Clinical Significance of the PICA High-Low Gap

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Porch (1967) developed the High-Low Gap concept as a tool for managing aphasic patients. He suggested that the 18 Porch Index of Communicative Ability (PICA) subtests could by analyzed to yield an Overall score—the mean of all 18 subtests; a Highs Score—the mean of the nine highest subtests; and a Lows Score—the mean of the nine lowest subtests. When the three scores are plotted as percentiles on the PICA Recovery Curve Form, they represent what Porch calls the patient's "dynamic range" for the test from which they are derived. The Highs indicate the patient's best performance, or his potential. The Overall Score indicates his current performance. The Lows indicate his poorest performance, or areas of communicative deficit. Porch contends that, unless there are other complications, the difference between the Highs and the Lows (the High-Low Gap) should be erased by treatment. Thus, a patient's performance should eventually result in a zero High-Low Gap.

The uses of the High-Low Gap are primarily prognostic. The Highs indicate potential improvement. A wide High-Low Gap, therefore, would indicate greater potential improvement than a narrow High-Low Gap. Further, as the High-Low Gap closes, the Overall and Lows percentiles ascend to meet the Highs. In fact, Porch has developed a method, the High Overall Preddiction (HOAP), that uses the Highs obtained early postonset to predict Overall performance at six months postonset.

The Highs, Overall, and Lows are represented by percentiles derived from Porch's normative sample of aphasic patients. To obtain the expected configuration, where the Highs percentile is the maximum number, followed by the Overall and the Lows percentiles, a patient's performance on the 18 PICA subtests must resemble the order of test difficulty represented on the PICA Ranked Response Summary. The patient must do his best on the tests that were easier for Porch's normative group, and he must do his worst on tests that were most difficult for the normative group. If his performance on the 18 subtests differs markedly from that represented on the Ranked Response Summary, the configuration of his High-Low Gap changes. For example, if he does much better on the easier tests and much worse on the harder tests than patients in the normative sample who were at his severity level, he demonstrates what Porch calls "Positive Max," a wide High-Low Gap with unusually elevated Highs and unusually depressed Lows. Conversely, if a patient does worse on the tests that were easier for the normative sample, it is possible for his Lows percentile to exceed his Highs percentile. This condition is called "Negative Max" and is indicated by a negative High-Low Gap.

The clinical significance of the High-Low Gap has been tested in a series of studies. Porch and his colleagues (1980, 1974, 1973) used the High-Low Gap as a predictor in multiple regression studies designed to develop formulae for predicting change in aphasia. The High-Low Gap failed to surface as a potent predictor. Further, we (Wertz, Deal and

Deal, 1980) tested the clinical efficacy of Porch's HOAP method and the Short-Direct HOAP Slope Method for predicting change in aphasia. While both methods predicted significantly for groups of aphasic patients, both mispredicted by unacceptable margins for many individual patients. Thus, the clinical significance of the High-Low Gap concept can be questioned.

We believe there are several questions in search of empirical answers, and that search is consistent with the purposes of this paper. First, we asked, what is the distribution of positive, negative, and zero High-Low Gaps in samples of patients seen at one month postonset? Second, we asked, what are the prognostic implications of a positive, negative, or zero High-Low Gap at one month postonset? Third, we asked, what is the consistency of positive, negative, and zero High-Low Gaps over time from one month postonset to 12 months postonset? Fourth, we asked, what is the relationship between the width of the High-Low Gap at one month postonset and change in aphasia? And, sixth, we asked whether the High-Low Gap closes over time in patients receiving treatment for aphasia.

METHOD

Seventy-nine aphasic patients who had received a PICA at one month postonset and a subsequent PICA or PICAs at three, six, or 12 months postonset provided the data for this study. Five groups—patients who had received a PICA at one and three; one and six; one and twelve; one, three, and six; or one, three, six, and twelve—were used to answer the questions posed about the clinical significance of the High-Low Gap. Descriptive data for these groups are shown in Table 1. Some patients are represented in more than one group.

Table 1. Descriptive data for subject groups.

GROUP (Evaluations)	N	AGE (In Years)		SEVERITY (In PICA %ile)	
		$\bar{X}$	Range	$\bar{X}$	Range
1 and 3 MPO	70	62	40-79	42nd	4-74
1 and 6 MPO	65	58	36-79	43rd	4-83
1 and 12 MPO	43	59	40-79	44th	4-74
1, 3, and 6 MPO	57	58	40-79	53rd	15-76
1, 3, 6, and 12 MPO	39	56	40-79	43rd	15-74

All patients had suffered a single, left hemisphere cerebral vascular accident, and all were diagnosed as demonstrating aphasia at one month postonset. All patients received speech and language therapy. However, the intensity and duration of treatment varied considerably.

RESULTS

To determine the incidence of positive, negative, and zero High-Low Gaps, we calculated the percent of patients demonstrating each at one month postonset in three of our groups—patients who had taken the PICA at 1 and 3 MPO, 1 and 6 MPO, or 1 and 12 MPO. The results are shown in Table 2. Approximately two-thirds of the patients in each group show a positive High-Low Gap at one month postonset; less than ten percent show a zero gap; and the remainder, 27 to 32 percent across groups, show a negative gap.

