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PICA Performance Following Left or Right Hemisphere Brain Damage: Influence of Side and Severity

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Duffy and Myers (1991) listed several problems in group comparisons across neurologic communication disorders and offered some potential methodologic solutions. One typical problem is that groups with different disorders differ in severity on the measures employed (Halpern, Darley, & Brown, 1973; Wertz, Dronkers, & Shubitowski, 1986). One proposed solution is to equate the samples from different disordered groups for severity. That is the approach we used in this investigation.

One purpose was to compare *Porch Index of Communicative Ability* (PICA) (Porch, 1967) performance by patients who suffered a left hemisphere thromboembolic infarct with performance by patients who suffered a right hemisphere thromboembolic infarct, determine the PICA measures on which the groups differed, and compute a discriminate function analysis to test the PICA's ability to discriminate between groups. A second purpose was to evaluate the influence of severity on group differences by equating the left and right hemisphere groups on overall PICA performance, identify PICA performance differences if they occurred, and compute a discriminant function analysis on the equated groups to test the PICA's ability to discriminate between groups that do not differ in overall severity.

METHOD

Patients met the following selection criteria. They: had suffered a first, single, left or right hemisphere thromboembolic infarct; had suffered no

previous neurologic involvement; had no other major medical or psychological disorder; displayed visual acuity adequate to match pictures and copy printing, auditory acuity adequate for conversation, and sensory and motor ability in one upper extremity adequate to gesture and write; and were premorbidly literate in English. Localization of the side of brain damage was confirmed by neurologic evaluation and neuroradiological reports (CT or MRI). All patients who met selection criteria were evaluated with the *Porch Index of Communicative Ability.*

Our initial comparison was done on 70 patients who had suffered a left hemisphere thromboembolic infarct and 30 patients who had suffered a right hemisphere thromboembolic infarct. Descriptive data on these patients are shown in Table 1. The left and right hemisphere groups did not differ significantly ($p < .05$) in age, education, or time post onset. Paired comparisons were conducted on PICA overall, modality, and subtest performance. A discriminant function analysis was computed to determine the PICA's ability to discriminate between patients with left and right hemisphere brain damage. Samples used in these comparisons are referred to as "unmatched" (for severity) groups.

Our second comparison was done on left and right hemisphere patients who were equated for severity. We selected all patients from our original samples who obtained a PICA overall score of 12.00 or above. This yielded 24 patients with left hemisphere lesions and 25 patients with right hemisphere lesions. Descriptive data on these patients are shown in Table 2. There were no significant differences ($p < .05$) between groups for age, education, or months post onset. As before, paired comparisons were conducted on PICA overall, modality, and subtest performance. In addition, a discriminant function analysis was computed to determine the PICA's ability to discriminate between patients with left and right hemisphere brain damage who were "matched" for severity.

Table 1. Descriptive Data for Unmatched Groups of Left Hemisphere and Right Hemisphere Patients

	Group			
	LEFT (N = 70)		RIGHT (N = 30)	
Variable	*Mean*	SD	*Mean*	SD
Age (in years)	56.10	10.58	54.97	7.11
Education (in years)	11.41	3.01	10.87	2.71
Months post onset	11.21	15.84	10.00	15.44

Table 2. Descriptive Data for Matched Groups of Left Hemisphere and Right Hemisphere Patients

	Group			
	LEFT (N = 24)		RIGHT (N = 25)	
Variable	*Mean*	SD	*Mean*	SD
Age (in years)	55.17	12.39	54.36	6.22
Education (in years)	12.54	3.26	11.28	2.56
Months post onset	9.69	11.57	11.38	16.54

RESULTS

A comparison of PICA overall and modality performance for unmatched groups of left and right hemisphere patients, shown in Table 3, indicated the right hemisphere group performed significantly better ($p < .001$) than the left hemisphere group in overall performance and on all modality measures—gestural, verbal, and graphic. Similarly, as shown in Table 4, the right hemisphere group performed significantly better ($p < .01$) on 14 of the 18 PICA subtests. Only visual matching (Subtests VIII and XI) and copying (Subtests E and F) did not differ significantly between groups.

A stepwise discriminant function analysis on the unmatched groups, shown in Table 5, classified 80% of the left hemisphere patients correctly and 93% of the right hemisphere patients correctly. Overall correct classification was 84%. PICA subtests selected by the analysis were Subtest III, pantomime; VIII and XI, visual matching; IX, verbal sentence completion; A, C, and D, writing; and E and F, copying.

Table 6 indicates that when left and right hemisphere groups were matched for overall performance on the PICA, no significant difference ($p < .05$) emerged between groups. Moreover, no significant differences ($p < .05$) occurred in the three PICA modality scores. Comparisons between matched groups on the 18 subtests, shown in Table 7, indicated the right hemisphere group performed significantly better on two—Subtest IV, verbal naming ($p < .05$), and Subtest IX, verbal sentence completion ($p < .01$).

