Melody and Serial Recall

Fred Cummins and Maria Elena Bravo

Department of Computer Science,
University College Dublin
fred.cummins@ucd.ie

Abstract. We investigated the effect of unfamiliar melody on the serial recall of lists of items. Prior studies have failed to show that the superposition of a melody on a list of items improves recall, and advantages which have been shown appear to derive exclusively from the role of melody in suggesting or imposing grouping on lists of items. Unresoved issues exist, however, with the choice of melody and the experimental design. We here detail a recent study in which subjects attempted to recall a list of 11 digits with or without a superimposed melody. Unfamiliar pentatonic melodies were used throughout, with a novel melody for each trial. Results suggest that the use of unfamiliar melodies without significant rhythmic grouping does not enhance recall.

1 Introduction

Does music help in encoding a given text in memory? There is ample anecdotal evidence that this may be the case. Firstly, there is a long tradition of encoding narratives in ballad or song form, which may be assumed to have facilitated their preservation in oral traditions. This is no longer easily amenable to empirical research, however. There is also an abundance of claims for the facilitative nature of musical accompaniment in the commercial world, as this quote from a commercial website illustrates (from [4]):

> "A catchy and carefully constructed academic song will address many of the above requirements for optimum learning, namely, sound, rhythm, emotion, and intellect, and leave an impression that invites recitation, review, and reflection. The power of teaching through music has only just begun to be tapped"

The empirical evidence for the benefit of melody in storing and recalling text is somewhat spottier. In a series of experiments, Wallace [5] demonstrated that the lyrics of a ballad were better recalled, both immediately and after a 20 min delay, if they were heard in sung form rather than merely recited, or spoken rhythmically over a metronome beat. In two experiments, three verses of one of two ballads were played and recalled, so that the melody was heard three times as often as any of the individual texts. This advantage for the sung form was reversed, however, if the melody was heard an equal number of times

as the text (using only one verse from a ballad). The demonstrated advantage over a rhythmically spoken text (with a background metronome) suggested that rhythmic structure alone was insufficient to account for the observed effects, although there does not yet exist an uncontroversial definition of 'rhythm' that would allow a strong separation of rhythmic and non-rhythmic components to music.

In a recent study, Rainey and Larsen examined list learning where items were either spoken or sung to a familiar melody ("Pop goes the weasel" or "Yankee Doodle") [2]. They measured the number of trials required to learn a list initially, and one week later. An advantage for the sung version was found, but only for the 'one week later' condition.

Frankish [1] directly tested the role of simple melodies in recalling lists of digits, as well as the importance of speech-like prosodic patterns. The hypothesis he explored was that speech and perhaps music might provide a physical structuring of the digit list which would facilitate chunking, and hence improve recall (the so-called *grouping effect*). In a first experiment, an intonation pattern which strongly suggested grouping of the list of nine digits into three three-word groups was used. This greatly facilitated recall. This result is in accord with previous experiments in which speaker identity or pauses were used to induce groups within a nine-digit list. In a second experiment, the notes of familiar melodies ("My Bonnie Lies Over the Ocean" and "Deutschland, Deutschland, Ueber alles") were used both in their usual form (familiar melody) and in note-reversed form (unfamiliar melody). No advantage was found for either melodic condition over a monotonous presentation. In a follow up experiment (Experiment 3), melodies which either strongly suggested a grouping into threes, or no obvious grouping, were used. Again, neither melodic condition showed an advantage over the monotone control condition. The use of even simpler melodies which practically forced a grouping-by-threes was then examined. Two melodic contours were used: Blocked Grouping (LLLHHHLLL) and Hierarchical Grouping (LMHLMHLMH). A pause-grouped monotone condition was also used. The pause grouped and block grouped conditions elicited more accurate recall than either the hierarchically grouped or ungrouped conditions. In summary, melody, or pitch variation, only provided a boost to recall when it was efficacious at inducing grouping of the digit lists into sub-lists. Pauses were as effective as pitch patterns at inducing groups.

