Performance of Normal (Non-Brain Injured) Adults on the Porch Index of Communicative Ability

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Implicit in the use of the Porch Index of Communicative Ability (PICA) is the assumption that patients with aphasia distinguish themselves from "normal" or non-brain injured individuals on the test. Porch (1967) has stated that the PICA ". . . is not at all demanding in terms of age, intelligence or experience. The reading and writing tasks, among the most difficult for aphasics, are easily mastered by a fourth grade child and the remaining tasks are even less difficult for uninvolved individuals" (p. 16). Currently, however, data regarding the performance of a representative sample of normal adults on the PICA are unavailable, and impressions that normal, literate adults usually average almost 15.00 on the PICA (Porch, 1971) have not been empirically validated. Such normative data appear crucial if scores of patients who are being evaluated for the presence of neurogenic communicative deficits are to be interpreted accurately. For example, do high scores by left brain injured patients accurately reflect mild degrees of aphasic impairment or performance which is within the normal range? Questions like this are not unwarranted in light of the fact that Schuell et al. (1964) found an 8% overlap in the performance of normal (non-brain injured) controls and aphasic patients on the Minnesota Test for the Differential Diagnosis of Aphasia.

It seemed to us that the availability of normative data for the PICA would help to define the limits of the "grey area" which exists between so-called normal and brain injured (or aphasic) performance, and would also further substantiate and improve the validity and clinical usefulness of the PICA. Consequently, we sought to test a large number of normal adults on the PICA in order to answer the following questions:

1. How do normal, non-brain injured adults perform on the PICA?
2. How does the performance of these normal adults compare with that of the large sample of aphasic patients on whom the PICA was standardized?

3. To what degree, if any, can the use of the non-preferred hand on the Graphic subtests of the PICA be expected to reduce PICA scores?

SUBJECTS AND PROCEDURES

In order to answer the above questions, the PICA was administered in its standardized form by two trained and experienced PICA users (J.D. and R.K.) to 130 adults. All subjects were native English speakers without histories of speech or language deficit, neurological impairment, or evidence of significant, uncorrected auditory or visual acuity deficits. This evidence of normalcy was obtained from each subject's verbal report and, whenever possible, from available medical records. Subjects included Mayo Clinic or affiliated hospital employees, patients or family members of patients waiting for appointments at one of the medical facilities, and residents of two nursing homes in the Rochester, Minnesota area.

Table I contains data descriptive of the age, education, handedness, sex, and time taken to complete the PICA for the 130 normal subjects who were tested. While the mean age of our group (56.84) was less than the mean age of 60.5 for the clinical sample of 150 brain injured patients originally tested by Porch (1967), the difference was not significant ($t=1.88$; $df=278$; $p > .01$). Our subjects were more highly educated ($t=8.24$; $df=275$; $p < .01$) than Porch's sample of brain injured patients, who had an average of 8.22 years of education. However, the average educational level of our sample (12.07 years) very closely approximates the 1974 national median of 12.3 years of completed education (Dept. of Health, Education & Welfare, 1975).

All subjects were screened with Part V of the Token Test (DeRenzi and Vignolo, 1963), which was used as an independent measure of language comprehension and general intactness of language skills. All 130 subjects who were subsequently given the PICA fell within two standard deviations of norms which have been established for Part V of the Token Test (Wertz, Keith & Custer, 1971).

In addition to receiving the PICA in its standardized form, 26 randomly selected subjects performed the Graphic subtests of the PICA with both their preferred and non-preferred hands for writing (counterbalanced order). The purpose of this part of the study was to obtain an estimate of the degree to which the use of the non-preferred hand for writing (as is necessary for many hemiplegic and hemiparetic aphasic patients) influences scores on the six Graphic subtests of the PICA.

RESULTS

Time to Complete PICA - As shown in Table I, our subjects required an average of 20.36 minutes to complete the PICA. With the group's standard deviation of 5.26, one would expect 95% of normal subjects to complete the PICA within 29 minutes. This is in marked contrast to the performance of the 150 left brain injured patients tested by Porch (1967) who averaged about 60 minutes (range = 22 to 128 minutes), with only four patients (3%) completing the test in 30 minutes or less. One can conclude from these results that test time, in and of itself, is a good discriminator between normal and left brain injured performance on the PICA.