Table 2. Number and percent of patients with positive, negative, or zero High-Low Gaps at one month postonset.

GROUP	N	POSITIVE		NEGATIVE		ZERO	
		N	%	N	%	N	%
1 - 3 MPO	70	46	66	19	27	5	7
1 - 6 MPO	65	41	63	21	32	3	5
1 - 12 MPO	43	29	67	12	28	2	5

To determine the prognostic significance of a positive, negative, or zero High-Low Gap at one month postonset, we computed the mean percentile improvement obtained between one month postonset and the final evaluation for patients in each of the three groups—1 and 3, 1 and 6, and 1 and 12 months postonset. Table 3 shows the results of these computations. If the sign of the High-Low Gap at one month postonset has prognostic significance, patients with one sign should improve more or less than patients with another sign. t tests computed among groups with positive, negative, or zero High-Low Gaps at one month postonset resulted in t values less than 1.00 for all comparisons. Thus, the sign of the High-Low Gap at one month postonset had no prognostic significance for patients in our samples.

Table 3. Mean percentile change scores for patients with positive, negative, and zero High-Low Gaps at one month postonset.

GROUP	N	POSITIVE			NEGATIVE			ZERO		
		$\bar{X}$	R	S.D.	$\bar{X}$	R	S.D.	$\bar{X}$	R	S.D.
1 - 3 MPO	70	15.4	0-39	9.6	17.0	1-47	10.7	18.8	3-26	12.6
1 - 6 MPO	65	22.9	3-45	11.5	22.2	3-60	13.7	23.0	16-34	9.6
1 - 12 MPO	43	29.0	5-52	13.1	25.0	10-39	9.3	10.5	4-17	9.2

To answer the question whether a positive, negative, or zero High-Low Gap at one month postonset remains consistent over time, we looked at patients who had received a PICA at 1 and 3; 1, 3, and 6; and 1, 3, 6 and 12

months postonset. Table 4 shows that for the shorter periods, 1 to 3 and 1 to 3 to 6 months postonset, more patients maintained the sign of their High-Low Gap at one month postonset than changed. For the longer period, 1 to 3 to 6 to 12 months postonset, over half of the sample changed the sign of the High-Low Gap at one or more evaluations. A comparison of the sign of the High-Low Gap at one month and the sign at the final evaluation with a X^2 test, however, revealed no significant ($p>0.05$) change in the sign of the High-Low Gap between initial and final evaluations. Thus, even though the sign may change across evaluations for some patients, there is no significant change between initial and final evaluations for our samples.

Table 4. Number and percent of patients with a consistent positive, negative, or zero High-Low Gap over time.

HIGH-LOW GAP	EVALUATION GROUPS					
	1 - 3 (N = 70)		1 - 3 - 6 (N = 57)		1 - 3 - 6 - 12 (N = 39)	
	N	%	N	%	N	%
Positive at Each Evaluation	35	50	25	44	16	41
Negative at Each Evaluation	11	16	10	18	2	5
Zero at Each Evaluation	1	1	0	0	0	0
Change Across Evaluation	23	33	22	38	21	54

To determine whether severity influences the sign of the High-Low Gap, we calculated the percent of patients with a positive, negative, or zero High-Low Gap for four severity levels at different times postonset. Table 5 shows that most of the patients, regardless of severity or time postonset, had a positive High-Low Gap. Only the mild to moderate group, 76th to 99th %ile, at six months postonset had more patients with a negative High-Low Gap than a positive gap. Therefore, no relationship between severity and the sign of the gap was apparent in our data.

Table 5. Percent of patients (N=39) with a positive, negative, or zero High-Low Gap for four severity levels at one, three, six, and 12 months postonset.

SEVERITY (In Percentiles)	SIGN OF HIGH-LOW GAP AT DIFFERENT MONTHS POSTONSET											
	ONE (%)			THREE (%)			SIX (%)			TWELVE (%)		
	+	-	0	+	-	0	+	-	0	+	-	0
1st - 25th	10	10	0	5	0	0	3	0	0	0	0	0
26th - 50th	41	3	0	21	3	0	15	0	0	8	0	0
51st - 75th	18	15	3	28	15	3	26	12	3	25	15	3
76th - 99th	0	0	0	15	5	5	15	26	0	41	8	0

To test whether the magnitude of the High-Low Gap at one month postonset was related with the magnitude of change in aphasia, we correlated the width of the gap, ignoring sign, in percentile units, at one month postonset, with the amount of change, in percentile units, each patient made between his one month and final evaluation. Three groups were analyzed, 1 and 3, 1 and 6, and 1 and 12 MPO. Table 6 shows none of the correlations was significant ($p > 0.05$). Therefore, the magnitude of the High-Low Gap at one month postonset does not appear to be related to the amount of improvement a patient does or does not make on the PICA at subsequent months postonset.

