

BENEFIT OF VISUAL SPEECH INFORMATION FOR WORD COMPREHENSION IN POST-STROKE APHASIA

Supplementary Material

1. Behavioral analysis

a. Matching trials

i. Accuracy results with a full sample size (49)

Random effects:		Name	Variance	SD	Corr	
ParticipantID		(Intercept)	0.86	0.93		
		SpeechClarity	0.29	0.54	0.33	
		Modality	0.05	0.22	0.15	
Item		(Intercept)	0.81	0.90		
		SpeechClarity	0.29	0.53	-0.09	
		Modality	0.08	0.28	-0.48	
Fixed effects:		β	SE	z	p	
(Intercept)		4.08	0.26	15.54	< 0.001	***
SpeechClarity		1.29	0.22	5.92	<0.001	***
Modality		0.25	0.14	1.71	0.09	
Group		0.50	0.19	2.59	0.01	**
SpeechClarity:Modality		-0.30	0.13	-2.38	0.02	*
SpeechClarity:Group		-0.27	0.15	-1.85	0.06	
Modality:Group		-0.12	0.11	-1.03	0.30	
SpeechClarity:Modality:Group		-0.06	0.11	-0.52	0.60	
Control variables:		β	SE	z	p	
AoA		0.11	0.10	1.10	0.27	
LogFrequency		0.60	0.31	1.94	0.05	
LengthSyllables		1.10	0.29	3.76	<0.001	***
PhonologicalDensity		0.01	0.01	1.04	0.30	

Note: Reference levels are SpeechClarity = "Clear", Modality = "Audiovisual", Group = "Controls"
0.05; **0.01; *p<0.001*

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- ii. Accuracy results with a reduced sample size (46), i.e., excluding 3 participants who did not pass the audiometry assessment

Random effects:		Name	Variance	SD	Corr	
ParticipantID		(Intercept)	0.93	0.97		
		SpeechClarity	0.31	0.56	0.35	
		Modality	0.05	0.23	0.17	
Item		(Intercept)	0.83	0.91		
		SpeechClarity	0.28	0.53	-0.10	
		Modality	0.04	0.20	-0.55	
Fixed effects:		β	SE	z	p	
(Intercept)		4.10	0.27	14.96	<0.001	***
SpeechClarity		1.28	0.23	5.65	<0.001	***
Modality		0.23	0.15	1.59	0.11	
Group		0.48	0.20	2.40	0.02	*
SpeechClarity:Modality		-0.33	0.13	-2.59	0.01	**
SpeechClarity:Group		-0.26	0.15	-1.71	0.09	
Modality:Group		-0.10	0.11	-0.83	0.40	
SpeechClarity:Modality:Group		-0.04	0.11	-0.40	0.69	
Control variables:		β	SE	z	p	
AoA		0.10	0.10	0.92	0.36	
LogFrequency		0.56	0.32	1.76	0.08	
LengthSyllables		1.03	0.30	3.44	<0.001	***
PhonologicalDensity		0.01	0.01	0.95	0.34	

Note: Reference levels are SpeechClarity = "Clear", Modality = "Audiovisual", Group = "Controls"
0.05; **0.01; *p<0.001*

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b. Mismatching trials

i. Accuracy results with a full sample size (49)

Random effects:				
	Name	Variance	SD	Corr
ParticipantID	(Intercept)	1.04	1.02	
	SpeechClarity	0.14	0.37	0.27
Item	(Intercept)	0.46	0.68	
	SpeechClarity	0.32	0.57	0.44
Fixed effects:				
	β	SE	z	p
(Intercept)	3.10	0.20	15.36	<0.001 ***
SpeechClarity	0.56	0.13	4.43	<0.001 ***
Modality	0.38	0.07	5.17	<0.001 ***
Group	0.27	0.19	1.47	0.14
RelationType(Phon)	-0.58	0.10	-5.76	<0.001 ***
RelationType(Sem)	-0.64	0.10	-6.26	<0.001 ***
SpeechClarity:Modality	-0.07	0.07	-0.99	0.32
SpeechClarity:Group	0.02	0.10	0.16	0.87
SpeechClarity:RelationType(Phon)	-0.59	0.10	-6.00	<0.001 ***
SpeechClarity:RelationType(Sem)	0.17	0.10	1.73	0.08
Modality:Group	0.22	0.07	3.18	0.001 **
Modality:RelationType(Phon)	-0.06	0.10	-0.58	0.56
Modality:RelationType(Sem)	0.09	0.10	0.94	0.35
Group:RelationType(Phon)	-0.02	0.10	-0.16	0.87
Group:RelationType(Sem)	-0.16	0.10	-1.71	0.09
SpeechClarity:Modality:Group	0.08	0.06	1.31	0.19
SpeechClarity:Modality:RelationType(Phon)	0.04	0.08	0.45	0.66
SpeechClarity:Modality:RelationType(Sem)	-0.04	0.08	-0.50	0.62
SpeechClarity:Group:RelationType(Phon)	-0.12	0.09	-1.30	0.20
SpeechClarity:Group:RelationType(Sem)	-0.02	0.09	-0.27	0.79
Modality:Group:RelationType(Phon)	-0.08	0.09	-0.88	0.38
Modality:Group:RelationType(Sem)	0.12	0.09	1.35	0.18
Control variables:				
	β	SE	z	p
AoA	-0.01	0.07	-0.15	0.88
LogFrequency	0.17	0.22	0.76	0.44
LengthSyllables	-0.19	0.20	-0.96	0.34
PhonologicalDensity	-0.02	0.01	-2.05	0.04 *