PICA Performance - Table II summarizes the group's performance on each of the 18 PICA subtests, the Gestural, Verbal, and Graphic modalities, and the Overall PICA score. As can be seen, mean scores for all portions of the PICA were uniformly high, with Gestural, Verbal, Graphic and Overall

TABLE I

Descriptive Data for Sample of 130 Normal Subjects
on the Porch Index of Communicative Ability

	Age	Education	Test Time	Sex	Handedness
N	130	127	128	45 males	R = 127
X	56.84	12.07	20.36	85 females	L = 2
SD	17.61	3.47	5.26		No Preference = 1
Median	59.5	12.01	19.71		
Range	20-96	2-21	13-49		

TABLE II

Summary of PICA Performance of 130 Normal Adults

	VERBAL				GESTURAL							
	I	IV	IX	XII	II	III	V	VI	VII	VIII	X	XI
$\bar{X}$	13.72	14.78	14.73	14.96	13.68	14.32	14.57	14.93	14.92	14.98	14.92	14.99
SD	1.01	.40	.32	.21	1.31	.93	.51	.18	.22	.10	.26	.018
Range	10.9-	11.9-	13.5-	13.2-	10.0-	9.8-	12.2-	14.0-	13.8-	14.1-	12.6-	14.8-
	15.0	15.4	15.0	15.0	15.0	15.4	15.0	15.0	15.0	15.0	15.0	15.0
exp. score* (95%)	12.05	14.12	14.20	14.61	11.52	12.79	13.73	14.63	14.56	14.81	14.49	14.96

	GRAPHIC						SUMMARY SCORES			
	A	B	C	D	E	F	Gestural	Verbal	Graphic	Overall
$\bar{X}$	12.57	14.21	14.42	14.63	14.71	14.18	14.66	14.55	14.12	14.46
SD	1.78	.95	.97	.63	.48	.71	.31	.33	.71	.33
Range	6.5-	10.5-	8.6-	11.8-	12.6-	11.4-	13.73-	13.48-	11.18-	13.40-
	15.3	15.0	15.0	15.0	15.0	15.0	15.00	15.03	15.02	14.99
exp. score* (95%)	9.63	11.61	12.82	13.59	13.92	13.01	14.15	14.01	12.95	13.92

*Minimum score expected to be obtained by 95% of the normal population based on obtained mean and standard deviation.

scores all exceeding 14.00 (for practical purposes, 15.00 can be considered the maximum obtainable score). Mean scores were also high for all subtests, although subtests I, II, and A (which require a description of object function in the Verbal, Gestural, and Graphic modalities respectively) yielded mean scores below 14.00, and in the case of subtest A, below 13.00.

Also shown in Table II are the minimal scores which one should expect to see 95% of the normal population receive on the various portions of the PICA. Using this 95% point as a cut-off for normal performance, certain comparisons can be made with Porch's PICA percentile data for left brain injured patients (1971) which can tell us something about the expected degree of overlap in performance between the left brain injured and normal populations. This estimated overlap for the various portions of the PICA is shown in Table III.

The percentages listed in Table III represent the approximate percentage of left brain injured patients who do as well as 95% of the normal patients we studied. For example, on subtest I of the PICA one would expect 24% of the left brain injured patients to do as well as 95% of the normal population. Looking at all of the overlaps we find that, of the 18 PICA subtests, the best discriminators between normal and left brain injured performance are subtests A through E of the Graphic subtests, subtests V and VII (the reading subtests), and subtest III (one of the pantomime subtests). All of these subtests, we should note, are among the most difficult for left brain injured patients. The subtests which are least discriminating, or have the greatest degree of overlap, were the visual matching tasks (subtests VIII and XI) and the verbal comprehension tasks (subtests VI and X). These subtests are the easiest for left brain injured patients.

