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The Role of Iconic Gesture in Facilitating Memory and Recall of Lyrics

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Abstract

Previous research has shown that bodily gesture aids in learning words and is useful for musical expression. However, no studies to date have examined the use of gesture in learning words and music together. The original impetus for the present study was observing students with cognitive disabilities learn musical songs, using gestures to reinforce the words and melody. This study aims to investigate if iconic gestures used by a conductor while songs are being learned, can facilitate better recall of song (lyrics and melody) compared with using no gestures, in the general population as opposed to a special needs population. Iconic gestures are visual representations, produced by the body (primarily hands), which carry referential meaning by depicting aspects of spatial images, actions, people, or objects. It is known that iconic gestures accompanying speech improve memory for words. This study tested the hypothesis that iconic gestures used by conductors will also facilitate recall of words and melody together, since they are stored in an integrated fashion. Recall accuracy was scored in terms of number of correct words, pitch, and rhythm. Results suggest that iconic gestures might help with learning and recalling lyrics to songs, but did not improve performance to a statistically significant degree. A primary finding of the study was that memorizing words and melody together yielded better memory than memorizing just the melody**.** In conclusion, using gestures to accompany words may aid in learning and remembering songs, which may be utilized in the context of music education. Future studies may consider long-term retention of songs, different types of gesture (iconic vs. beat), or simultaneous vs. sequential learning of gesture and song.

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Acknowledgements

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Introduction

Previous research has shown that bodily gesture aids in learning words and is useful for musical expression (de Nooijer, van Gog, Paas, & Zwaan, 2013; Kelly, Barr, Church, & Lynch, 1999; Krönke, Mueller, Friederici, & Obrig, 2013; Liao & Davidson, 2007; Nafisi, 2010; So, Chen-Hui, & Wei-Shan, 2012). However, no studies to date have examined the use of gesture in learning words and music together. The original impetus for the present study was observing students with cognitive disabilities learn musical songs, using gestures to reinforce the words and melody. This study aims to investigate if iconic gestures used by a conductor while songs are being learned, can facilitate better recall of song (lyrics and melody) compared with using no gestures, in the general population as opposed to a special needs population. Before delving into the use of gesture to learn and remember songs, this paper first investigates the phenomenon of memorizing music.

Song and Memory

Researchers have long studied how lyrics and melodies of songs relate to one another and how they are stored in memory. Memorization requires a retrieval organization that provides access to specific passages in a serial chain of associations that usually develops automatically during practice and engagement with a piece of music. In relation to song and memory, there is currently no established theory of effective memorization for singers based on empirical research (Ginsborg, 2004).

To understand the relationship between lyrics and melodies, researchers have sought to learn if there are separate neural networks that exist in semantic, veridical, and episodic memory for verbal and melodic processing of familiar songs. A study conducted by Saito et al. (2012) examined the neural substrates involved in musical and phonological lexicons and found separate neural networks. Saito and colleagues noticed that verbal lexical processing activated the left fusiform gyrus and the left inferior occipital gyrus, whereas melodic lexical processing engaged the right middle temporal sulcus and the bilateral temporo-occipital cortices. However, both melody and lyrics activated the

left posterior inferior temporal cortex, which may serve as an interface between verbal and musical representations in order to facilitate song perception, recognition, and recall.

In a similar vein, Racette and Peretz (2007) investigated whether learning verbal materials through song should facilitate word recall, arguing that text and melody of a song contain separate representations in memory. Their experiment consisted of learning unfamiliar lyrics in a sung-sung condition (i.e. both stimulus and response were sung) and sung-spoken condition (i.e. stimulus was sung and response was spoken). They found that fewer words were recalled when singing than when speaking, even though words were articulated more slowly when sung. They also demonstrated that the mode of presentation, whether sung or spoken, had no influence on short or long term lyric recall, indicating that learning words through song does not facilitate word recall. The implication of these separate representations makes singing a dual task to perform, at least during the beginning stages of learning songs.

On the other hand, studies have shown that melody and text may be stored and retrieved from memory as an integrated unit. In an early study conducted by Serafine, Crowder, and Repp (1984), participants heard excerpts of unfamiliar folksongs, then engaged in a recognition test. The test consisted of five different renditions: (a) exact songs heard in the presentation; (b) new songs; (c) old tunes with new words; (d) new tunes with old words; and (e) old tunes with old words of a different song from the same presentation (or what they termed "mismatch songs"). They found that participants recognized exact songs better than familiar but mismatched components. Interestingly, melody recognition proved difficult unless the original words were present. A follow-up study by Serafine, Davidson, Crowder, and Repp (1986) also supports the integrated memory representation for melody and text in songs. Their experiment discarded the hypothesis that integration was due to semantic connotations imposed on the melody by the text, since songs with nonsense words yielded the same effect. Moreover, they ruled out the possibility that earlier results

were caused by a reduction in recognition when a previously heard component was tested in an unfamiliar context.

As a result, Crowder, Serafine, and Repp (1990) proposed an "association-by-contiguity" hypothesis to account for the integration effect. The hypothesis states that recognition of a melody (or text) of a song is better in the presence of the text (or melody) with which it had been heard originally than in the presence of a different text (or melody). Two events experienced in close temporal proximity may become connected in memory such that each element acts as a recall cue for the other. Thus, lyrics can act as a recall cue for melody and vice versa, but are stored as independent units such that changing memory representation for one does not concurrently change memory representation for the other. This association-by-contiguity theory was demonstrated in a study years later by Ginsborg and Sloboda (2007), who found that, for singers with musical expertise, memorizing lyrics and melody together proved to be an effective strategy for more accurate and fluent recall as opposed to memorizing them separately. They concluded that retrieving one enables retrieval of the other, but that storage of lyrics and melodies are not integrated to the extent that failure to recall one accurately always results in failure to recall the other. Since lyrics and melody are stored and retrieved in association with one another, the best way for a singer to learn and memorize a song is to memorize the lyrics and melody together. Similarly, Kilgour, Jakobson, and Cuddy (2000) also found that those with music training outperformed those without training in verbatim recall for sung lyrics, suggesting that music training leads to enhanced memory for verbal material.

In another study, Peretz, Radeau, and Arguin (2004) investigated the occurrence of priming in memory for music, wondering if lyrics could prime melody more effectively than the opposite. They found that both seemed to be equally effective in priming the other, suggesting that the rhythmic similarity between linguistic stress patterns and musical meter might account for the priming effects

of lyrics on melodies and vice versa. In keeping with the concept of relations between metrical patterns and syllabic structure, an earlier study by Wallace (1994) on recall for the words of ballads found that musical structure can assist in learning, retrieving, and even reconstructing a text. They demonstrated that text is better recalled when heard as a song than speech, but only when the music is made familiar through repetition. When participants heard different melodies for each verse of a song, they performed better on verbatim recall of lyrics when the text was spoken instead. Wallace concluded that a melody provides the listener with structural information such as stress patterns, line lengths, and syllabic structure. She argued that the repetition of rhythmic information and a meaningful framework for retrieving lyrics facilitated memory and recall.

However, an issue with Wallace's study as indicated by Purnell-Webb and Speelman (2008), was that the prosodic factors of lyrics (pitch, loudness, tempo, stress, intonation, and articulation) have the ability to alter the sound of the melody, and conversely, musical elements may affect the intonation of lyrics. Thus, the use of three different melodies in Wallace's study might have been confounded by the prosodic variations imposed on the lyrics, resulting in poorer verbatim recall. Purnell-Webb and Speelman sought to address this issue by keeping the melody constant and measuring recall after each verse. They tested the prediction that familiar melodies would support higher verbatim recall, whereas unfamiliar melodies would initially have lower recall accuracy. However, once the melody had been familiarized, recall scores increased and were higher than those for spoken lyrics. In addition, Purnell-Webb and Speelman wanted to know if rhythmically spoken text would facilitate higher recall than text lacking rhythmic information. But since a melody with text would contain pitches associated with the rhythmic beat and stress patterns, they argue that song would facilitate the highest recall of text. As a result, they found that familiarity with a rhythmic pattern of strong and weak beats may facilitate recall of text by providing a schematic frame for the lyrics. They also found that unfamiliarity with a melody adversely affected recall, and that repeated

exposure to the unfamiliar melody did not improve recall. Verbatim recall was better for sung and rhythmically spoken material, hence rhythm, with or without musical accompaniment, can facilitate recall of text.

Although the debate regarding lyrics and melodies being stored separately or in integrated networks continues, the empirical evidence presented so far proves valuable as to how music with lyrics is stored in memory. The next section explores the use of gesture and the "enactment effect" both in learning and remembering language and music.

Gesture and the Enactment Effect

What is the role of gesture in the context of speech? Gestures help to formulate thoughts into utterances. They act as crucial parts of the representational system of verbal communication, aiding in speech perception, while serving as a cue for communication of intention. According to one commonly-used coding system, there are four types of gestures that co-occur with speech and narrative discourse (Cassell, McNeill, & McCullough, 1998; Kendon, 2004; McNeill, 1992):

1. Iconic: describing an action; visual representations of referential meaning that depict aspects of spatial images, actions, people, or objects.
2. Metaphoric: illustrating a metaphor; representing a concept with no physical form.
3. Deictic: indicative or pointing gesture to locate something in the physical space.
4. Beat: repetitive motor gestures that do not change in form with the content of the accompanying speech.