In another experiment which examined grouping in serial recall, Reeves and colleagues superimposed three-beat stress patterns on digit lists [3]. Stress patterns enhanced recall performance, and they were able to show that the advantage so gained was derived for the most part from the perceptual grouping afforded by the stress patterns.

The evidence suggesting that melody or musical setting may improve recall is thus equivocal at best. Tests in which lyrics are learned are difficult to compare to the learning of lists of unconnected items. The latter, being almost devoid of significant semantic content, seem to offer greater potential in uncovering the role of auditory short term memory, at the expense of naturalism.

One issue which the Frankish study [1] failed to address is the possible role of novelty in forming initial associations between a melody and associated words. In all conditions which used a melody, subjects repeatedly heard a familiar melody. Any associations they might have between items and melodic structure would necessarily be transient, and competition between associations formed on one trial might well compete with associations to be formed on subsequent trials. A similar caveat must be made with regard to Rainey and Larsen's study [2], in that only familiar melodies were used, and they were repeated very often in the course of a single experimental session.

2 An Experiment to Investigate the Possible Role of Melody in Serial Recall

We conducted an experiment which sought to pursue the possible advantage which might be conferred by unfamiiliar melodies in a serial recall task. The methods used (below) were designed to allow a novel melody to be used for each list presentation. Melody structure was essentially random, so that any grouping effects which individual melodies produce were evenly distributed across all positions in the list. To further counteract more obvious grouping effects, eleven-item lists were used, which precluded any simple, rhythmic, subdivision.

2.1 Methods

A total of thirteen post-graduate students participated in the experiment. All subjects were native speakers of English, with no speech or hearing deficits, as established by self-report. They were tested individually in sessions lasting approximately an hour. They received payment for their participation.

There were two conditions: 'sung' and 'monotone'. In each condition, subjects heard a signal tone, followed by an 11 note melody repeated twice, with one second between melodies. They then heard a series of 11 digits which were either monotone, or which had been pitch altered to match the melody. They then had to attempt to recall the series of digits, writing from left to right, with signal tones at the start and end of a 15 second recall period.

Digit lists were prepared by first recording each digit from 'one' to 'ten' in a carrier frame "I say X again". Several recordings were made and individual digit tokens extracted which were judged to have a natural and relatively stable monotone. 'Sung' versions of these digits were made by resynthesis, replacing the original contour with a monotone pitch to match the melody. Praat's PSOLA resynthesis algorithms were used to generate the sung tokens (www.praat.org). In the monotone condition, all digits had the same synthetic pitch (D♭, 138 Hz). For each list, positions 1–9 contained a pseudo-random permutation of the digits 'one' to 'ten', except for 'seven' (omitted due to being bisyllabic), with a constraint prohibiting consecutive digits at any point. The final two positions in the list contained a random selection of two digits from the same set, and with the same sequencing constraint.

Melodies were generated by producing random sequences of the five notes of one pentatonic scale (C♯, D♯, F♯,G♯,B♭). The generation algorithm sequenced two permutations of the five notes, with an eleventh note chosen randomly from among the five, with the additional constraint that no two consecutive notes were identical. Notes were rendered using sampled piano tones from the octave below Middle C, and had an inter-note onset interval of 0.5 sec. Subjects completed three blocks of 20 trials (10 monotone, 10 sung) in a single session, with short breaks between blocks. Recall was done using written response sheets with serial position indicated by a printed grid. No group boundaries were indicated. Subjects were instructed to write the digits in the space provided, recalling the digits from beginning to end, without backtracking. They were instructed to leave blanks or simply guess, where they could not remember a digit. They were also instructed not to make any correction after the final signal tone indicating the end of the recall task.

Subjects had a practice session, consisting of 4 lists, in which monotone and sung conditions alternated. They could repeat the practice session until they felt familiar with the trial structure and task demands.