When the Gestural, Verbal, and Graphic modalities are examined for degree of overlap we find that the Graphic modality has the greatest degree of discriminative power. That is, the degree of overlap between the normal and aphasic populations is considerably less in the Graphic modality (8%) than in the Verbal (21%) and Gestural (15%) modalities.

Regarding the degree of overlap between the normal and left brain injured populations for Overall PICA scores, there is approximately an 8% overlap between Porch's sample and our group of normal subjects. This means that about 8% of left brain injured patients score within the normal range on the Overall PICA, if we use 95% of our sample of normal subjects as a cut-off point for normal. (In addition, only 3% of aphasic patients performed as well as the <u>average</u> normal subject, and no normal subject performed as poorly as 86% of Porch's left brain injured patients.) These findings suggest that about 8% of the scores of left brain injured patients on the Overall PICA are not distinguishable from normal performance. We subsequently wondered if comparing the Ranked or Modality Response Contours of our normal sample with Porch's (1971) contours for 95th and 99th percentile left brain injured patients (aphasia without complications) might show differing, and, therefore, discriminating contours between the two groups. But we found the shape of the contours to be strikingly similar. We are led to conclude, therefore, that using the <u>numerical mean</u> subtest, modality, and Overall scores of the PICA to distinguish between aphasic and normal performance, when that performance exceeds the 92nd percentile for left hemisphere damaged patients, is not possible. While we do not yet know, we suspect that greater differentiation between these populations may be obtained by examining individual item scores (specific response characteristics) obtained within the various PICA subtests. Our word of caution, therefore,

TABLE III

Approximate Degree of Overlap Between
Aphasic (Porch, 1967) and Normal (95% of sample)
Ss on Overall PICA Scores

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Percent of Overlap	24	21	15	22	16	40	17	65	20	47	75	30

	A	B	C	D	E	F	Gestural	Verbal	Graphic	Overall
Percent of Overlap	14	11	8	7	8	30	15	21	8	8

is directed only at using numerical summary scores to decide whether or not a 92nd percentile score (or higher), based on Porch's data for left brain injured patients, is representative of aphasia or normal performance.

Influence of Age and Education on Performance (regression analysis) - In addition to looking at our normal group's performance on the PICA, we also sought to examine the effects of age and education on test performance. Table IV shows the correlations obtained between age and education and PICA performance for our subjects. As can be seen, age is negatively correlated with PICA scores and education is positively correlated with the same scores. With the exception of the correlation between education and Gestural scores, all of the correlations are significant beyond the .01 level of confidence. This means that PICA scores of normal subjects tend to be reduced with increasing age and increased with increasing education. Our findings also indicate that education affects scores to a greater degree than age, and that the effects of education are greatest, as would be expected, in the Graphic modality. It should also be noted that these correlations are uniformly higher in our normal sample than they were for Porch's 150 brain injured patients. For example, Overall PICA scores in Porch's sample were correlated -.18 with age and .12 with education as compared to -.34 and .51, respectively, in our sample of normal subjects. This suggests that the roles of age and education in affecting PICA scores is significantly reduced once brain injury or aphasia becomes a characteristic of the patient being tested.

Because both age and education were significantly correlated with Overall PICA scores, we completed a multiple regression analysis of PICA scores with age and education as independent variables. Such an analysis generates some clinically useful information related to accounting for the effects of age and education when trying to determine if a PICA score is within normal limits. Table V contains the regression equation and expected Overall PICA scores for a variety of ages and educational levels. With a standard error of .279, we would expect 95% of normal individuals to score no more than .46 points below the scores listed in this table. Regarding errors which might be made relative to identifying a normal person as abnormal (i.e., aphasic) on the basis of these expected scores, a scattergram analysis of our data suggests that errors in prediction are most likely to be made in the upper age ranges and at the lower educational ranges.