There has been an ongoing debate on the benefits of gesture production and comprehension in memory, more particularly in recall. People often remember verb-object or action phrases (e.g. "kick the ball," "pick up the pencil") better if they have been enacted during study, than if they have just been learned verbally. This phenomenon is referred to as the "enactment effect" or "subject-performed task" (SPT), and was first identified in the early 1980s (Cohen, 1981; Engelkamp &

Zimmer, 1984). Engelkamp and Zimmer (1984) demonstrated that free recall of enacted sentences is not only superior to recall from standard verbal learning and visually imagined sentences, but also to the recall of sentences performed by a model experimenter. They postulated the importance of the motor system over the visual and verbal-memory systems, based on the assumption that the motor system is efficient due to providing excellent item-specific information, while simultaneously hindering integration of action pairs.

Meanwhile, studies by Cohen (1981, 1983, 1985) focused more on the differences between enactment (subject-performed task) and verbal-learning (verbal task) conditions through recall of word lists. Cohen examined an increase in whole-list relational processing based on organizational strategies in memory. He found good predictive power for the recall of words, but not of action events. In a similar vein, Bäckman and Nilsson (1984, 1985) explained the mnemonic effect of enactment and increase in retention by focusing on the multimodality of SPT encoding. They claim that enactment leads to better recall due to several modality-specific components such as color, texture, weight, movement, etc., which automatically leads to a rich multimodal encoding of each action event. In contrast, verbal tasks (VT) are constrained to acoustic or visual aspects of language, hence explaining why memory for SPTs is superior to that for VTs.

However, it has been argued that enactment does not increase recall in the absence of context cues (Nyberg, Nilsson, & Bäckman, 1991; Steffens, Buchner, Wender, & Decker, 2007). In other words, if the object enacted is not present (i.e. the phrase "lift the mug" without the presence of a coffee mug), then the phrase is unlikely to be recalled better compared to a verbal-learning condition. A study by Steffens, Buchner, and Wender (2003) found no statistically significant enactment effect in free recall for phrases without objects in the context. Given this finding, a follow-up study (Steffens et al., 2007) focused on how much carrying out a verb-object phrase movement without the object affects memory. They argue that carrying out actions ensures the

semantic processing of task-relevant features of verb-object phrases. Moreover, the verb-object relation leads to an integrated memory representation that is enhanced by enactment. Their results indicated that the enactment effect was indeed observed in the absence of cues, although it was not statistically significant for salient objects.

With regards to gesture comprehension, research has shown that imitation of iconic gestures during retrieval is most effective for learning words (de Nooijer et al., 2013; Kelly et al., 1999). Kelly et al. (1999) investigated the use of hand gesture in helping recall of spoken information for gesture comprehension by reviewing different types of speech acts to iconic gestures. Other studies show how actively performed and meaningful iconic gestures help with learning and memory of words (Krönke et al., 2013; So et al., 2012). The article published by So et al. (2012) compared the mnemonic effect of iconic gestures and beat gestures. They define beat gestures as simple motoric movement produced along with the rhythm of the speech (e.g., hand with open palm flips outwards) that do not convey semantic meaning. They found that participants recalled more words when encoded with iconic gestures than with no gesture. They also found that encoding beat gestures aided recall in adults, suggesting that both meaningful and nonmeaningful gestures could strengthen their memory.

In another study, Kelly, Özyürek, and Maris (2010) showed that speech and congruent gestures produced faster recognition than speech or gesture alone. They proposed an integrated-systems hypothesis, explaining how gesture and speech are integrated through mutual and obligatory interactions in language comprehension. Their study showed that participants related primes to targets more quickly and accurately when they contained congruent information (speech: "chop"; gesture: chop) than when they contained incongruent information (speech: "chop"; gesture: twist). Their results confirm that gesture and speech form an integrated system during language production and comprehension. Similarly, de Nooijer et al. (2013) observed that imitation during retrieval is

most effective for learning object-manipulation words. Their results support previous research that gesture imitation is more beneficial than observation in fostering word learning.

So far, gesture studies on memory, production, and comprehension pertain to the learning of words. This current study is interested in the utilization of gesture in music, which leads to the next section in examining existing literature on gesture in musical contexts.

Gesture in Musical Contexts

Hand gesture in music is most often associated with the Kodály method, using Curwen hand signs as an abstract representation for pitch and scale degrees. Developed in the early 20th century, educators trained in the Kodály and Orff traditions taught sight singing with Curwen hand signs to help students learn intervals and maintain tonal memory (Chosky, 1988). Cassidy (1993) investigated the use of Curwen hand signs to teach non-music majors sight singing. She found that those who learned sight singing with hand signs had the highest mean accuracy during a recall posttest. This result suggests that using gesture can aid in aural skills and sight singing. Additionally, Wakefield and James (2011) explored the use of non-causal, associable movements, and how these change neural processing during learning of sung melodies and affects recognition of melodies by adults and children. Their gestures included hand signs adapted from Curwen, such that each hand sign corresponded to a discrete pitch and modified solfege syllable (i.e. Fo, Ga, Di instead of Do, Re, Mi). However, these hand signs were not intuitively representative of the pitches they were associated with, thus making it difficult to form associations between the visual cue and aural melody. Despite this, the study did find that participants encoded sung melodies and hand signs together, such that the stored motor movements were reactivated when presented with the same melody at a later time. As such, abstract motor representations can cause changes in cognitive processing.

In addition to hand gestures, there is also research on musical shaping gestures, such as height and pitch, size and loudness, and time and rhythm. Previous literature explored the effects of musical and movement gesture particularly in children's singing. In a preliminary study by (Liao & Davidson, 2007), findings demonstrated a link between children's singing voice and their use of gesture by observing Dalcrozian mirror and follow games. Dalcroze Eurhythmics is a method of studying and experiencing musical elements through movement. It is based on the premise that rhythm may be found in the natural rhythms of the human body and aims to help people develop kinesthetic imagination and muscular memory, which are both important skills in learning music. Liao and Davidson believe that gesture can help to transfer an overt activity into an imagined activity, such that movement experienced in the body can be stored in memory and internalized to be drawn upon in the future to recall the physical sensations without the individual actually making the gesture. In other words, gesture and physical movement can promote musical memory, and when used as a metaphor can aid in music learning. They also argue that gesture may be used to improve intonation, tone quality, and articulation. By conducting semi-structured interviews and observations, they found that various gestures (level of hands, direction of hand movement, size of movement) reflected different musical ideas. These gesture techniques helped children improve their vocal techniques and correct vocal mistakes. Three follow-up experimental studies were conducted (Liao, 2008; Liao & Davidson, 2016a, 2016b) which found that children who received movement training received a significantly higher score on pitch accuracy, gesture quality, and intonation respectively, and that the combination of gesture and movement training could be a powerful teaching strategy in children's singing.

Moving away from children and towards young adults, (Nafisi, 2010) investigated the use of gesture as a pedagogic tool in one-to-one university-level singing lessons. She observed and recorded eighteen singing lessons given by five different singing teachers, to see if gesture was used as a tool

to communicate pedagogic concepts. This study dealt mainly with singing technique, namely mechanisms of breathing, tone placement, support, and phonation, though it also investigated musical concepts of phrasing and articulation. The study found that a large proportion of the observed gestures served to illustrate technical phenomena such as physiological processes or acoustic quality. Some gestures were linked to lyrics, while others were used to visualize a particular thought or sensation. This small-scale study thus confirmed that gestures can be used as a pedagogical tool to communicate singing related concepts.

The Current Study

Despite this abundant research on gesture and memory for text as well as gesture and improving musicality, no studies to date seem to have applied gesture to the memorization and recall of lyrics. Hence, this current study aims to utilize the enactment effect and apply it to the recall of lyrics along with the melody. In light of the integrated trace between language and melody in memory for songs, it will be interesting to bridge the gap and test if producing gestures has an effect on remembering song and lyrics together as it does for words. If so, music teachers may be able to apply the use of gestures in their teaching practice so that students can develop to be better musicians and performers.

The empirical evidence presented so far highlights two concepts: 1) melody can act as a recall cue for lyrics (through rhyming patterns, rhythmic structure, and stress patterns); and 2) enacting iconic gestures can help with memory of action or verb-object words. The present study did not examine singing technique, but rather utilized gestures to act as a recall cue and help with memory for melody and lyrics. The first phase of this study involved semi-structured interviews with choral conducting graduate students to understand their strategies for helping students learn and memorize

lyrics. This phase determined what repertoire to use and what types of gesture to focus on in the second phase of the study, which was the recall experiment.

Ultimately, the research questions are: Do iconic gestures help with memorizing lyrics and melody, or just lyrics? Do iconic gestures help with memorizing just the melody? The purpose of the experiment is to investigate if iconic gesture will allow for better recall of song (lyrics and melody) than with no gesture. It also seeks to investigate if gesture can facilitate better recall of lyrics in comparison to song. The hypotheses that this study will investigate are:

H_1: Gestures will improve participant recall of lyrics.

H_2: Gestures will improve participant recall of lyrics and melody together (song).

H_3: Melody alone conditions will be significantly worse than lyrics and melody conditions.

H_4: Participants will improve significantly more with repetition in the gesture condition than without gesture.

For the purposes of this paper, the term "lyrics" can be used interchangeably with "song text," "text," and "words." The term "melody" is interchangeable with "tune," and "song" means words and melody together.

