Please Don't Stop the Music: Song Completion in Patients with Aphasia

Anna V. Kasdan[1] & Swathi Kiran,[2]

Boston University, Undergraduate Program in Neuroscience[1]; Boston University, Sargent College of Health and Rehabilitation Sciences[2]

Aphasia Research Laboratory
Rehabilitation → Rewiring @ Boston University

BACKGROUND

- Many non-fluent patients with aphasia (PWA) have been observed to be able to sing lyrics of songs more easily than they can say the same words (Wan et al., 2010).
- Intoning words can help facilitate speech output in patients with aphasia, the observation of which formed the basis for Melodic Intonation Therapy (Sparks, 1974; Schlaug et al., 2008).
- Music tasks can activate brain regions in the right hemisphere that are homologous to language governing regions in the left hemisphere.
- Music may facilitate access to words because the two are tightly associated in memory, especially for familiar songs (Peretz et al., 2004).
- Singing can facilitate speech at multiple stages of processing, including speech rate, word retrieval, and recreational motivation (Racette et al., 2006).

CURRENT STUDY

AIM: To further the understanding of music and language processing in PWA versus neurologically-intact controls by examining the effect of music on access and retrieval of language.

Research Question 1: How do PWA and controls perform in terms of accuracy across all three experimental conditions (sung, spoken, melodic)?

Research Question 2: How do PWA and controls perform on the melody and lyric components when comparing across conditions?

Research Question 3: What does the format of the response tell us about PWA ability to access lyrics?

METHODS

Participants

- 19 PWA- 18 as a result of left MCA stroke(s), 1 as a result of a right MCA stroke (P17) and 15 neurologically-intact controls.
- Two bilingual PWA (P7 and P19) and one bilingual control (C7) participated.

Prevalence of Aphasia Type

- Anomic 37%
- Broca 47%
- Wernicke
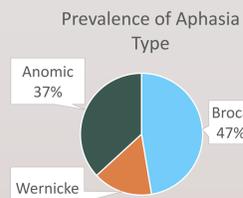
Patient	Age at Consent	Gender	Handedness	MPO	Aphasia Type	AQ	Musical Experience
P1	57	M	R	39	Anomic	84.7	N
P2	57	F	R	40	Anomic	97.2	Y
P3	50	M	R	130	Broca	64.1	Y
P4	73	M	R	80	Wernicke	37.6	Y
P5	69	M	R	111	Broca	40	N
P6	69	F	R	96	Broca	28.6	Y
P7	42	M	L	25	Anomic	92.7	N
P8	66	M	L	119	Wernicke	37	Y
P9	65	F	R	49	Wernicke	38	Y
P10	55	F	L	48	Broca	62.8	N
P11	49	M	R	79	Anomic	96.6	Y
P12	70	M	R	45	Broca	22.9	N
P13	67	F	R	76	Broca	67.4	N
P14	50	M	R	74	Broca	33.6	N
P15	74	M	R	171	Anomic	90.6	Y
P16	52	F	L	55	Broca	31.6	Y
P17	59	M	L	177	Anomic	81.4	N
P18	53	F	R	69	Anomic	97.3	Y
P19	80	M	R	23	Broca	28.9	Y
AVERAGE	60.89	12M, 7F	13R, 6L	79.26		59.63/100	11Y, 8N
STDEV	10.33			45.01		27.9	

Control	Age at Consent	Gender	Handedness	Musical Experience
C1	55	M	R	Y
C2	58	M	R	Y
C3	58	M	R	N
C4	60	F	R	Y
C5	60	M	R	Y
C6	62	F	L	Y
C7	61	F	R	N
C8	68	F	R	Y
C9	38	M	R	N
C10	57	F	R	N
C11	67	F	R	N
C12	79	F	R	N
C13	68	F	R	N
C14	73	F	R	N
C15	81	F	R	Y
AVERAGE	63	5M, 10F	14R, 1L	7Y, 8N
STDEV	10.50			

The Task

- The computerized, experimental stem completion task consisted of 3 conditions- Sung, Spoken, and Melodic. Each condition contained 20 songs (counterbalanced across conditions), for a total of 60 unique songs presented throughout the experiment.
- Participants heard the first half of a phrase and were asked to complete the phrase in the correct target modality for that condition, either sung, spoken, or intoned.
- All participants completed all conditions and heard each phrase only once.

	Cue Words	Target Words
	Mary had a	*little lamb*
	Rain rain go away	*come again another day*

	Correct Target Modality	% Words Correct	% Melody Correct
Sung	X	X	X
Spoken	X	X	
Melodic	X		X

- The number of cue and target words were the same for each musical phrase.
- A preliminary survey was administered to determine the songs used in the task.
- Participants completed a survey on musical experience upon task completion.

Scoring

Set 2 Sung						
SONG	RESPONSE	CORRECT FORMAT 0, 0.5, 1	%MELODY CORRECT	% WORDS CORRECT	CORRECT ANSWER	
O'er the land	(on "oohs")	0.5	100%	0%	*of the free*	
Take me out to	ball game	1	100%	66%	*the ball game*	
Set 1 Spoken						
Bye bye Miss	Aie owie rooo	1		0%	*American pie*	
Pop! Goes	weasel	1		50%	*The weasel*	
Set 3 Melody						
Because you're mine	(on video)	1	0%		*I walk the line*	
Oh Susanna oh don't	(on video)	1	50%		*you cry for me*	

■ Sample scores from P6.