A stepwise discriminant function analysis on the matched groups, shown in Table 8, classified 67% of the left hemisphere patients correctly and 88% of the right hemisphere patients correctly. Overall correct classification was 78%. PICA subtests selected by the analysis were Subtest III, pantomime; VII, reading; IX, verbal sentence completion; XII, verbal repetition; and F, copying.

Table 5. Classification of Unmatched Left Hemisphere and Right Hemisphere Patients by Discriminant Function Analysis of All PICA Subtests

	Predicted Group	
Actual Group	*Left*	*Right*
Left (n = 70)		
number of cases	56 (80%)	14 (20%)
Right (n = 30)		
number of cases	2 (7%)	28 (93%)

Note: Percent of all patients classified correctly = 84; subtests selected by the analysis: F, A, VIII, XI, C, D, IX, E, III.

Table 6. PICA Overall and Modality Performance for Matched Groups of Left Hemisphere and Right Hemisphere Patients

	Group				
	LEFT (N = 24)		RIGHT (N = 25)		
PICA Component	*Mean*	SD	*Mean*	SD	*Mean Difference*
Overall	13.12	.76	13.43	.77	.31
Gestural	13.99	.43	14.20	.54	.21
Verbal	13.23	1.31	13.84	1.06	.61
Graphic	11.91	1.44	12.21	1.58	.30

DISCUSSION

Our results indicate that Duffy and Myers's (1991) observations about the influence of severity on comparisons between and among different neurologic communication disorders are correct. Different results are obtained when severity between groups differs. The importance of this, of course, depends on the question asked.

Samples unmatched for overall severity indicated that left hemisphere brain damage results in more severe communication deficits than right hemisphere brain damage. This is certainly not a new observation. Moreover, right hemisphere patients do not differ significantly from left hemisphere patients in visual matching or copying performance. Again, nothing is new about this observation. Finally, the PICA seems to be a decent means for differentiating between patients with right hemisphere (93%) and left hemisphere (80%) brain damage when severity of overall impair-

Table 3. PICA Overall and Modality Performance for Unmatched Groups of Left Hemisphere and Right Hemisphere Patients

	Group				
	LEFT (N = 70)		RIGHT (N = 30)		
PICA Component	*Mean*	SD	*Mean*	SD	*Mean Difference*
Overall	11.12	1.92	13.03	1.21	1.91*
Gestural	12.75	1.55	14.02	.79	1.27*
Verbal	10.48	3.13	13.64	1.15	3.16*
Graphic	9.40	2.54	11.39	2.47	1.99*

*Significant at $p < .001$.

Table 4. Performance on PICA Subtests for Unmatched Left Hemisphere and Right Hemisphere Patients

	Group				
	LEFT (N = 70)		RIGHT (N = 30)		
Subtest	*Mean*	SD	*Mean*	SD	*Mean Difference*
I	8.66	3.06	12.26	1.39	3.60**
II	10.03	2.28	11.73	1.87	1.70**
III	11.11	2.14	12.78	1.61	1.67**
IV	10.12	3.70	13.96	1.07	3.84**
V	11.79	2.60	13.46	1.95	1.67*
VI	13.41	2.21	14.83	.31	1.42**
VII	12.46	2.70	14.55	.74	2.09**
VIII	14.57	1.08	14.90	.28	.33
IX	10.58	3.58	14.25	.97	3.67**
X	13.73	1.66	14.86	.24	1.13**
XI	14.81	1.07	14.98	.08	.17
XII	12.56	3.13	14.55	.91	1.99**
A	6.64	2.21	9.09	2.55	2.45**
B	8.20	3.34	10.99	2.91	2.79**
C	8.89	3.42	10.95	3.13	2.06*
D	9.14	3.25	11.98	2.80	2.84**
E	11.03	3.14	12.07	2.76	1.04
F	12.54	1.74	12.41	2.68	–.13

*Significant at $p < .01$. **Significant at $p < .001$.

Table 5. Classification of Unmatched Left Hemisphere and Right Hemisphere Patients by Discriminant Function Analysis of All PICA Subtests

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Actual Group	*Left*	*Right*
Left (n = 70)		
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Note: Percent of all patients classified correctly = 84; subtests selected by the analysis: F, A, VIII, XI, C, D, IX, E, III.