Phase 1: Interview with choral conductors

Method

Participants

Participants included a total of four Northwestern graduate students (1 female) between the ages of 31 and 42 (M = 34 years). Two of the participants were second-year DMA choral conducting students, one was a second-year PhD Music Education student, and one was a first-year Masters Music Education student. All participants specialized in choral conducting, and the number of years of conducting experience ranged from 8 to 16 (M = 11 years).

Procedure

Participants were interviewed about their strategies for helping students learn and memorize lyrics. All participants gave informed consent to be interviewed and video recorded. Questions included: what kind of gestures they use when teaching and conducting, what purpose these gestures serve in various repertoires, how important memorizing pieces is, and how they get students to go off-score (i.e. not reading from musical notation). A full list of questions can be found in Appendix A. Participants were also asked to perform a brief example of how they would conduct a piece of their choice. Participants were video recorded using a Canon digital video camera, so that their responses could be transcribed and analyzed later. Participants also filled out a questionnaire at the end of the interview regarding their musical background. Each interview took no more than 30 minutes. This first-phase study determined what repertoire to use and what types of gesture to focus on in the remainder of the study.

Results & Discussion

Informal analysis of the interviews suggests that, in traditional choral settings, gestures are used to represent articulation and help with intonation, vowel shaping, phrasing, and expressiveness. Conductors rarely use gestures to represent meanings of words but rather to represent vowel quality, diction, and syllables. This statement is not surprising as conducting gestures tend to articulate musical shape, reinforcing previous literature regarding musical shaping gestures and singing technique. These musical gestures applied in the choral rehearsal are verified by existing articles on using movement in the choral rehearsal for musical expression (Apfelstadt, 1985; Peterson, 2000).

These interviews provided valuable information about the use of gesture in educational settings and helped inform Phase 2, which is the core of this study. The recall experiment in Phase 2 utilized *iconic* gestures instead of conducting or musical gestures. Due to the interest in the use of gestures for memorization of words, iconic gesture is most appropriate to highlight the meaning of

individual words. As for repertoire, the conductors consulted in Phase 1 suggested simple songs with less text and repetition, as well as pieces that permit certain kinds of imagery (i.e. concrete nouns for iconic gestures), hence folksongs were chosen as stimuli in the next phase.

Phase 2: Experiment for immediate recall

Method

Participants

25 Northwestern undergraduate students (16 female) between the ages of 18-24 years (*M* = 21 years, *SD* = 1.26) took part in this phase of the study. However, one participant's data was discarded due to inaccurate completion of the protocol. Participants took the Ollen Musical Sophistication Index (OMSI), a ten-question index indicating musical competence, comprehension, expertise, aptitude, and ability (Ollen, 2006). The OMSI score indicates the probability that a music expert would categorize the respondent as "more musically sophisticated." Respondents with a score greater than 500 are classified as "more musically sophisticated" and those with a score less than 500 as "less musically sophisticated." The test accounts for aural and receptive skills, such as listening to, understanding, and evaluating music and musical performances; generative skills such as performing, singing, reading, composing, and improvising music; and individual qualities such as motivation, commitment, and development of musical abilities. Participants scored between 33.05 and 879.42 (*M* = 249.05, *SD* = 235.77), indicating a wide range of musical abilities but were more consistently "less musically sophisticated."

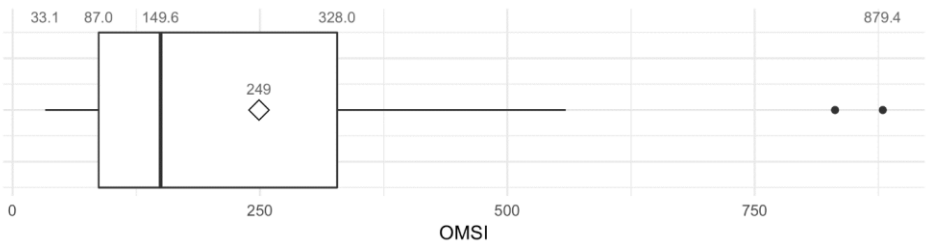


Figure 1. OMSI scores for 24 participants

Participants had self-described normal hearing and English proficiency sufficient for study at Northwestern University. Participants were kept anonymous and were paid $5.00 for participation, and an additional $2.00 for accuracy of recall. The additional bonus is to ensure that participants are taking the test seriously and putting in the effort to memorize the melody and/or lyrics. Nonetheless, all participants received a $7.00 cash card at the end of each experimental session.

Stimuli

The stimuli consisted of eight American folksongs drawn from Erdei's (1974) collection of 150 American folksongs. Some of these songs were also used in the study by Serafine et al. (1984) and were considered unfamiliar to the average listener. All eight songs were 8 bars long, in 2/4 time, and ranged from 17 to 28 notes, lasting 9 to 12 seconds. Melodies and sung and spoken text were recorded by a female vocalist, and the key of each song was transposed to suit the vocal range of the singer presenting the songs. A separate song "Page's Train" was used for the practice trials. General music educators were consulted and all deemed stimuli comparable in terms of difficulty and musical features including rhythm, vocal range, key, and melodic contour. Below are some examples of melodies used, with explanations of what was altered. The rest of the songs can be found in Appendix B.

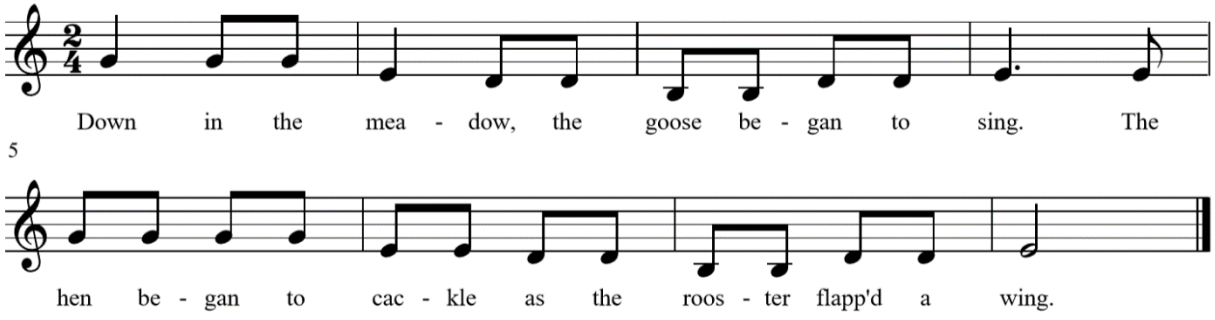


Figure 2. Down in the Meadow

This song was transposed to G Major and transcribed from cut time to 2/4 to conform with the rest of the stimuli. It utilized melodic lines 3 and 4 of the original piece, and the text was altered to use the second verse instead of the first for better iconic representation to employ gesture. The excerpt sits in a comfortable tessitura (B3-G4), with a range of a sixth, moving mostly in steps and skips.

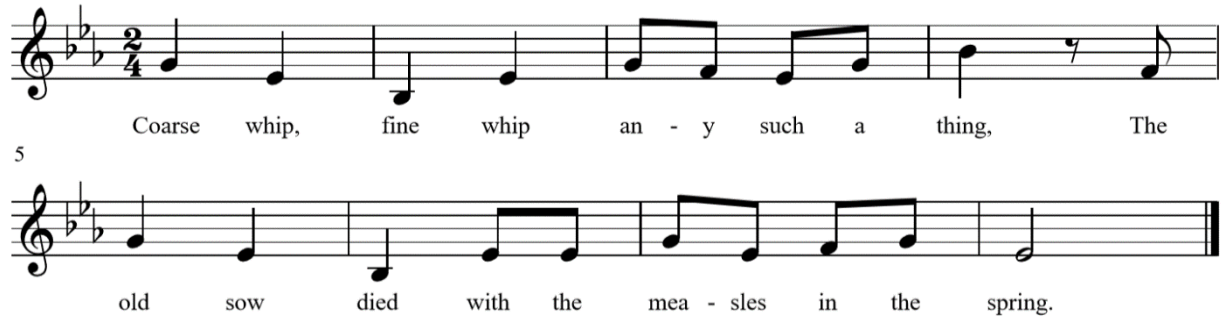


Figure 3. The Old Sow

This song was kept in B♭ Major but transcribed from cut time to 2/4, and used melodic lines 3-4 of the original song. The text comes from the second verse of the song for better iconic representation to employ gesture. It sits on a comfortable tessitura (B3-B4), spans an octave, and moves mostly in thirds, steps, and an occasional perfect fourth.

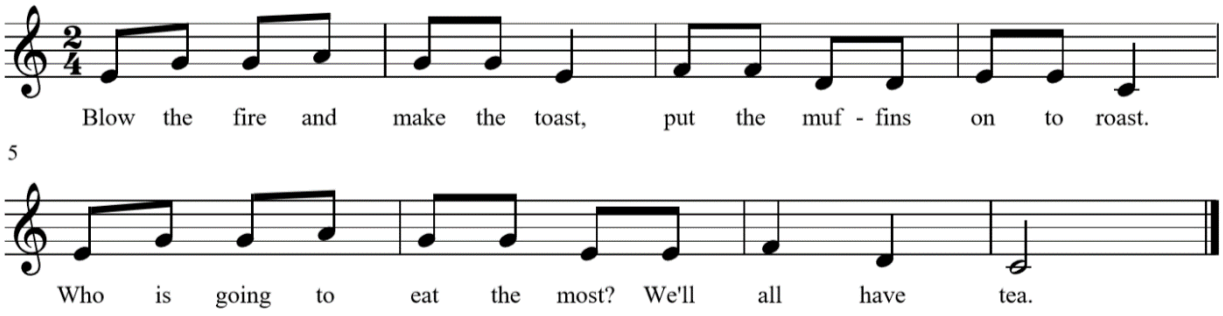


Figure 4. Housekeeping

This song was transposed to C Major and used verse 3 provided by Iona and Peter Opie (1955) since the original text did not allow for iconic gestures. It sits in a comfortable tessitura (C4-A4), with a range of a sixth, moving mostly in steps and in thirds.