Note: Reference levels are SpeechClarity = "Clear", Modality = "Audiovisual", Group = "Controls", RelationType = "Unrelated"
0.05; **0.01; *p<0.001*

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- ii. Accuracy results with a reduced sample size (46), i.e., excluding 3 participants who did not pass the audiometry assessment

Random effects:				
	Name	Variance	SD	Corr
ParticipantID	(Intercept)	1.11	1.05	
	SpeechClarity	0.16	0.39	0.29
Item	(Intercept)	0.47	0.68	
	SpeechClarity	0.38	0.61	0.44
Fixed effects:				
	β	SE	z	p
(Intercept)	3.16	0.21	15.05	<0.001 ***
SpeechClarity	0.60	0.13	4.56	<0.001 ***
Modality	0.38	0.08	5.04	<0.001 ***
Group	0.25	0.19	1.27	0.20
RelationType(Phon)	-0.61	0.10	-6.01	<0.001 ***
RelationType(Sem)	-0.63	0.10	-6.04	<0.001 ***
SpeechClarity:Modality	-0.08	0.07	-1.08	0.28
SpeechClarity:Group	-0.01	0.11	-0.13	0.90
SpeechClarity:RelationType(Phon)	-0.64	0.10	-6.43	<0.001 ***
SpeechClarity:RelationType(Sem)	0.21	0.10	2.04	0.04 *
Modality:Group	0.23	0.07	3.21	0.01 **
Modality:RelationType(Phon)	-0.06	0.10	-0.56	0.58
Modality:RelationType(Sem)	0.09	0.10	0.89	0.38
Group:RelationType(Phon)	0.01	0.10	0.13	0.90
Group:RelationType(Sem)	-0.17	0.10	-1.78	0.08
SpeechClarity:Modality:Group	0.09	0.06	1.42	0.15
SpeechClarity:Modality:RelationType(Phon)	0.02	0.09	0.26	0.79
SpeechClarity:Modality:RelationType(Sem)	-0.04	0.08	-0.43	0.67
SpeechClarity:Group:RelationType(Phon)	-0.08	0.09	-0.85	0.39
SpeechClarity:Group:RelationType(Sem)	-0.04	0.09	-0.47	0.64
Modality:Group:RelationType(Phon)	-0.08	0.09	-0.90	0.37
Modality:Group:RelationType(Sem)	0.12	0.09	1.42	0.15
Control variables:				
	β	SE	z	p
AoA	-0.02	0.07	-0.25	0.80
LogFrequency	0.18	0.22	0.80	0.43
LengthSyllables	-0.24	0.20	-1.17	0.24
PhonologicalDensity	-0.02	0.01	-2.40	0.02 *

Note: Reference levels are SpeechClarity = "Clear", Modality = "Audiovisual", Group = "Controls", RelationType = "Unrelated"
0.05; **0.01; *p<0.001*

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- iii. Accuracy results with a reduced sample size (29), i.e., only for PWA for whom lesion information was available to control for lesion volume.