Influence of Use of the Non-Preferred Hand on Performance - The last question which this study sought to answer was related to the influence that using the non-preferred limb for writing might have on Graphic subtest scores and Overall PICA scores. Results indicated that twenty-five of the twenty-six subjects who used their preferred and non-preferred hands for the Graphic subtests received lower scores with their non-preferred hand (the one reversal represented the smallest difference found). Subtest F (copying geometric forms) showed the smallest mean difference (.35 points) while Subtest B yielded the largest mean difference (2.22 points). Using the non-preferred hand reduced overall Graphic subtest scores by an average of 1.22 points ($t=6.74$; $df=25$; $p < .01$). Since the six Graphic subtests represent one third of the Overall PICA score, one would expect the Overall PICA score of a person who uses his non-preferred hand for the Graphic subtests to be reduced by an average of .41 points. For a left brain injured patient, this translates to an average of approximately 5 percentile points. It should be noted that the normative data presented in the preceding sections are based on performance with the preferred hand, so use of this data for persons using their non-preferred hand will have to be

TABLE IV

Correlations* Between Age and Education
and PICA Performance

	Gestural	Verbal	Graphic	Overall
Age	-.29	-.33	-.21	-.34
Education	.20	.25	.53	.51

*All r's significant beyond .01 level of confidence except Education with Gestural ($<.05$).

TABLE V

Expected Overall PICA Scores* for Normal Ss
at Given Levels of Age and Education

	Education (yrs)								
AGE	4	6	8	10	12	14	16	18	20
20	14.27	14.36	14.45	14.53	14.62	14.71			
25	14.25	14.34	14.42	14.51	14.60	14.69	14.77	14.86	14.95
30	14.23	14.32	14.40	14.49	14.58	14.67	14.75	14.84	14.92
35	14.21	14.29	14.38	14.47	14.56	14.64	14.73	14.82	14.90
40	14.19	14.27	14.36	14.45	14.54	14.62	14.71	14.80	14.88
45	14.17	14.25	14.34	14.43	14.51	14.60	14.69	14.78	14.86
50	14.15	14.23	14.32	14.41	14.49	14.58	14.67	14.76	14.84
55	14.11	14.20	14.29	14.37	14.46	14.55	14.64	14.72	14.81
60	14.09	14.18	14.27	14.35	14.44	14.53	14.62	14.70	14.79
65	14.07	14.16	14.25	14.33	14.42	14.51	14.60	14.68	14.77
70	14.05	14.14	14.23	14.31	14.40	14.49	14.58	14.66	14.75
75	14.03	14.12	14.21	14.29	14.38	14.47	14.56	14.64	14.73
80	14.00	14.09	14.18	14.26	14.35	14.44	14.53	14.61	14.70
85	13.98	14.07	14.16	14.24	14.33	14.42	14.51	14.59	14.68
90	13.96	14.05	14.14	14.22	14.31	14.40	14.49	14.57	14.66

*Regression equation: Overall PICA = 14.1859 - .0042 (age) + .0434 (ed.)
Standard error = .2785
(95% of normals should score above (listed score - .46)

adjusted when decisions about "normalcy" of performance on the Graphic subtests and Overall PICA are made.

SUMMARY

The results of this study indicate that normal, non-brain injured, non-aphasic individuals perform very well on the PICA. While perfect scores, or scores of 15.00, are often achieved on several subtests of the PICA, such scores are rare for other subtests as well as for Gestural, Verbal, Graphic and Overall PICA scores. In addition, the use of the non-preferred hand on the Graphic subtests of the PICA significantly reduces Graphic subtest scores. Finally, when the performance of normal subjects is compared to that of left brain injured patients, there is an overlap of about 8% between the two populations. This suggests that numerical PICA scores which fall above the 92nd percentile (based on Porch's data for left brain injured patients) may not be distinguishable from normal performance. This further suggests that our decisions about the normalcy of patients receiving such scores must be based on our observations of behavior on individual items of the PICA and/or other assessment devices. While this conclusion may be disappointing to those interested in the objectivity provided by mathematics, it is a gratifying reminder that the true benefits to be derived from the use of a test like the PICA are ultimately based on our ability to observe the salient features of communicative behavior and not our ability to generate numbers.

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