Design

The experiment was a factorial design based on a mixed model. The dependent variables were the number of verbatim words recalled, and the accuracy of pitch and rhythm in each melody/song. The between subjects independent variable was gesture, as participants were assigned to different gesture and no gesture conditions. The within subjects independent variable was the word/melody/song stimulus as each participant engaged in all four conditions (but with different songs for each). The four conditions were: (a) no gesture and song; (b) iconic gesture and words; (c) iconic gesture and melody; and (d) iconic gesture and song. Each song only had two conditions, yielding a total of 8 songs x 2 conditions = 16 stimuli video recordings. The conditions were randomly chosen using a coin toss method to reduce selection bias. They were then assigned to either block 1 or block 2.

Songs	**Block 1**	**Block 2**
Cripple Creek	B	D
Down Came a Lady	D	C
Down in the Meadow	B	C
Grandma Grunts	C	A
Housekeeping	C	D
Hunt the Slipper	D	A
Let Us Chase the Squirrel	A	B
The Old Sow	A	B

Table 1. Stimuli songs and conditions
(A- no gesture and song; B- iconic gesture and words; C- iconic gesture and melody; D- iconic gesture and song)

Procedure

Participants were tested individually in a soundproofed music cognition lab at the Ryan Center for the Musical Arts. The presentation of the experiment was done on E-Prime 3 and videos were played back over Alesis Monitor One Mk2 speakers. The experimenter was not in the room except to collect consent at the beginning and to debrief after the experiment ended. The aim of this was to limit the observer effect, whereby participants consciously or unconsciously alter their behavior

during an observation. After participants had signed the consent form, they were instructed to watch a series of videos and to listen carefully to the lyrics/melody/song in each video as their memory for them would be tested.

Participants were first presented with a practice session involving all four conditions so they knew what to expect in the experiment. As mentioned above, the four conditions were: (a) no gesture and song; (b) gesture and words; (c) gesture and melody; and (d) gesture and song. Participants were instructed to watch each video and recall the lyrics/melody/song following the presentation of each stimulus. They were told not to imitate or sing along while listening. Each video looped two times before participants had to speak or sing back. After the first recall, the same video was played one more time to collect a second recall. After the practice session, participants engaged in the same procedure for eight American folksongs in varying conditions. There were two blocks of this experiment (see Table 1) that were counterbalanced by session, such that participant 1 gets block 1, participant 2 gets block 2, participant 3 gets block 1, and so on. The order of trials in each block was also randomized to minimize order effects. There were 12 participants per block, yielding a total of 24 participants.

Participants were video recorded using a Canon digital video camera, but only their audio recordings were analyzed and scored for results. This process was to ensure that participants paid attention to the task, and to double check if they used gestures during recall. Following So et al.'s (2012) experiment on iconic and beat gesture in memory recall, participants were not allowed to sing or gesture while listening. However, they were not explicitly told to not imitate the gestures while recalling. After the experiment ended, participants filled out the Ollen Musical Sophistication Index (OMSI) and a brief questionnaire about their familiarity with the songs, if any, and whether or not they used gestures during the recall process.

Scoring Method

The scoring method for participants' audio data was adapted from Demorest's (1998) study on sight-singing performance, and Ginsborg and Sloboda's (2007) study on singers' recall for words and melody. The scoring unit of the song chosen was a half-bar, or, in other words, two quarter notes. For every half bar, 1 point was available for accurate pitch and 1 point was available for accurate rhythm. Since each song consisted of 8 bars, and for every half bar there were 2 points, the total possible score was 32. For condition B with just gesture and lyrics (and no melody), the number of correctly recalled words was counted and a percentage was calculated in relation to the proportion of words recalled in each condition. In the event that a participant missed the second recall due to skipping over the instruction to proceed to the next stimuli, the first recall was used to calculate the average total score for each condition.

Results

The purpose of this study was to investigate if iconic gesture can facilitate better recall of song (words and melody) as opposed to no gesture. The study also aimed to confirm that gesture can facilitate better recall of words, while examining if gesture can aid in remembering just the melody. Finally, the study looked at the effect of gesture and repetition on memorization by employing two immediate recalls.

Condition	N	M	SD	Minimum	Maximum
A – No gesture and song	24	86.17	13.56	55.56	100
B – Gesture and words	24	89.63	12.24	50	100
D – Gesture and song	24	86.14	14.89	47.22	100

Table 2. Overall word scores (in percent) for conditions A, B, and D

First, a paired-samples t-test was conducted to compare the accuracy of word recall for song in no gesture (A) and gesture (D) conditions. There was no significant difference in the scores for the no gesture and gesture conditions; $t(23) = .009$, $p = .993$.

Condition	N	M	SD	Minimum	Maximum
A – No gesture and song	24	80.34	14.14	52	100
C – Gesture and melody	24	71.29	16.15	39.06	98.44
D – Gesture and song	24	81.97	12.98	51.56	96.88

Table 3. Overall song scores (in percent) for conditions A, C, and D

A one-way repeated measures analyses of variance (ANOVA) was conducted to evaluate the effect of gesture on participants' song (pitch and rhythm) recall scores (N =24). The results indicated a significant condition effect for melody, $F(2, 22) = 9.98$, $p < .01$, Wilks' Lambda = .001, and a large effect size $\eta^2 = .48$.

A post hoc Tukey's HSD test showed a significant difference between song with gesture (M = 81.97, SD =12.98) and melody only (M = 71.29, SD = 16.15), $p < .01$. Additionally, there was a significant difference between song without gesture (M = 80.34, SD = 14.14) and melody only, $p < .01$. These results suggest a higher difficulty in achieving accurate recall of melody only as opposed to melody with words. There was no significant difference between gesture (M = 81.97, SD = 12.98) and no gesture conditions (M = 80.34, SD = 14.14), $p > .05$. Thus, we cannot reject the null hypothesis that there is no change in participants' song (pitch and rhythm) recall scores when measured with or without gesture. However, there is significant evidence to reject the null hypothesis that melody alone condition was equal to the words and melody condition (Figure 5).

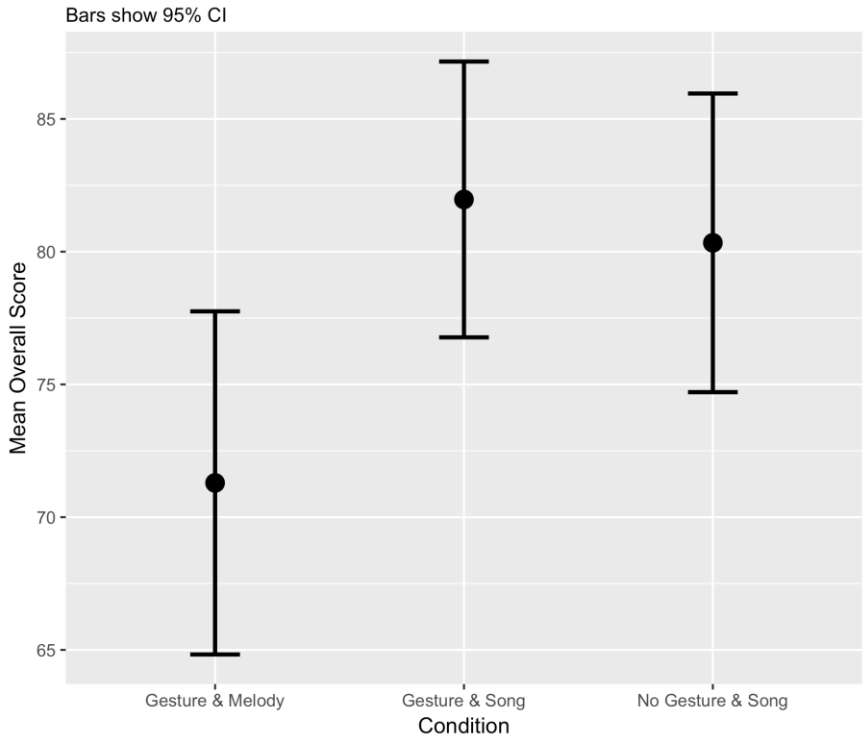


Figure 5. Comparison of means for overall song (pitch and rhythm) scores

One-way repeated measures ANOVA were conducted to evaluate the effect of gesture on participants' melodic, rhythmic, and text gain scores. The study looked at whether there was an improvement in participants' recall scores from first to second recall when measured with or without gesture (Figures 6-8). The results indicated no significant effect for pitch across conditions, $F(2, 22) = 1.736$, $p > .05$, Wilk's Lambda = .864, $\eta^2 = .136$; no significant effect for rhythm across conditions, $F(2, 22) = .043$, $p > .05$, Wilk's Lambda = .996, $\eta^2 = .004$; and no significant effect for words across conditions, $F(2, 22) = .025$, $p > .05$, Wilk's Lambda = .998, $\eta^2 = .002$. Therefore, our hypotheses that gesture and repetition would lead to larger gains in melodic, rhythmic, and word performance scores are not supported by the analysis.