Random effects:				
	Name	Variance	SD	Corr
ParticipantID	(Intercept)	1.13	1.06	
	SpeechClarity	0.20	0.45	0.31
Item	(Intercept)	0.42	0.65	
	SpeechClarity	0.24	0.49	0.36
Fixed effects:				
	β	SE	z	p
(Intercept)	2.88	0.23	12.60	<0.001 ***
SpeechClarity	0.48	0.14	3.47	<0.001 ***
Modality	0.20	0.07	2.93	0.003 **
RelationType(Phon)	-0.48	0.09	-5.11	<0.001 ***
RelationType(Sem)	-0.59	0.09	-6.29	<0.001 ***
SpeechClarity:Modality	-0.14	0.07	-2.12	0.03 *
SpeechClarity:RelationType(Phon)	-0.41	0.09	-4.39	<0.001 ***
SpeechClarity:RelationType(Sem)	0.19	0.10	1.98	0.05 *
Modality:RelationType(Phon)	0.04	0.10	0.41	0.68
Modality:RelationType(Sem)	-0.10	0.09	-1.09	0.28
SpeechClarity:Modality:RelationType(Phon)	0.06	0.10	0.66	0.51
SpeechClarity:Modality:RelationType(Sem)	-0.07	0.09	-0.79	0.43
Control variables:				
	β	SE	z	p
LesionVolume	-0.14	0.20	-0.66	0.51
AoA	0.06	0.07	0.82	0.41
LogFrequency	0.16	0.24	0.65	0.51
LengthSyllables	-0.04	0.22	-0.16	0.87
PhonologicalDensity	-0.02	0.01	-1.73	0.08

Note: Reference levels are SpeechClarity = "Clear", Modality = "Audiovisual", Group = "Controls", RelationType = "Unrelated"
0.05; **0.01; *p<0.001*

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2. Average accuracy scores in different conditions