Scoring was based on errors as a function of serial position. Below, we score every absent or wrong digit as an error, without taking into account that a sub part of the list may be reproduced with a slight positional shift.

2.2 Results

Figure 1 shows results from all 13 subjects. Shaded bars show errors in the sung condition, unshaded are monotone. The well known primacy effect, whereby list elements from the beginning of a list are preferentially recalled, and the recency effect, whereby the final element presented is also preferentially recalled, are clearly evident.

For each subject, we calculated the proportion of digits correctly recalled in each trial. A matched t-test was done to compare the proportion correct in the 'mono' and 'sung' conditions. A significant difference between conditions was found [t(12)=2.98,$p < 0.05$], due to slightly better performance in the monotone condition than the sung condition[1].

A fuller analysis requires a repeated measures ANOVA, with condition and serial position as factors, and the error count over three trials as the dependent variable. This showed the expected main effect of serial position [F(10,252)=93, $p < 0.001$], confirmed the smaller effect of condition [F(1,252)=4.5,$p < 0.05$], but did not reveal any interaction between serial position and condition [F(10,252)=0.8,n.s.].

3 Discussion

It appears that there is no advantage for a list presented in this kind of melodic context. The effect of condition demonstrated that the 11 note unfamiliar melodies

[1] An arcsine transform of the data revealed the same picture.

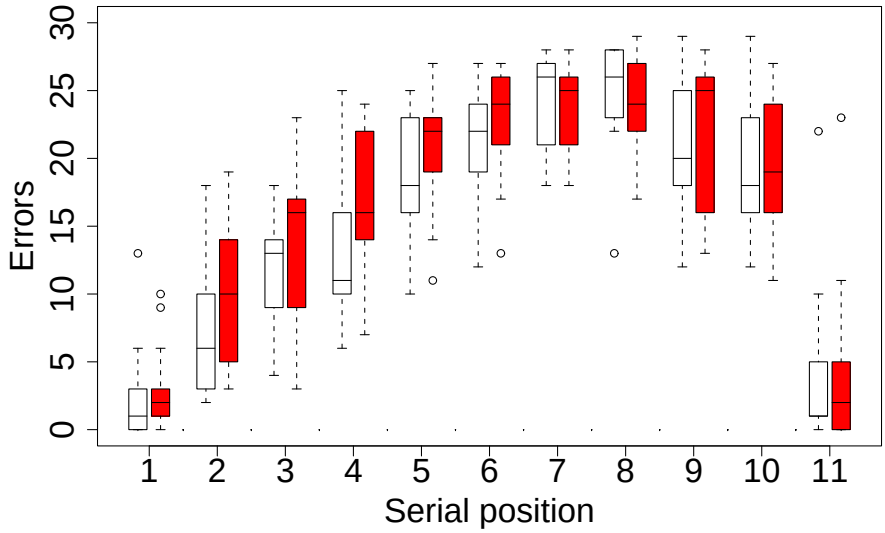

Fig. 1. Errors as a function of serial position. Shaded bars are sung, unshaded bars are monotone. Data are from 13 subjects, 60 trials each.

used actually made the recall task harder, rather than easier, while the absence of any interaction between serial position and condition suggests that this is a general recall problem, quite independent of known primacy and recency effects.

The melodies used here were designed to avoid any systematic grouping effect, as they were randomly chosen from a set of five notes of the pentatonic scale. Most previous studies which have examined the role of melody in serial recall have either used melodies which were crafted to induce specific grouping, or they have used simple, well-known melodies which were associated with many different lists. The latter precludes the formation of stable associations between a melody and any one particular list, while the former leaves many questions unanswered about the possible relationship between a succession of pitches and a list, beyond the induction of groups.

From the present study, it appears that any documented or suspected role of melody in assisting recall may, indeed, arise from the induction of groups by such

factors as rhythmic grouping and accent, or may critically depend on familiarity to produce such improvements. Caution is therefore advised in interpreting claims about any clear facilitative effect of melody on learning or memorization.

References

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