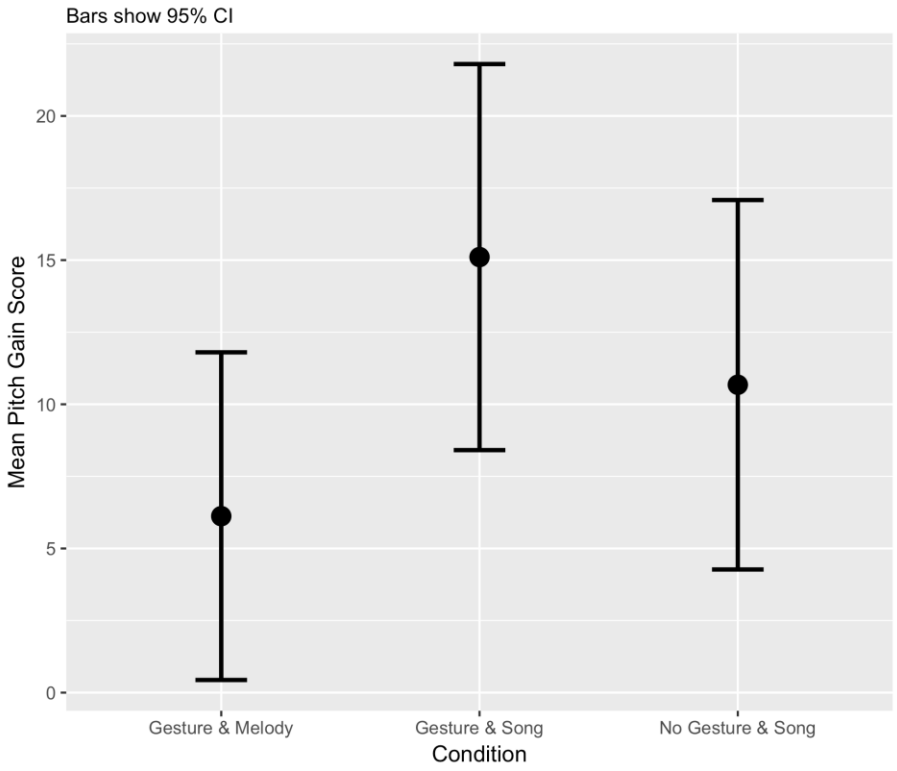


Figure 6. Comparison of means for melodic gain from recall 1 to 2

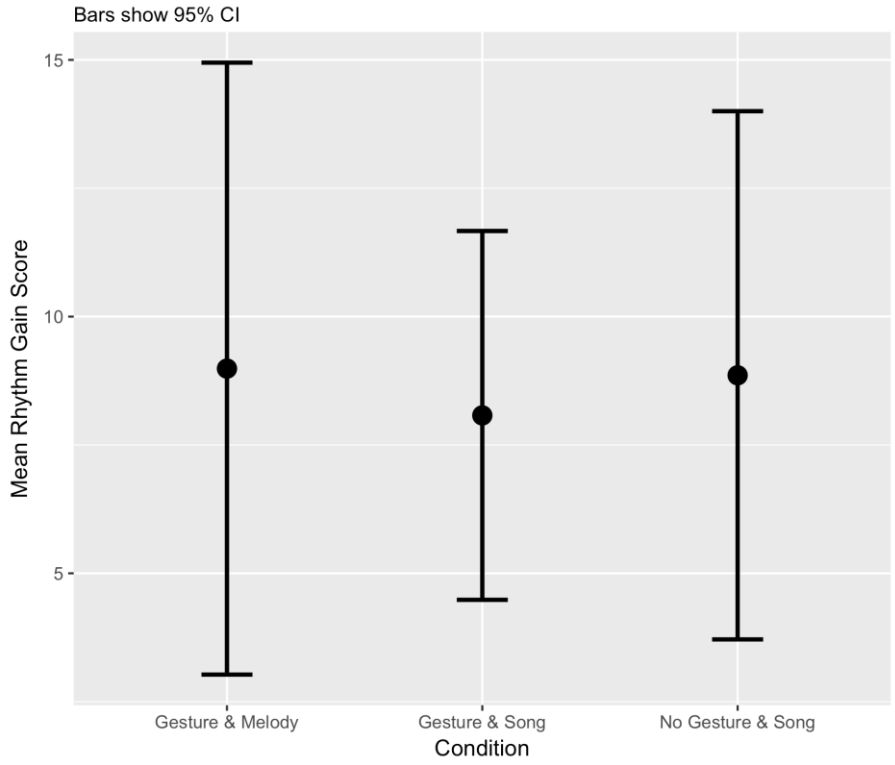


Figure 7. Comparison of means for rhythmic gain from recall 1 to 2

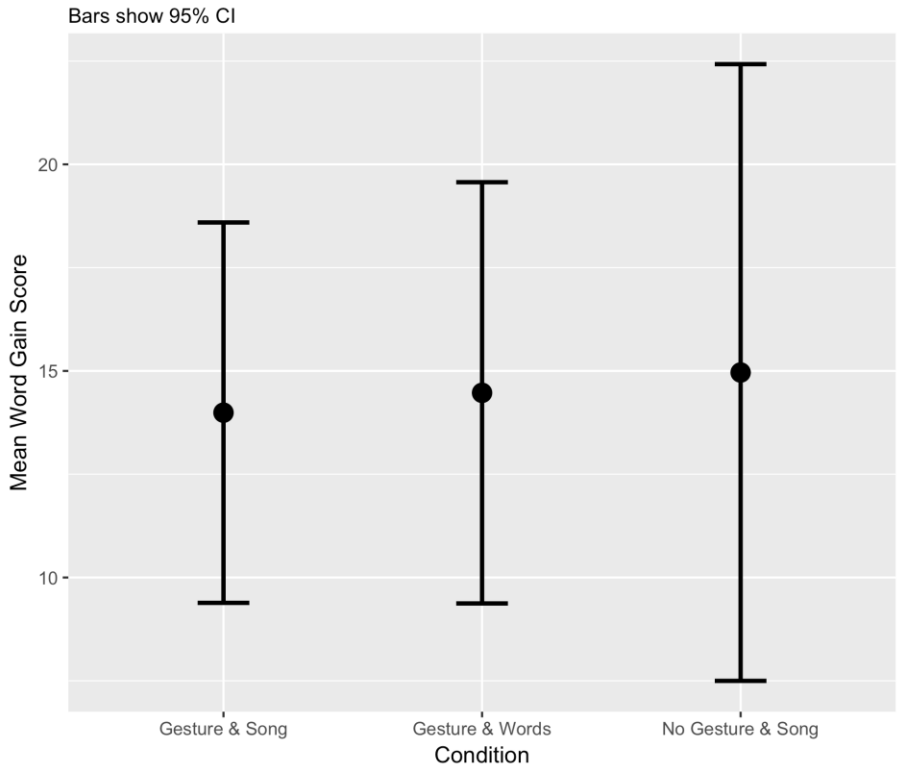


Figure 8. Comparison of means for word gain from recall 1 to 2

Discussion

This study explored whether encoding iconic gestures enhanced memory recall for lyrics, melody, and song in adults. The main findings showed a significant difference in accurate recall between song and melody, but not between gesture and no gesture conditions. In other words, having text accompany a melody aids memory more than having gesture accompany a melody. This is perhaps because there is no semantic meaning found in the sound attached to the gesture. Pitch and rhythm results show that people performed better in song conditions than in melody only conditions. This finding suggests that words help with remembering the melody, especially in terms of rhythm. An explanation for this is that if people can remember the words, then they are likely to get the rhythm correct as well. For example, "cobbler, cobbler" has four syllables, which also corresponds to four eighth notes. This explanation is in accordance with an earlier study that deduced a schematic frame

whereby text can be attached to rhythm, therefore using rhythmic information to facilitate recall of text (Purnell-Webb & Speelman, 2008).

An alternative suggestion is that the presence of melody actually enhances recall for lyrics when there is a learned association between them. This association was first investigated by Crowder et al. (1990) and Serafine et al. (1984, 1986), who claimed that there is an integration effect between melody and text. They found that participants were more likely to judge words as familiar if they were paired with their original melody, and vice versa. They acknowledged the connectedness between melody and text such that the presentation of one would lead to the retrieval of the other; however, they found that participants were not able to recognize melody on its own, independently of the words. Similarly, out present study showed that participants performed more poorly when recalling just the melody. Studies by Crowder et al., (1990) and Ginsborg & Sloboda (2007) both continued the exploration of the cognitive representation for remembered songs. They tested the association-by-contiguity hypothesis, which asserts that two events occurring in close temporal contiguity (successively or simultaneously) tend to become connected in memory. Both articles concluded that retrieving words enables retrieval of melody, and the other way around, but not integrated to the extent that failure to recall one accurately always results in failure to recall the other. Moreover, Racette and Peretz (2007) also argue that songs possess structural characteristics that may assist text recall. For instance, the metrical structure of the music and the number of musical notes in a phrase can cue word recall.