ID	MATCHING TRIALS				MISMATCHING TRIALS				COMBINED			
	<i>Audio Clear</i>	<i>Audio Degraded</i>	<i>AV Clear</i>	<i>AV Degraded</i>	<i>Audio Clear</i>	<i>Audio Degraded</i>	<i>AV Clear</i>	<i>AV Degraded</i>	<i>Audio Clear</i>	<i>Audio Degraded</i>	<i>AV Clear</i>	<i>AV Degraded</i>
C01	1.00	0.92	1.00	1.00	0.92	0.91	0.97	0.96	0.96	0.92	0.99	0.98
C02	1.00	0.86	1.00	1.00	1.00	0.88	1.00	0.90	1.00	0.87	1.00	0.95
C03	1.00	0.89	1.00	0.97	0.92	0.73	0.97	0.96	0.96	0.81	0.99	0.97
C04	1.00	0.93	1.00	0.90	0.80	0.53	0.90	0.80	0.90	0.73	0.95	0.85
C05	1.00	0.93	1.00	1.00	0.90	0.90	0.97	0.97	0.95	0.92	0.98	0.98
C06	1.00	0.77	0.97	1.00	0.93	0.87	0.97	1.00	0.97	0.82	0.97	1.00
C07	1.00	0.97	0.97	0.97	0.66	0.80	0.97	0.83	0.83	0.88	0.97	0.90
C08	1.00	0.90	1.00	1.00	1.00	0.90	0.97	1.00	1.00	0.90	0.98	1.00
C09	1.00	0.93	1.00	0.97	0.93	0.93	0.97	1.00	0.97	0.93	0.98	0.98
C10	0.97	0.90	0.93	0.87	0.87	0.83	0.90	1.00	0.92	0.87	0.92	0.93
C11	1.00	0.93	1.00	0.93	0.83	0.97	1.00	0.97	0.91	0.95	1.00	0.95
C12	0.90	0.90	0.97	0.93	0.87	0.70	0.93	1.00	0.88	0.80	0.95	0.97
C13	1.00	1.00	0.97	0.97	0.93	0.87	0.97	0.83	0.97	0.93	0.97	0.90
P01	1.00	0.20	1.00	0.53	0.63	0.97	0.70	0.97	0.82	0.58	0.85	0.75
P02	1.00	0.79	1.00	0.81	0.95	0.91	0.94	0.92	0.97	0.85	0.97	0.86
P03	1.00	0.83	0.97	0.93	0.90	0.63	0.97	0.90	0.95	0.73	0.97	0.92
P04	1.00	0.81	0.95	0.86	0.97	0.88	0.92	0.82	0.99	0.84	0.94	0.84
P05	1.00	0.63	1.00	0.73	0.90	0.80	0.87	0.87	0.95	0.72	0.93	0.80
P06	1.00	0.76	1.00	0.92	1.00	0.91	0.97	0.92	1.00	0.84	0.99	0.92
P07	1.00	0.58	1.00	0.97	1.00	0.96	1.00	0.95	1.00	0.77	1.00	0.96
P08	1.00	0.97	1.00	0.94	0.97	0.59	0.94	0.92	0.99	0.78	0.97	0.93
P09	0.93	0.70	0.97	0.93	0.86	0.93	0.97	0.97	0.90	0.82	0.97	0.95
P10	0.96	0.81	1.00	0.97	0.97	0.88	0.97	0.95	0.97	0.84	0.99	0.96
P11	1.00	0.93	1.00	0.90	0.97	0.87	0.93	0.97	0.98	0.90	0.97	0.93
P12	1.00	0.84	1.00	0.92	0.95	0.73	1.00	0.96	0.97	0.78	1.00	0.94
P13	1.00	0.82	1.00	1.00	0.66	0.32	0.69	0.38	0.83	0.57	0.85	0.69
P14	1.00	0.78	1.00	0.97	0.83	0.67	0.87	0.55	0.92	0.72	0.93	0.76
P15	1.00	0.57	1.00	0.87	0.97	1.00	1.00	1.00	0.98	0.78	1.00	0.93
P16	1.00	0.97	1.00	1.00	0.93	0.80	0.97	0.90	0.97	0.88	0.98	0.95
P17	0.97	0.87	0.97	0.90	0.97	0.97	0.93	0.97	0.97	0.92	0.95	0.93
P18	1.00	0.67	0.97	0.93	0.93	0.93	0.97	0.93	0.97	0.80	0.97	0.93
P19	0.97	0.80	1.00	0.87	1.00	0.90	0.97	0.97	0.98	0.85	0.98	0.92
P20	1.00	0.93	1.00	1.00	0.97	0.83	1.00	0.97	0.98	0.88	1.00	0.98
P21	0.93	0.63	1.00	0.87	0.87	0.70	0.83	0.73	0.90	0.67	0.92	0.80
P22	0.97	0.70	1.00	0.83	0.93	0.87	0.90	0.90	0.95	0.78	0.95	0.87
P23	1.00	0.60	1.00	0.80	0.77	0.67	0.80	0.83	0.88	0.63	0.90	0.82
P24	1.00	0.97	1.00	1.00	0.97	0.93	1.00	1.00	0.98	0.95	1.00	1.00
P25	0.97	0.67	0.90	0.90	0.76	0.73	0.97	0.90	0.86	0.70	0.93	0.90
P26	0.80	0.60	0.90	0.60	0.63	0.50	0.47	0.43	0.72	0.55	0.68	0.52
P27	1.00	0.63	1.00	0.93	0.87	0.83	0.90	0.77	0.93	0.73	0.95	0.85
P28	0.93	0.60	1.00	0.90	0.86	0.97	0.97	0.93	0.90	0.78	0.98	0.92
P29	1.00	0.83	1.00	0.83	0.87	0.53	0.77	0.73	0.93	0.68	0.88	0.78
P30	1.00	0.70	1.00	0.90	0.97	0.87	0.93	0.93	0.98	0.78	0.97	0.92
P31	1.00	0.77	1.00	0.90	0.90	0.73	0.90	0.90	0.95	0.75	0.95	0.90

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P32	0.93	0.40	1.00	0.57	0.90	0.87	0.90	0.90	0.91	0.63	0.95	0.73
P33	0.97	0.83	0.97	0.90	1.00	0.83	1.00	1.00	0.98	0.83	0.98	0.95
P34	0.90	0.47	0.93	0.83	0.77	0.83	0.73	0.83	0.83	0.65	0.83	0.83
P35	1.00	0.83	0.93	0.93	1.00	0.93	0.97	1.00	1.00	0.88	0.95	0.97
P36	0.93	0.67	0.90	0.80	0.97	0.87	0.93	0.93	0.95	0.77	0.91	0.87

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3. Additional SVR-LSM analyses
 - a. Mismatching trials only

Figure 1

SVR-LSM results showing significant regions in red, which when lesioned, are associated with reduced benefit from audiovisual presentation relative to auditory-only presentation during degraded listening condition for the mismatching trials. Voxelwise threshold set to $p < 0.05$ with 10,000 Monte Carlo permutations and 5-fold cross-validation. Clusters of < 500 contiguous 1mm^3 voxels were excluded.