- Accuracy scores and format (modality) scores were analyzed separately.

RESULTS

RQ1: How do PWA and controls perform in terms of accuracy across all three conditions?

- For PWA (and controls), the average accuracy in the sung condition was higher than in the spoken condition and the melody condition.
- There was no difference in the melody condition for PWA and controls.
- 8/19 PWA scored higher in the melody condition than the spoken condition, while none of the controls exhibited this trend.
- A composite accuracy for the sung condition was achieved by averaging the % word and % melody scores.
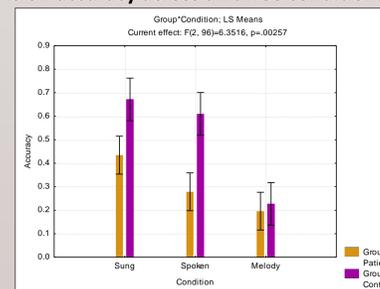

Group*Condition; LS Means Current effect: F(2, 96)=6.3516, p=.00257

RQ2: How do PWA and controls perform on the melody and lyric components when comparing across conditions?

Group*Condition; LS Means Current effect: F(1, 64)=2.6241, p=.11017

Group*Condition; LS Means Current effect: F(1, 64)=.05369, p=.81750
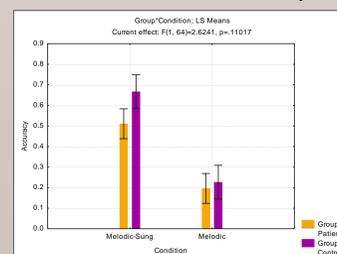
- Main effect of condition: F=94.755, p=0.00
  Main effect of group: F=5.807, p=0.0189
- For PWA (and controls), the melody in the sung condition is higher than in the melodic condition alone
- For PWA in the sung condition, mean melody score=51.1% and mean spoken score= 35.8%. For controls, the mean melody and spoken scores in the sung condition were exactly the same, 67.0%.
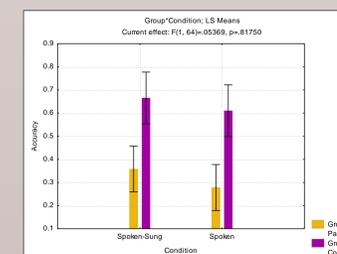
- Main effect of condition: F=1.633, p=0.2059
  Main effect of group: F=36.457, p=0.00
- For PWA (and controls), the lyrics in the sung condition are no better than in the spoken condition

RQ3: What does the format of response tell us about PWA ability to access lyrics?

- Format responses were coded as a 0, 0.5 or 1
  0- no response or "I don't know"
  0.5- produced a response in the incorrect modality (i.e. sang in the spoken condition)
  1- produced a response in the correct modality
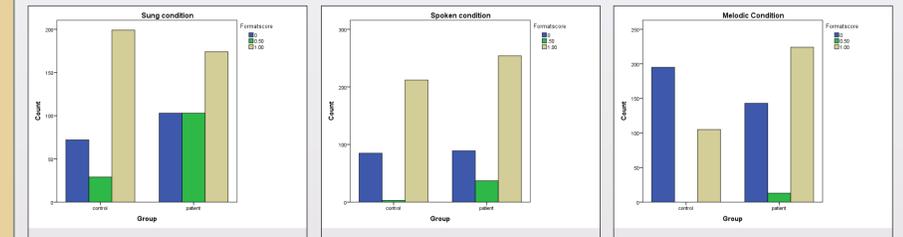
- A Pearson chi-squared analysis was conducted as a means to analyze format scores.
  $\chi^2= 39.79$, df=2 for the Sung condition, p<0.001;
  $\chi^2= 23.69$, df=2 for the Spoken condition p<0.001;
  $\chi^2 = 55.39$, df=2 for Melodic condition, p<0.001.
- High individual variability for format scores in each condition.
- PWA, more often than controls, responded in the incorrect modality in all three conditions. Controls responded in the incorrect modality in the sung condition more than in the other two conditions.
- PWA produced more responses in the incorrect modality in the sung condition than controls
- PWA (and controls) most often produced a response in the correct modality for each condition, with the exception of controls in the melodic condition, who were more inclined to not produce any response at all.
- A univariate ANCOVA was conducted to account for musical experience on task performance. $R^2 = 0.528$. p <.ns There is no effect of prior musical experience on task performance for patients or controls.

CONCLUSIONS

- Singing is more beneficial to PWA than normal controls when trying to access lyrics to songs
- PWA and controls are better able to access the melody of songs in a sung context as opposed to when the songs are intoned
- Regardless of condition, controls exhibit higher accuracy than PWA when accessing the lyrics to songs
- PWA are better at accessing the melody of songs as compared to the lyrics, indicating that music is preserved at some level in PWA and music may facilitate access to language

FUTURE DIRECTIONS

- Further study could examine which brain regions are activated in the task, using fMRI analysis, when singing and speaking.
- The musical experience survey outcomes, including self-rated measures of musical expertise and familiarity with the songs, may be correlated with task performance
- Amusic patients' performance on the task could also be obtained (Peretz et al., 2003)
- Potentially, this short term task could be configured into a long term treatment paradigm to help PWA regain speech and improve word access and retrieval.

SELECTED REFERENCES

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ACKNOWLEDGEMENTS