The present study also found that iconic gestures did improve participant recall of words, although results were not significant. Previous studies have shown how imitation of iconic gestures helps with learning and memory of words (de Nooijer et al., 2013; Kelly et al., 1999; Krönke et al., 2013; So et al., 2012). A more informative way of testing this phenomenon would be to include a condition using words without gestures, and to compare it to words paired with gestures. Although

there was no significance in word gain from recall 1 to recall 2, participants generally scored higher accuracy of words when accompanied with gesture. This study also showed that gestures improve participant recall of words and melody together, but results were not significant. This could be the result of this study's relatively small sample size. However, there was a general trend showing that gesture helps with words as the gesture and song condition had the highest recall score overall.

A limitation of the present study was that some songs were harder to remember than others. Taking the average scores for second recall across participants, results indicated that songs "Housekeeping" and "The Old Sow" were harder to remember, whereas "Let Us Chase the Squirrel" and "Cripple Creek" were easier to remember. The scores for "Housekeeping" displayed a mean accuracy of 70% for words (*SD* = 33.86) and 77% for melody (*SD* = 23.29) in the song and gesture condition, and 63% accuracy (*SD* =23.14) in the melody only condition. Scores for "The Old Sow" showed a mean accuracy of 74% for words (*SD* = 30.90) and 73% for melody (*SD* = 22.47) in the song and no gesture condition, and 78% accuracy (*SD* = 23.39) in the word only condition. In contrast, mean scores for "Let Us Chase the Squirrel" were as high as 98% for the word only condition (*SD* = 4.44), and a mean accuracy of 95% for words (*SD* = 15.88) and 85% for melody (*SD* = 17.31) in the song without gesture condition. Finally, "Cripple Creek" scored a mean accuracy of 94% for the word only condition (*SD* = 5.00), and 89% for words (*SD* = 7.11) and 83% for melody (*SD* = 11.58) in the song and gesture condition. Although the songs were chosen to be as similar as possible in terms of difficulty, they could have been further scrutinized to minimize variability. It may be argued that the stimuli used in this study had low ecological validity or relevance to participants as it used simple American folk songs to test college students. To increase ecological validity, achieve generalizability of findings, and reduce the potential ceiling effect, a future approach could be to test elementary or middle school children who are more accustomed to learning and hearing folksongs in their music classrooms.

Additionally, participants did not improve significantly with repetition in the gesture condition than without gesture from the first to second recall. However, results suggest a positive trend in improvement of overall word and melody scores, regardless of gesture. A more sensitive test might look into long term retention of songs rather than immediate recall. Due to the nature of the study, there may have been too much informational and sensory input (visual and aural) at a given moment for a brief period of time. Contrary to intuition, some participants did worse in the second recall in terms of melody (rhythm and pitch). Although there was no discernible pattern, possible reasons include fatigue, concentrating on words instead of melody, or inability to focus. There were four participants who did not attempt the second recall for various songs because they accidentally skipped over it—perhaps an issue with the experimental design—and so their data was limited such that one song was used for the average gain score instead of two songs.

It was interesting to observe that some participants' recalls displayed a primacy effect, while others showed a recency effect. 12 participants' recalls demonstrated a primacy effect, such that they remembered the words and melody presented at the beginning of the song, while 6 participants demonstrated a recency effect, remembering only the last few measures of the song. This effect was not surprising as Ginsborg & Sloboda (2007) found that more hesitations were made at the ends of phrases than at the beginning or mid-phrase, which suggests that formal structure of a song provides a framework for recall.

The results do suggest however, that gesture helps people recognize words in a song. Of 24 total participants, 13 of them gestured without being asked to. A follow-up interview could have been carried out to ask participants if gesturing while singing helped them remember the words. Existing literature on multisensory and sensorimotor learning suggests that incorporating a modality in a learning paradigm will improve an individual's ability to learn, even if this modality is not utilized during recall (Seitz, Kim, & Shams, 2006). In other words, even if participants did not

gesture during recall, incorporating gesture in the learning process should have improved memory and recall. Cassell et al. (1998) also provide evidence for listeners' representation of accumulating information and attending to gestures that accompany narrative speech.

Although this study did not investigate the effects of musical training on recall accuracy, there was a high standard deviation across conditions for word and song accuracy. Despite the indication that some participants clearly performed better than others, there was no obvious trend that showed that musically sophisticated participants performed better. Most participants fell below 500 on the Ollen Musical Sophistication Index (OMSI) and hence were considered less musically sophisticated. However, upon review of the OMSI method, someone who is considered a "serious amateur musician" received a higher score than one who considered him/herself a "semi-professional musician." Additionally, someone with more than three years of music coursework and study scored lower than someone who only accomplished two years. Given these seemingly incongruous weightings, the validity of the measure may be called into question. Nonetheless, the OMSI is still indicative of musical ability, experience and expertise, though perhaps not the best method of measuring musicality. There are a few studies that have investigated the effect of musical expertise and training on recall. Interestingly, Racette and Peretz (2007) found that musical training had little impact on singing performance, suggesting that vocal learning is a basic and widespread skill. Meanwhile, Kilgour et al. (2000) found that musically trained adults had better verbatim recall for sung words than did non-musically trained adults. Sloboda and Parker (1985) also showed that musicians perform significantly better than non-musicians, but only in retaining harmonic structure of the original melody. This suggests that those with more experience performing music are better able to encode and represent music, and therefore recall and perform it accurately from memory. If this study's sample had included more participants who were considered "more musically

sophisticated," then a between-subjects analysis could be conducted to investigate whether there are any recall differences between those considered more or less musically sophisticated.

Phase 3: Pilot study to test longer term memory

Thus far, melody helps with memorizing words in immediate recall of relatively short songs. However, immediate recall does not necessarily tap into the learning process, and participants may generally have a good verbal working memory span. As such, cross-modal encoding (visual information from gesture) may play an effect on longer term memory of songs. A pilot study was conducted to test participants' memory for the same stimuli after an hour delay. This study tested the hypothesis that participants' memories would degrade with time, but that stimuli learned in gesture conditions would show less memory loss as a result of multimodal encoding.

Method

Participants

Two Northwestern undergraduate students, both female, ages 21 and 22, took part in this pilot study. One was considered more musically sophisticated than the other, with an OMSI score of 699.52 compared to 240.31. Both participants had self-described normal hearing and English proficiency sufficient for study at Northwestern University. Participants were kept anonymous and were paid $5.00 for participation, and an additional $2.00 for accuracy of recall. The additional bonus is to ensure that participants are taking the test seriously and putting in the effort to memorize the melody and/or lyrics. Nonetheless, both participants received a $7.00 cash card at the end of the first experimental session. Participants were also paid an additional $7.00 cash card for part two of the study.

Stimuli

The same two blocks of eight American folksongs described in the previous Phase 2 experiment were used in this pilot study.

Design

The design was exactly as in the previous experiment in the second phase of the study.

Procedure

The procedure for the first part of the study was identical to that of Phase 2. For the second part of this pilot study, participants were asked to return to the lab an hour after finishing the first experiment to test their memory for the songs they heard. However, they were not informed that they would be tested for their memory of these songs. Upon arriving at lab once again, participants were asked to freely recall any or all of the songs (words and/or melody) they remembered from the experiment, in no particular order. As in the previous experiment, participants were video recorded for analyses and the experimenter was not present in the room.

Results & Discussion

Based on the two trials, there was essentially no recall of songs after an hour delay. This result was not surprising as the participants were given no motivation to try to remember them. One participant only recalled 23% of the words of one song out of eight, while the other remembered only some contextual information of a few of the songs. Gesture did not play a role in participants' recall, but it was noticed that participants recalled information from the second half of the study, suggesting a slight recency effect. Neither participant could reproduce the melody or exact phrases of any song. This task was perhaps too difficult seeing as participants were not told to learn the song and return an hour later to repeat what they had recalled previously. Nonetheless, a follow-up to this

pilot could be a longer experiment utilizing more trials with participants having the intention of learning songs, then having the participants come back a week later to recall what they had learned.

Conclusion

Despite ample research on gesture and memory for words, as well as on gesture and improving musicality, to date it appears that no studies have applied gesture to the memorization and recall of lyrics. Hence, this current study applied the enactment effect to the recall of songs. In summary, these are the main findings:

1. Memorizing lyrics and melody together produces better recall than memorizing just the melody.
2. Iconic gesture helps with memorizing lyrics, but does not make a statistically significant difference in immediate recall of songs (lyrics and melody).
3. Iconic gesture does not help with memorizing just the melody since there is no semantic meaning attached.
4. Gesture does not significantly improve either immediate or longer term recall of songs.
5. Words can help memory for melodic and rhythmic elements of song and vice versa.
6. Gesture can accompany words to aid in learning and remembering songs, which can be utilized in music education.

