SSW
SSW
SSW

REPORTS

AR: RIGHT VS LEFT

Vol. 8 No. 3 August 1986

AUDITORY RECEPTION LESIONS:
RIGHT VS LEFT
Jack Katz

Abstract: Twenty three individuals with well localized lesions of the auditory reception center were studied to determine similarities and differences between right and left hemisphere impairments. Although the R-AR cases were about 11 years older than the L-AR group, they had better WDS and SSW scores. CES scores were approximately equal for the two groups. The results on the SSW and CES tests were generally symmetrical, however, some important deviations were noted.

It is diagnostically and theoretically important to understand how an auditory reception (AR) lesion shows up on SSW and CES tests. We have made many assumptions about AR performance and have wondered about any differences between right and left sided lesions. I recently had the opportunity to test out some of these questions.

Cases tested over the past 13 years were gathered. Most came from three research studies (Katz & Pack, 1975; Katz, Kushner & Pack, 1975; Katz, McCarthy, Jacobs and Wilson, 1986). Each subject had a diagnosed lesion of Heschl's gyrus, involving the AR center (Brodmann's area 41) on one side and the absence of brainstem or other contaminating variables (mod. hearing loss, MR etc.). Of course, other cortical regions, besides area #41 were involved in all cases.

Statistics

Medians are used in this study to best describe typical performance. Medians tend to deemphasize extreme performance which may be due to 1) the influence of the lesion on other major brain centers or 2) diagnostic errors. Medians represent the 50th percentile of the data. Semi-interquartile ranges are used with medians to designate the 25th %-ile at the lower end and the 75th %-ile at the upper end. Thus between the upper and lower quartiles the middle 50% of the cases fall. Also 25 % of the scores fall above the 75th %-ile and 25% fall below the 25th %-ile.

Part I: WDS and SSW

Subjects

Records for 10 R-AR and 13 L-AR subjects, with diagnosed lesions were obtained. They ranged from 17-71 years. Medians for age and word discrimination scores (WSD) are shown in Table 1.

			WDS	
GROUP	N	AGE	RE	LE
R-AR	10	64	92%	85%
L-AR	13	53	82%	88%

Table 1. Medians for age and word discrimination scores (WDS) for cases with R-AR and L-AR lesions.

Age Factor

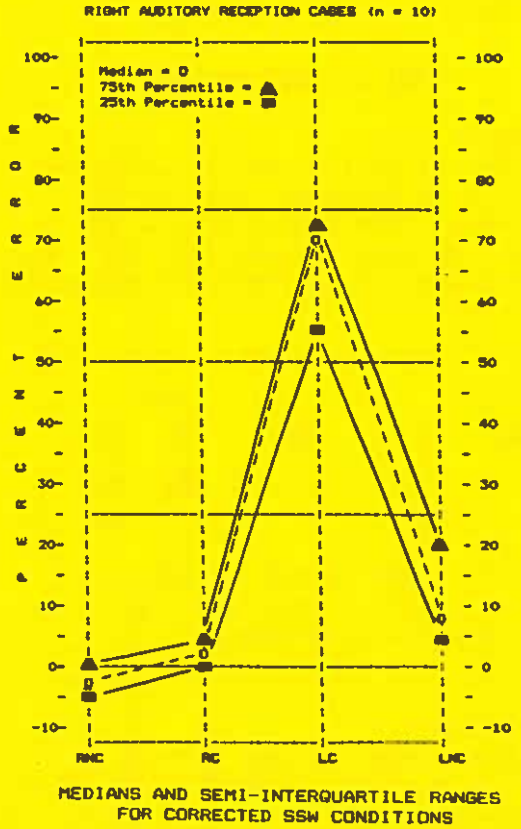
The R-ARs ranged in age from 42 to 71 yrs and the L-ARs from 17 to 71. The median age difference was 11 years, with the R-ARs being the older group. A number of indicators show that this age difference favoring the L-ARs did not have a major effect. 1) The WDS results favored the R-AR group despite the difference in age, 2) the Total R-

SSW and C-SSW scores were better for the R-ARs in both ears, and 3) the CES test results were essentially the same for the two groups. In addition to the above, the remarkable symmetry for some scores suggests that the age difference did not have an important effect on the results. Both median ages were close to the range in which SSW scores are equivalent (11-60 yrs).

