, 82(2), 395-400.
- Rainey, D. W., & Larsen, D. (2002). The effects of familiar melodies on initial learning and long-term memory for unconnected text. *Music Perception*, 20(2), 173-186.

- Samson, S., & Zatorre, J. (1991). Recognition memory for text and melody of songs after unilateral temporal lobe lesion: Evidence for dual encoding. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 793-804.
- Serafine, M. L., Crowder, R. G., & Repp, B. H. (1984). Integration of melody and text in memory for songs. *Cognition*, 16, 285-303.
- Serafine, M. L., Davidson, J., Crowder, R. G., & Repp, B. H. (1986). On the nature of melody - text integration in memory for songs. *Journal of Memory and Language*, 25, 123-135.
- Wallace, W. T. (1994). Memory for music: Effect of melody on recall of text. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20, 1471-1485.
- Wolfe, D. E. & Hom, C. (1993). Use of melodies as structural prompts for learning and retention of sequential verbal information by preschool students. *Journal of Music therapy*, 30(2), 100-118.
- Yalch, R. F. (1991). Memory in a jingle jungle: Music as a mnemonic device in communicating advertising slogans. *Journal of Applied Psychology*, 76(2), 268-275.

Appendix

Mary Had a Little Lamb

1. The family enjoyed the legends of the caves.
2. The uncle took his niece to the carnival.
3. The manager sent notices to the tenants.
4. The couple drove the Cadillac to get supper.
5. The crowd watched the tournaments from the bleachers.
6. The woman put the mulch around the vines.
7. The detective looked for clues at the collision.
8. The committee judged the applicants for the scholarships.

Old McDonald Had a Farm

1. The children followed the turtle to the riverside.
2. The band played at the banquet for the diplomats.
3. The dog followed the scent to the bluff.
4. The artist placed the easel in the booth.
5. The girl carried the oranges in her apron.
6. The man found the kitty in the sewer.
7. The guests joined the hostess in the ballroom.
8. The man hit his elbow on the hatch.

Twinkle, Twinkle, Little Star

1. The police stopped the rally at the midway.
2. The hero placed the relic on the altar.
3. The student studied the rat in a maze.
4. The team won the trophy at the debates.
5. The guests looked at the statues in the mansion.
6. The men drove the tractors on the expressway.
7. The child wanted a balloon from the circus.
8. The workers carried the luggage to the airplanes.