What do these results tell us about use of gesture and memory for music and text? They point towards the notion that using iconic gesture can aid in learning and remembering songs, although further extensive research needs to be done to claim ecological validity of such a method. Nonetheless, the findings of this study generate several ideas for future research. Since the bulk of this experiment focused on immediate recall, the next task would be to test long-term retention of songs. Empirical studies on gesture use have shown that learning a concept with the help of gesture results in learning that is retained across time, as opposed to learning without gesture (Cook,

Mitchell, & Goldin-Meadow, 2008). A longitudinal case study by Ginsborg & Chaffin (2009) followed a singer's long-term recall of *Ricercar* from Stravinsky's "Cantata," and found that sung recall was much more accurate than written recall. They also found that the use of piano accompaniment enhanced accuracy and fluency by providing auditory cues that had to be imagined otherwise. Although this present study does not use instrumental accompaniment, it uses gestural accompaniment, which can be argued to aid longer term recall. Future studies may also consider using different types of gesture. As mentioned in the literature review, there are four types of speech-accompanying gestures (Cassell et al., 1998; Kendon, 2004; McNeill, 1992). With regards to music, researchers could look into the different effects between iconic and beat gesture, with the latter referring to simple, rhythmic gestures that do not convey semantic content. Beat gestures emphasize certain words and phrases during speech, activating prosodic processing of the accompanying speech. For example, So et al. (2012) found that encoding beat gestures aided verbatim speech recall in adults, suggesting that both meaningful iconic and nonmeaningful beat gestures could strengthen their memory. Future studies can also utilize more musical gestures (Liao & Davidson, 2007, 2016a, 2016b; Nafisi, 2010) to approach memorization of lyrics.

Finally, researchers may investigate the difference in simultaneous vs. sequential learning of gesture and song, to see which condition will result in higher retention of lyrics. For example, although unrelated to music, Congdon et al. (2017) tested children's retention of mathematical concepts, and found that children retain and generalize what they learn better when given instruction containing simultaneous speech and gesture than sequential speech and gesture. In the context of multimodal learning theories, they conclude that gesture capitalizes on its synchrony with speech to promote long lasting learning. It would be interesting to expand on this study to see if simultaneous or sequential learning of gesture and song makes a difference in learning and remembering lyrics.

Overall, this paper has shown that there is encouraging evidence that iconic gestures can be used to accompany words to aid in learning and remembering songs. Although more research needs to be conducted to generalize findings to real-life music education settings, gestures can be utilized in the context of music education to reinforce memory for words.

References

Apfelstadt, H. (1985). Choral music in motion: The use of movement in the choral rehearsal. *The Choral Journal*, *25*(9), 37–39.

Bäckman, L., & Nilsson, L.-G. (1984). Aging effects in free recall: An exception to the rule. *Human Learning: Journal of Practical Research & Applications*, *3*(1), 53–69.

Bäckman, L., & Nilsson, L.-G. (1985). Prerequisites for lack of age differences in memory performance. *Experimental Aging Research*, *11*(2), 67–73. https://doi.org/10.1080/03610738508259282

Cassell, J., McNeill, D., & McCullough, K.-E. (1998). Speech-gesture mismatches: Evidence for one underlying representation of linguistic and nonlinguistic information. *Pragmatics & Cognition*, *6*(2). https://doi.org/10.1075/pc.7.1.03cas

Cassidy, J. W. (1993). Effects of various sightsinging strategies on nonmusic majors' pitch accuracy. *Journal of Research in Music Education*, *41*(4), 293–302. https://doi.org/10.2307/3345505

Chosky, L. (1988). *The Kodály method*. Englewood Cliffs, NJ: Prentice Hall.

Cohen, R. L. (1981). On the generality of some memory laws. *Scandinavian Journal of Psychology*, *22*(1), 267–281. https://doi.org/10.1111/j.1467-9450.1981.tb00402.x

Cohen, R. L. (1983). The effect of encoding variables on the free recall of words and action events. *Memory & Cognition*, *11*(6), 575–582. https://doi.org/10.3758/BF03198282

Cohen, R. L. (1985). On the generality of the laws of memory. In *Perspectives on learning and memory* (pp. 247–277). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

Congdon, E. L., Novack, M. A., Brooks, N., Hemani-Lopez, N., O'Keefe, L., & Goldin-Meadow, S. (2017). Better together: Simultaneous presentation of speech and gesture in math instruction supports generalization and retention. *Learning and Instruction*, *50*, 65–74. https://doi.org/10.1016/j.learninstruc.2017.03.005

Cook, S. W., Mitchell, Z., & Goldin-Meadow, S. (2008). Gesturing makes learning last. *Cognition*, *106*(2), 1047–1058. https://doi.org/10.1016/j.cognition.2007.04.010

Crowder, R. G., Serafine, M. L., & Repp, B. (1990). Physical interaction and association by contiguity in memory for the words and melodies of songs. *Memory & Cognition*, *18*(5), 469–476. https://doi.org/10.3758/BF03198480

de Nooijer, J. A., van Gog, T., Paas, F., & Zwaan, R. A. (2013). Effects of imitating gestures during encoding or during retrieval of novel verbs on children's test performance. *Acta Psychologica*, *144*(1), 173–179. https://doi.org/10.1016/j.actpsy.2013.05.013

Demorest, S. M. (1998). Improving sight-singing performance in the choral ensemble: The effect of individual testing. *Journal of Research in Music Education*, *46*(2), 182–92. https://doi.org/10.2307/3345622

Engelkamp, J., & Zimmer, H. D. (1984). Motor programme information as a separable memory unit. *Psychological Research*, *46*(3), 283–299. https://doi.org/10.1007/BF00308889

Erdei, P. (Ed.). (1974). *150 American folk songs to sing, read and play*. New York: Boosey & Hawkes.

Ginsborg, J. (2004). Singing by heart: Memorization strategies for the words and music of songs. In J. W. Davidson (Ed.), *The Music Practitioner: Research for the Music Performer, Teacher and Listener* (pp. 149–160). Routledge.

Ginsborg, J., & Chaffin, R. (2009). Very long term memory for words and melody: An expert singer's written and sung recall over six years. *The Second International Conference on Music Communication Science*.

Ginsborg, J., & Sloboda, J. A. (2007). Singers' recall for the words and melody of a new, unaccompanied song. *Psychology of Music*, *35*(3), 421–440. https://doi.org/10.1177/0305735607072654

Kelly, S. D., Barr, D. J., Church, R. B., & Lynch, K. (1999). Offering a hand to pragmatic understanding: The role of speech and gesture in comprehension and memory. *Journal of Memory and Language*, *40*(4), 577–592. https://doi.org/10.1006/jmla.1999.2634

Kelly, S. D., Özyürek, A., & Maris, E. (2010). Two sides of the same coin: Speech and gesture mutually interact to enhance comprehension. *Psychological Science*, *21*(2), 260–267. https://doi.org/10.1177/0956797609357327

Kendon, A. (2004). *Gesture: visible action as utterance*. Cambridge, U.K. ; New York: Cambridge University Press.

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. https://doi.org/10.3758/BF03198404

Krönke, K.-M., Mueller, K., Friederici, A. D., & Obrig, H. (2013). Learning by doing? The effect of gestures on implicit retrieval of newly acquired words. *Cortex*, *49*(9), 2553–2568. https://doi.org/10.1016/j.cortex.2012.11.016

Liao, M.-Y. (2008). The effects of gesture use on young children's pitch accuracy for singing tonal patterns. *International Journal of Music Education*, *26*(3), 197–211. https://doi.org/10.1177/0255761408092525

Liao, M.-Y., & Davidson, J. W. (2007). The use of gesture techniques in children's singing. *International Journal of Music Education*, *25*(1), 82–94. https://doi.org/10.1177/0255761407074894

Liao, M.-Y., & Davidson, J. W. (2016a). Enhancing gesture quality in young singers. *Music Education Research*, *18*(3), 283–294. https://doi.org/10.1080/14613808.2015.1060953

Liao, M.-Y., & Davidson, J. W. (2016b). The effects of gesture and movement training on the intonation of children's singing in vocal warm-up sessions. *International Journal of Music Education*, *34*(1), 4–18. https://doi.org/10.1177/0255761415614798

McNeill, D. (1992). *Hand and mind: what gestures reveal about thought*. Chicago: University of Chicago Press.

Nafisi, J. (2010). Gesture as a tool of communication in the teaching of singing. *Australian Journal of Music Education; Parkville, Vic.*, (2), 103–116.

Nyberg, L., Nilsson, L.-G., & Bäckman, L. (1991). A component analysis of action events. *Psychological Research*, *53*(3), 219–225. https://doi.org/10.1007/BF00941390

Ollen, J. E. (2006). A criterion-related validity test of selected indicators of musical sophistication using expert ratings. Retrieved May 20, 2018, from http://marcs-survey.uws.edu.au/OMSI/omsi.php

Opie, I., & Opie, P. (1955). *The Oxford nursery rhyme book*. Oxford University Press.

Peretz, I., Radeau, M., & Arguin, M. (2004). Two-way interactions between music and language: Evidence from priming recognition of tune and lyrics in familiar songs. *Memory & Cognition*, *32*(1), 142–152. https://doi.org/10.3758/BF03195827

Peterson, C. W. (2000). Moving musical experiences in chorus. *Music Educators Journal*, *86*(6), 28–30. https://doi.org/10.2307/3399617

Purnell-Webb, P., & Speelman, C. P. (2008). Effects of music on memory for text. *Perceptual and Motor Skills*, *106*(3), 927–957. https://doi.org/10.2466/pms.106.3.927-957

Racette, A., & Peretz, I. (2007). Learning lyrics: To sing or not to sing? *Memory & Cognition*, *35*(2), 242–253. https://doi.org/10.3758/BF03193445

Saito, Y., Ishii, K., Sakuma, N., Kawasaki, K., Oda, K., & Mizusawa, H. (2012). Neural substrates for semantic memory of familiar songs: Is there an interface between lyrics and melodies? *PLOS ONE*, *7*(9), e46354. https://doi.org/10.1371/journal.pone.0046354

Seitz, A. R., Kim, R., & Shams, L. (2006). Sound facilitates visual learning. *Current Biology*, *16*(14), 1422–1427. https://doi.org/10.1016/j.cub.2006.05.048

Serafine, M. L., Crowder, R. G., & Repp, B. H. (1984). Integration of melody and text in memory for songs. *Cognition*, *16*(3), 285–303. https://doi.org/10.1016/0010-0277(84)90031-3

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*(2), 123–135. https://doi.org/10.1016/0749-596X(86)90025-2

Sloboda, J. A., & Parker, D. H. (1985). Immediate recall of melodies. In P. Howell, I. Cross, & R. West (Eds.), *Musical structure and cognition* (pp. 143–167). London: Academic Press.