SSW Results

The C-SSW results were compared for the two groups. Figure 1 shows the performance for the four Conditions. At first glance the symmetrical peaks of errors for the groups stand out. That is, the peak in the ear contralateral to the lesion (LC for the R-ARs and RC for the L-ARs) appears surprisingly similar. The medians for the two peak Conditions were almost identical for R-ARs and L-ARs (69% and 67%, respectively).

Dichotic tests are quite sensitive to AR lesions because they, in effect, inhibit or extinguish the ipsilateral pathway, while the crossed pathway to the damaged Heschl's gyrus cannot transmit information to that hemisphere. Thus, the only competing signal to get through is the one contralateral to the normal hemisphere. The results shown are just as expected in AR cases. The competing word in the ear opposite the lesion is the one that is degraded. Overall, it appears that for the SSW (EC list), AR lesions tend to cause about 65 to 70% error



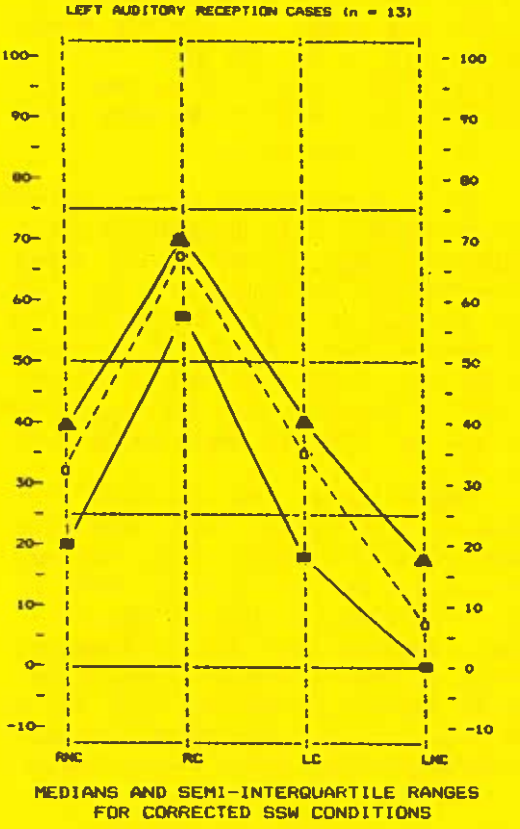


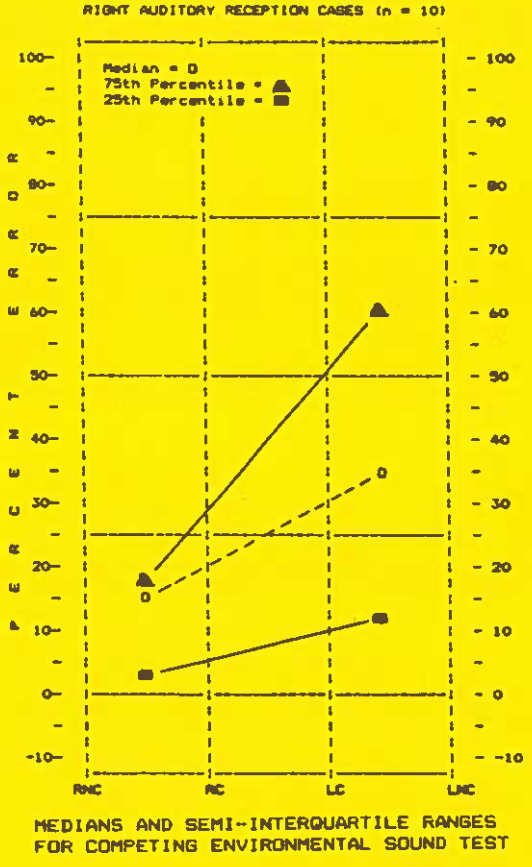
Figure 1. Median C-SSW results for 23 AR cases on the 4 Conditions. The semi-interquartile range is shown above and below each median. (A) R-AR, (B) L-AR.

after correction for WDS. This is true whether the lesion is on the right or left side of the brain.