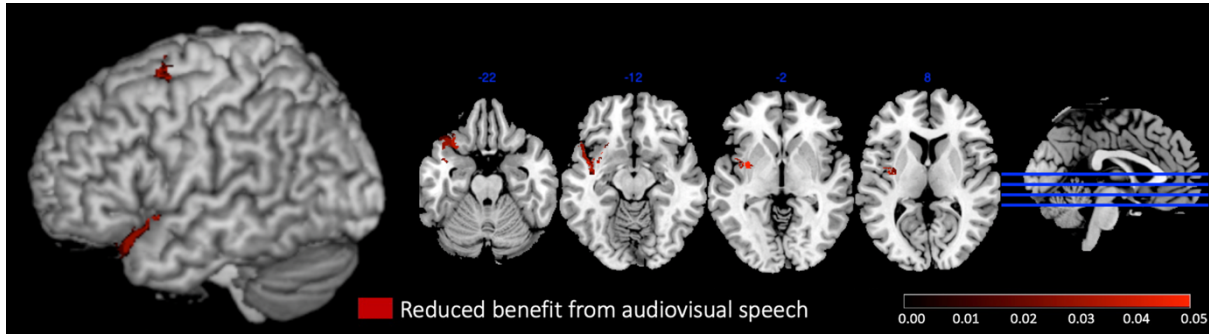


Table 1

SVR-LSM results (with X, Y and Z coordinates) associated with reduced benefit from the audiovisual speech relative to auditory-only in the degraded listening condition for the mismatching trials. Regions with clusters of > 500 voxels were identified by Automated Anatomical Labeling (AAL).

Regions	Abbrev.	Number of Voxels in Damaged Region	Percentage of Voxels in Damaged Region	MNI Centers of Mass		
				X	Y	Z
Temporal Pole: Superior Temporal Gyrus	TPOsup	1618	15.82	-43	2	-14
Insula	INS	604	4.02	-38	-1	0

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b. Combined (matching + mismatching) trials

Figure 2

SVR-LSM results showing significant regions in red, which when lesioned, are associated with reduced benefit from audiovisual presentation relative to auditory-only presentation during degraded listening condition for the combined (matching and mismatching) trials. Voxelwise threshold set to $p < 0.05$ with 10,000 Monte Carlo permutations and 5-fold cross-validation. Clusters of < 500 contiguous 1mm^3 voxels were excluded.

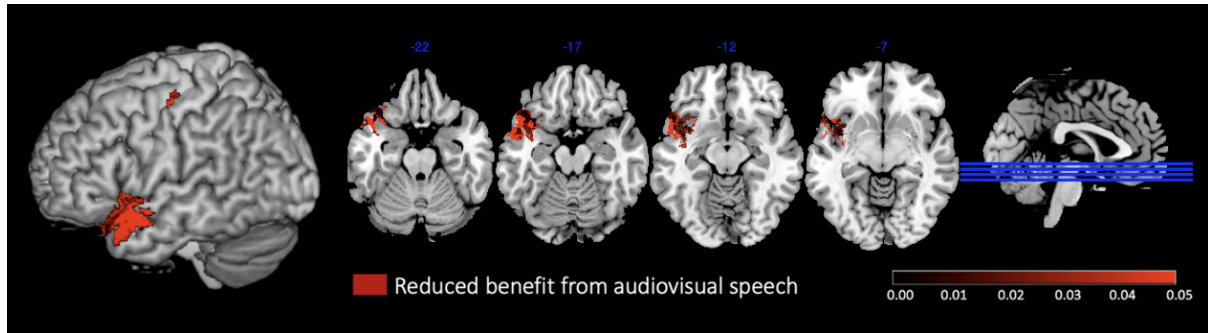


Table 2

SVR-LSM results (with X, Y and Z coordinates) associated with reduced benefit from the audiovisual speech relative to auditory-only in the degraded listening condition for the combined (matching and mismatching) trials. Regions with clusters of > 500 voxels were identified by Automated Anatomical Labeling (AAL).

Regions	Abbrev.	Number of Voxels in Damaged Region	Percentage of Voxels in Damaged Region	MNI Centers of Mass		
				X	Y	Z
Insula	INS	4010	26.69	-35	-4	8
Temporal Pole: Superior Temporal Gyrus	TPOsup	3560	34.81	-30	10	-19
Putamen	PUT	954	12.01	-20	2	12
Superior Temporal Gyrus	STG	898	4.91	-45	3	-6