So, W. C., Chen-Hui, C. S., & Wei-Shan, J. L. (2012). Mnemonic effect of iconic gesture and beat gesture in adults and children: Is meaning in gesture important for memory recall? *Language and Cognitive Processes*, *27*(5), 665–681. https://doi.org/10.1080/01690965.2011.573220

Steffens, M. C., Buchner, A., & Wender, K. F. (2003). Quite ordinary retrieval cues may determine free recall of actions. *Journal of Memory and Language*, *48*(2), 399–415. https://doi.org/10.1016/S0749-596X(02)00517-X

Steffens, M. C., Buchner, A., Wender, K. F., & Decker, C. (2007). Limits on the role of retrieval cues in memory for actions: Enactment effects in the absence of object cues in the environment. *Memory & Cognition*, *35*(8), 1841–1853. https://doi.org/10.3758/BF03192919

Wakefield, E. M., & James, K. H. (2011). Effects of sensori-motor learning on melody processing across development. *Cognitie, Creier, Comportament/Cognition, Brain, Behavior*, *15*(4), 505–534.

Wallace, W. T. (1994). Memory for music: Effect of melody on recall of text. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*(6), 1471–1485. https://doi.org/10.1037/0278-7393.20.6.1471

Appendix A

Interview Questions for Choral Conductors:

Begin by asking about their conducting background/experience.

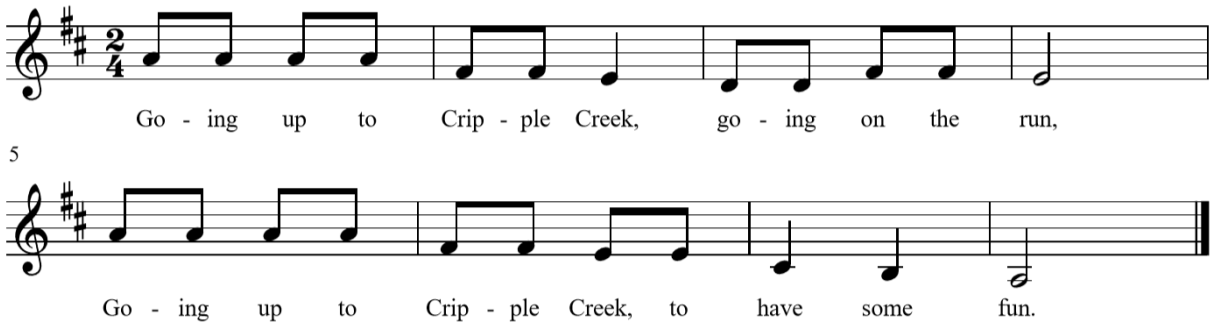
1. What are your strategies for helping your choir learn lyrics?
2. What are your strategies for helping your choir memorize lyrics?
3. How do you get students to go "off-score" (i.e. not read off notation) and to focus on you as the conductor?
4. When ensemble members have trouble memorizing words, what circumstances do you see associated with the difficulty of memorizing lyrics?
5. Are some types of lyrics easier to remember than others? For example, are verbs easier to remember than concrete nouns?
6. Does the structure of the music (form, or refrain/chorus) help with remembering lyrics?
7. Can you give me a piece of music where the lyrics was easy to learn? Hard to learn? What makes the difference?
8. Can you give an example of how you would conduct your students?
9. What do you focus on with your conducting? Phrasing? Meter? Expressiveness?
10. What do you use gestures for? Expressive purposes? Intonation etc.?
11. Are there certain gestures you use to represent words?
12. Do you have your students imitate your gestures while singing?
13. On average, how many times do you teach/go through a piece before the students can sing from memory?
14. How important is memorizing the lyrics of a musical text for a performance?
15. Do you think memorizing lyrics has become less important in today's world because of new contemporary pieces that are harder to memorize or perform without the music?

Note: These questions are subject to change depending on the interviewee's responses.

Appendix B

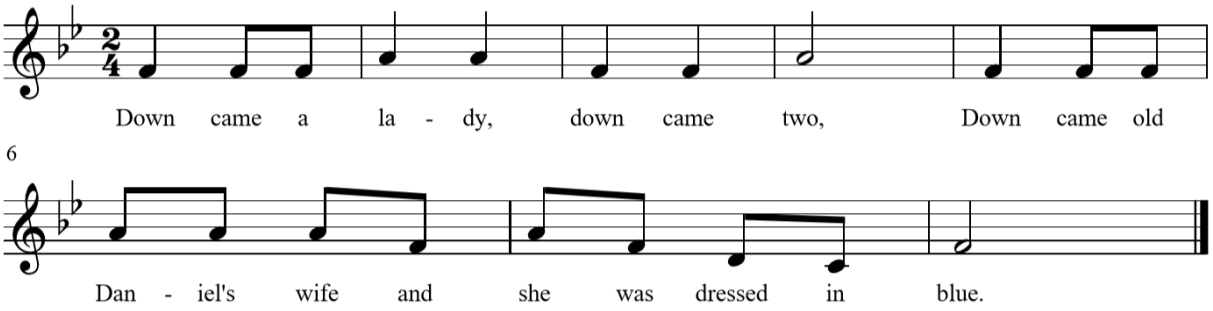
Cripple Creek

American Folksong



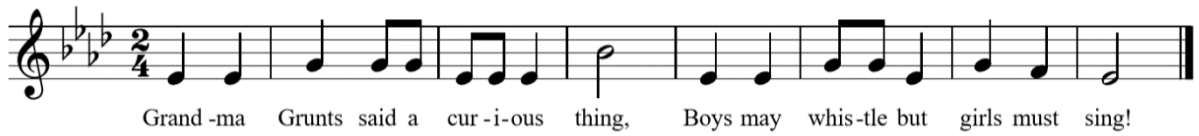
Down Came a Lady

American Folksong



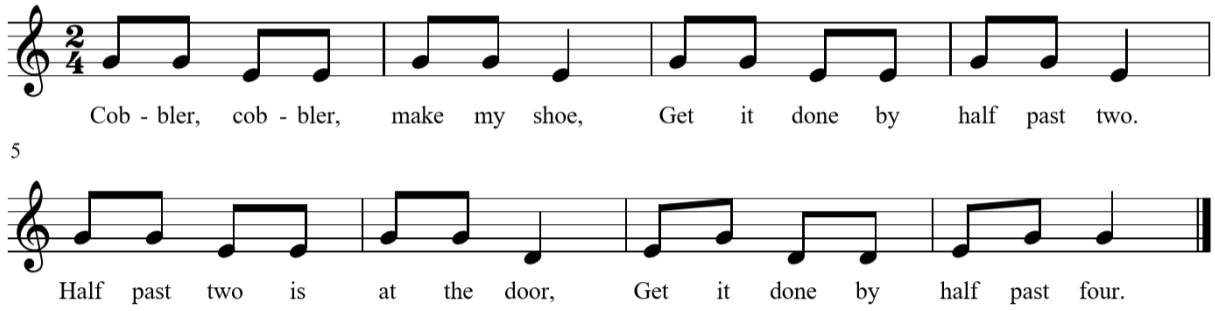
Grandma Grunts

American Folksong



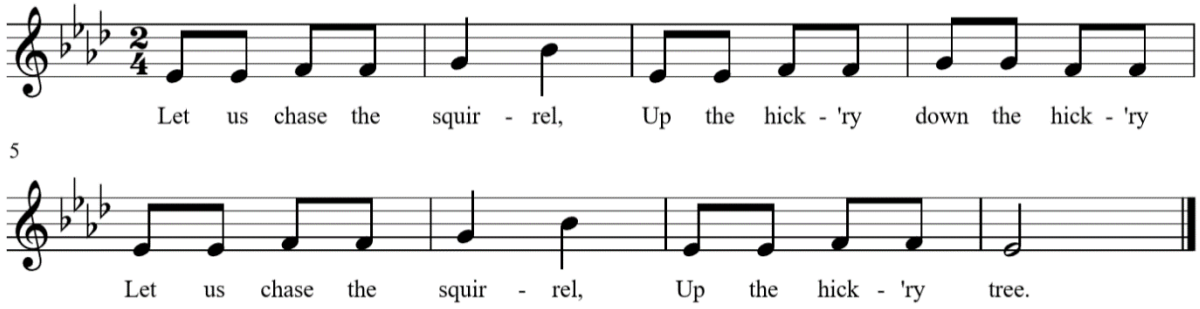
Hunt the Slipper

American Folksong



Let Us Chase The Squirrel

American Folksong



Page's Train

American Folksong