The symmetry between the 2 curves tends to deteriorate to some extent for the other 3 Conditions. The R-ARs had very fine performance for the ear ipsilateral to the lesion and just a relatively small percentage of error for the NC Condition contralateral to the lesion. The L-ARs, on the other hand, had considerable error in the LC Condition, despite the fact that it was ipsilateral to the damage. The RNC words, contralateral to the damaged Heschl's gyrus, were even more depressed than LC Condition. Finally, LNC was also affected in more than half of the cases.

The contralateral NC Conditions tended to be depressed in both groups suggesting that damage to the AR center can have an effect even on the NC words that are presented to the ear opposite the lesion. Berlin et al had noted that certain cases with temporal lobe involvement showed poor performance even when the competing words were separated by 500 msec. Rudmin & Katz (1982) point out that the average spondee on the EC list is separated by only 371 msec. Therefore, most of the NC words would be vulnerable in such temporal lobe cases.

It is common to see L-AR cases with significant peaks in both ears, whereas R-AR cases usually have unilateral peaks. Therefore, the results



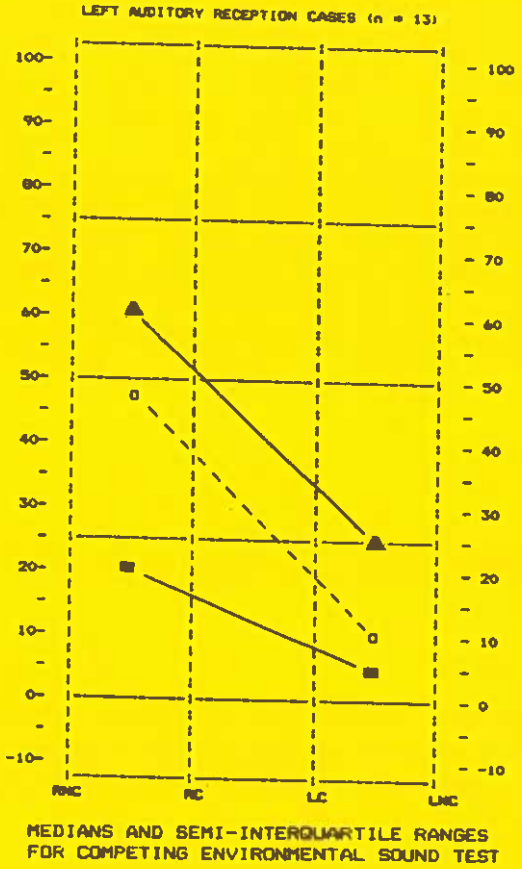


Figure 2. Median and semi-interquartile CES results for right and left ears.

in Figure 1 were of no surprise. However, the reason for the poorer results in the 3 "non peak" Conditions (for the L-ARs) is not obvious. The difference was not due to age, because the R-ARs were older. It is also reasonable to to exclude larger or more complete AR lesions in the L-ARs as an explanation. One could assume that the R-ARs had the more extensive lesions because severe aphasia would prevent L-AR subjects from participating, while severe R-hemisphere cases could be tested with dichotic speech.

Two more reasonable suggestions may be advanced to explain the differences between groups. The L-ARs may be assumed to have aphasia. This language impairment could influence SSW performance, and likely did. Nevertheless, it is somewhat surprising that the influence was not more homogeneous across the 4 Conditions. Individual R-NC, LC and LNC performances did not give strong support to this notion (although, it was probably important in some cases). Table 2 illustrates the possible effect but lack of consistency in 3 pairs of Ss. They were matched for similar LCs and compared on the 2 other Conditions less affected by AR disorder. Some showed a possible language effect, others not.

#	RNC	(LC)	LNC
1A	32	(59)	44
1B	0	(54)	6
2A	34	(36)	18
2B	22	(38)	1
3A	15	(14)	19
3B	20	(18)	-4

Table 2. Pairs of L-AR cases. The As can be viewed as suggesting a general influence of aphasia, the Bs cannot.