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Samples unmatched for overall severity indicated that left hemisphere brain damage results in more severe communication deficits than right hemisphere brain damage. This is certainly not a new observation. Moreover, right hemisphere patients do not differ significantly from left hemisphere patients in visual matching or copying performance. Again, nothing is new about this observation. Finally, the PICA seems to be a decent means for differentiating between patients with right hemisphere (93%) and left hemisphere (80%) brain damage when severity of overall impair-

Table 7. Performance on PICA Subtests for Matched Left Hemisphere and Right Hemisphere Patients

	Group				
	LEFT (N = 24)		RIGHT (N = 25)		
Subtest	*Mean*	SD	*Mean*	SD	*Mean Difference*
I	11.52	2.00	12.36	1.39	.84
II	11.59	1.58	11.95	1.58	.36
III	12.58	1.13	13.12	.96	.54
IV	13.44	1.58	14.26	.77	.82*
V	13.79	1.10	13.90	1.12	.11
VI	14.83	.41	14.93	.18	.10
VII	14.37	.89	14.74	.49	.37
VIII	14.82	.33	14.90	.30	.08
IX	13.68	1.25	14.54	.45	.86**
X	14.76	.50	14.91	.16	.15
XI	14.99	.04	14.99	.04	.00
XII	14.26	1.24	14.77	.43	.51
A	8.95	1.89	9.79	2.12	.84
B	11.43	2.04	11.90	2.13	.47
C	12.10	2.04	11.92	2.27	−.18
D	12.28	1.77	12.75	1.95	.47
E	13.21	1.32	13.06	1.41	−.15
F	13.50	1.10	12.78	2.37	−.72

*Significant at $p < .05$. **Significant at $p < .01$.

Table 8. Classification of Matched Left Hemisphere and Right Hemisphere Patients by Discriminant Function Analysis of All PICA Subtests

	Predicted Group	
Actual Group	*Left*	*Right*
Left (n = 24) number of cases	16 (67%)	8 (33%)
Right (n = 25) number of cases	3 (12%)	22 (88%)

Note: Percent of all patients classified correctly = 78; subtests selected by the analysis: IX, F, VII, III, XII.

ment differs between groups. Thus, if the question is whether left and right hemisphere patients differ on a general measure of communicative ability, there appears to be no need for controlling severity.

Samples matched for overall severity indicated only two differences between right and left hemisphere patients, verbal naming and verbal sentence completion. This may imply the presence of persisting "anomic" or word-finding deficits in mildly aphasic (left hemisphere) patients. The PICA's ability to discriminate between left and right hemisphere patients who do not differ in overall severity is reduced for classifying left hemisphere patients (67%) but remains high for classifying right hemisphere patients (88%). Thus, if the question is whether left and right hemisphere patients who display essentially the same overall impairment differ on specific measures of communicative ability, there is a need to control for severity.

The message in methodology may be that a method's value depends on the question asked. This too is not a new observation, but it probably is useful to remember. Thus, we are not advocating the PICA as the best measure for comparing performance between or among different neurologic communication disorders; however, it seems to be a pretty good one. For us, it was a means to explore the influence of severity in group comparisons. Other questions will require different means. The same question may require a better means.

One should exercise caution when interpreting our discriminant function analyses. There is not an exact literature on determining sample size for discriminant function analysis, and there is no prescribed analytical means for deriving appropriate sample size or determining statistical power. A general "rule of thumb" is to include 15 to 20 cases for each variable when using this multivariate procedure. We entered the 18 PICA subtests in the analysis, thus our samples of 100 and 49 are woefully inadequate. The confidence intervals are probably wide, and the probability of a Type II error is high. Nevertheless, correct classification in both analyses was pretty good. More importantly, the purpose of our effort was to examine the influence of severity on comparing left and right hemisphere groups, not to test the PICA's ability to discriminate between groups. Our paired comparisons indicate that severity influences how and how much the groups differ. The discriminate function analyses, interpreted with the limitation of inadequate sample size, suggest the PICA may be a promising means for differentiating between groups.

Duffy and Myers (1991) were prophetic when they observed that "across-group comparison studies are going to be with us as long as we are interested in the classification of communication disorders, their differential diagnosis, and understanding the basic nature of a variety of neurogenic communication deficits" (p. 13). At least 40 papers presented in the Clinical Aphasiology Conferences between 1978 and 1987 made comparisons between or among different brain-injured groups.

We might wonder why we persist in making these comparisons. Duffy and Myers (1991) suggest comparisons may identify similarities and differences among groups, establish the discriminative power of various tests, explore theories about the nature of different communicative deficits, and refine classification systems. These appear to be noble ends; if they are, they require appropriate means.

Our effort examined only one of several problems that may flow from inappropriate means. We examined the influence of severity on group differences, but we may have done this with an inappropriate measure. Moreover, our groups were classified on the basis of side of brain damage. Is that an important classification attribute? Perhaps we should have classified on the basis of side and size of brain damage or on side, size, and site of brain damage. More importantly, we may want to change the question and classify on the presence or absence of specific behaviors, equate severity on other behaviors, and determine what the results tell us about lesion localization. Essentially, how valid is the side of lesion as a criterion for classifying different neurogenic communication disorders? Not all patients with a hole in the left hemisphere are aphasic. Not all patients with a hole in the right hemisphere display what we grossly call right hemisphere communication deficits.

Certainly, our examination of the influence of side and severity on the variety of behaviors measured by a single test has not solved the problems inherent in comparisons across neurologic communication disorders. It does indicate that the severity of impairment in the samples compared will influence conclusions about group differences. Also, it has confirmed an axiom for aphasiologists: "Over the mountain are mountains."

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