A second contributing factor, perhaps the most important one, is involvement of the corpus callosum (CC) or other commissural pathways. Damage to the CC can be expected to produce a LC SSW peak, whether the lesion is on the right or left side (Musiek & Wilson, 1979). For L-AR cases this would appear as a bilateral effect, with depressed scores in the RC Condition associated with the AR damage and in the LC because of the CC involvement. This would help to explain why many cases with L-hemisphere lesions have double peaks while others only RC peaks. [A LC peak alone would suggest a commissural disorder.] Table 3 illustrates the possible com-missural effect in 3 L-ARs showing bilateral peaks and the lack of CC damage in 3 L-ARs with R-ear peaks. Other possibilities also exist for the double peak in L-lesion cases (e.g., arcuate fasciculus lesion affecting transmission to the expressive language regions). In R-ARs both AR and CC disorders would affect the same LC Condition. This would produce a unilateral L-ear peak (see Figure 1A).

#	RNC	RC	LC	LNC
1A	32	60	59	44
1B	40	68	4	0
2A	30	70	34	22
2B	45	80	12	0
3A	22	67	32	7
3B	15	75	14	19

Table 3. Three pairs of L-AR cases. These results might be viewed in A cases as showing a LC influence associated with commissural/deep structure disorder (e.g., arcuate fasciculus). Bs do not show such an effect. Presumably this suggests these pathways to be spared to a considerable extent.

Part II: CES and SSW-CES

CES Results

Figure 2 shows the results for the two groups on the CES test. It can be noted that the performance for

the R-AR and L-AR subjects is quite symmetrical and that the magnitude of the scores is very similar. This is particularly true for the semi-interquartile range measure. Thus, both groups show the expected contralateral effect on CES as well as the SSW. This supports the notion that AR lesions produce a major interference in getting clear information to the affected hemisphere. This is true whether the signal is speech or environmental sounds as measured by the CES.

Unlike the SSW, the semi-interquartile ranges are quite wide in the ear opposite the lesion. This reduces our confidence that the contralateral effect for the two groups is indeed different (R-ARs = 35%; L-ARs = 48%). More data are needed.

Environmental sounds, like music, are thought to be processed primarily in the right hemisphere. Therefore, the R-ARs should perform more poorly on CES than L-ARs. Actually, the groups were about equal on CES. One hypothesis that has been put forth is that the music and environmental sound centers may not be as localized in the R-hemisphere as language is in the L-. Therefore, a lesion is more likely to knock out language on the left before a comparable disorder would knock out music or enviornmental sounds on the right. Another consideration is that the processing of environmental sounds is an anterior function. It would follow that AR lesions would produce about the same CES effect regardless of the side damaged because the major effect would be limited to blocking auditory input to the hemisphere. Neither hemisphere appears to have important CAP centers specifically for environmental sounds in the area of Heschl's gyrus.

SSW-CES Results

Figure 3 shows the relationship of CES scores to both R-SSW and C-SSW findings. The general relationship has been discussed already. That is, for both tests the signals presented to the ear opposite the lesion had the poorest scores. It remains to be seen how the ear scores compare for the two tests and whether the comparisons differ for the right and left ARs.

It is interesting to note that for the ear opposite the lesion, CES and C-SSW scores are very similar. Thus, typically the difficulty level of CES and C-SSW are about equal with damage to Heschl's gyrus. One would think that CES would be less affected than the raw SSW (as it was), but it was even slightly better than the C-SSW. Assuming that these are fairly reliable results, it is the ear ipsilateral to the lesion that seems to express the dominance factor. For the RE, the R-ARs' CES scores were poorer than the SSW and for the LE, the L-ARs' SSW scores were considerably poorer than the CES.

It is reasonable to assume that cases that have significant AR lesions will show the contralteral effect on both tests. There is also an inclination (by no means universal) for the ear ipsilateral to the lesion to be depressed to some extent depending on the test and hemisphere damaged. For R-ARs this is seen on the CES in the RE and for the L-ARs it is found in the LE on the SSW. This tends to support my original prediction (in 1974) when I tried to conceptualize the SSW-CES comparisons. While the 8 SSW-CES formulas have not worked out very well, the general comparisons seem to have some merit as suggested by the present study. The general comparisons are shown in Table 4.

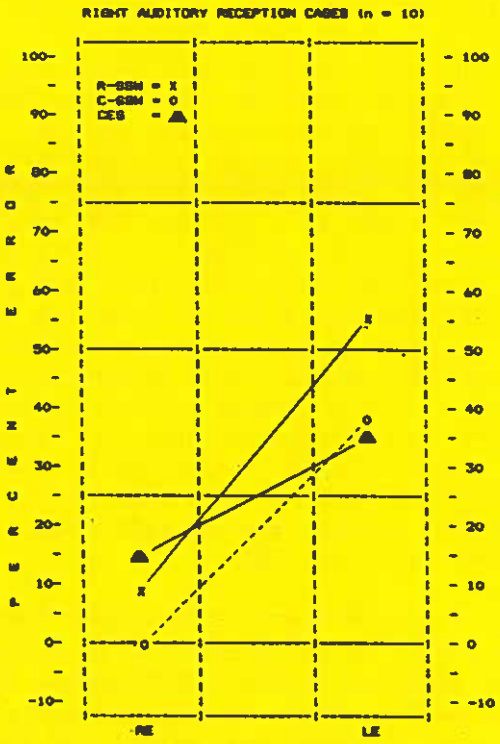
Summary

This study noted:

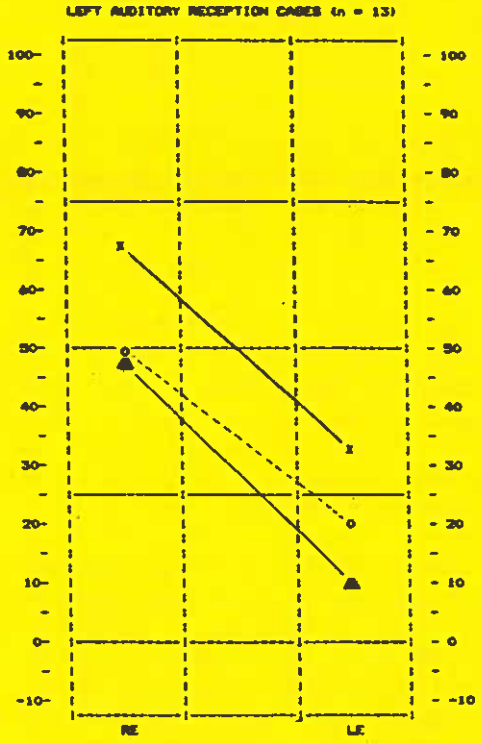
1) In AR cases, the ear opposite the lesion shows the major deficit on both the SSW and CES tests.

2) The extent of the contralateral effect on the SSW is equal for both the R-AR and L-AR cases.

3) The extent of the contralateral effect on CES is also equal in both groups.



MEDIANS FOR R-SSW, C-SSW AND CES



MEDIANS FOR R-SSW, C-SSW AND CES

LOCUS OF LESION	SSW	CES
Corpus Callosum*	LE	RE
R-AR	LE	LE
L-AR	RE	RE
R-AR & CC	LE	BIL
L-AR & CC	BIL	RE

Table 4. Original concept of SSW-CES comparisons for AR and Corpus Callosum (CC) lesion cases. *CC refers to the splenium portion in particular (and possibly genu). CES performance for lesion cases with involvement of the body of the CC and/or the anterior commissure is not known at this time.

4) The left sided cases had poorer performance on the three SSW Conditions other than the competing one contralateral to the damaged hemisphere. Thus the overall SSW performance was poorer for the L-ARs than for the R-ARs.

5) Both groups performed equally on the CES test when considering the ears ipsilateral and contralateral to the damage.

6) When comparing the SSW and CES tests for dominance effects, it is necessary to study the ear not showing the contralateral effect. In those cases the SSW was better in the RE (R-ARs) and the LE better on CES (R-ARs).