Table 6. Correlation between the magnitude of the High-Low Gap at one month postonset and change in aphasia.

GROUP	N	$\bar{X}$ H - L GAP AT ONE MPO	$\bar{X}$ OVERALL %ile CHANGE	r
1 - 3 MPO	70	8.47	16.06	-.12
1 - 6 MPO	65	8.89	22.68	-.04
1 - 12 MPO	43	9.37	27.05	+.11

Porch has suggested that treatment should close a patient's High-Low Gap over time. We analyzed PICA data on 43 patients who were treated between one and twelve months postonset in an attempt to provide empirical support for Porch's suggestion. The mean High-Low Gap at one month postonset was 9.37 percentile units with a range from zero to 39 and a standard deviation of 7.91. The mean High-Low Gap at 12 months postonset was 7.23 percentile units with a range from zero to 25 and a standard deviation of 5.60. A t test comparing the High-Low Gap at one month postonset with the High-Low Gap at 12 months postonset was not significant ($p > 0.05$). Therefore, treatment, in this sample of patients, did not close the High-Low Gap during the first year postonset.

DISCUSSION

When reporting data on the connubial behavior of penguins, it is possible to tell the reader more than he or she wants to know. So it may be with the PICA High-Low Gap. However, no one has speculated that the connubial behavior of penguins is clinically significant in the management of aphasia. That speculation has been made about the PICA High-Low Gap, and we have provided some information about this significance.

First, more patients appear to demonstrate positive High-Low Gaps than demonstrated negative or zero High-Low Gaps. Thus, most of our patients appear to have done what Porch's normative sample did. There is some comfort in consistency. Second, the sign of the High-Low Gap (+, -, or 0) does not appear to have prognostic significance. Thus, a positive or a negative or a zero high-low gap in our samples did not indicate whether or how much the

patient would or would not improve. There appears to be no predictive value in doing (positive max) or not doing (negative max) what the PICA normative sample did. Third, the sign of the High-Low Gap changes across evaluations, but this change is not significant. Thus, a patient is not rigidly consistent in his performance as he travels the path postonset, but he does not deviate markedly from his early performance at points in time during his journey. Fourth, severity of aphasia does not influence the sign of the High-Low Gap. Thus, severity does not appear systematically to reduce or increase variability among PICA subtests. Fifth, the magnitude of the High-Low Gap at one month postonset does not appear to be related to improvement or lack of improvement in aphasia. Thus, the width of the PICA high-low gap at one month postonset did not predict whether or how much a patient would or would not improve. Sixth, treatment during the first 12 months postonset did not close the High-Low Gap in the patients we studied. Thus, patients at 12 months postonset continued to display a dynamic range.

All of our results are essentially negative. The questions we asked did not uncover any clinical significance for the High-Low Gap concept. Perhaps the amount, duration, or quality of the treatment our patients received had an influence on our results. For example, perhaps it is necessary to continue treatment beyond 12 months postonset to close the PICA high-low gap in some patients. However, the variability of the gap during the first year postonset would not lead one to predict more stability in its senescence after one year postonset, and the example provided by Porch in the PICA manual suggests that closure should occur during the first 12 months. Perhaps converting PICA data on patients who were tested at specific points in time postonset to percentiles derived from PICA data on patients who were tested at only one point in time is spurious. Perhaps Porch's election of the term "dynamic range" was apt, because the range is "dynamic;" it changes over time. Therefore, perhaps recovery curve percentile equivalents should be derived from patients who were followed over time. Or, perhaps, like the connubial behavior of penguins, the PICA High-Low Gap has more influence on the observer than it does on the aphasic patient or the penguin.

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DISCUSSION

Q: Was the t test the appropriate test to use with these data?
A: Yes. We used a t test for dependent measures.

Q: The PICA High-Low pattern changes dramatically during the acute phase. You should look at the High-Low Gap between six and 12 months postonset. A negative High-Low Gap is probably related to motoric problems. Did you look at etiology? It probably affects the size of the gap. The High-Low Gap and peak-mean differences are probably more meaningful concepts in the chronic stage. I still believe we should be able to close the gap with treatment. A maximally recovered patient should have a zero High-Low Gap.
A: We did not look at change during the period six to 12 months postonset. Change may have been "dramatic," but it was not significant in any of our groups. We did not look at etiology, because all of our patients had the same etiology, first, left hemisphere, thromboembolic CVA.

Q: Did all patients receive the same amount and type of therapy?
A: No.

Q: Was your choice of treatment affected by the sign of the patient's High-Low Gap?
A: It could have been, but not because the sign of the High-Low Gap was considered when selecting what and how to treat. For example, Dr. Porch suggested that a negative High-Low Gap is probably related to motoric problems. If a patient had a motor problem, we probably treated it. But, we treated it because it was a motor problem not because the patient had a negative High-Low Gap. Incidentally, no one has published empirical data that demonstrate a negative High-Low Gap results from the presence of motor problems.

Q: Did you select specific subtests to use as the nine highs and the nine lows?
A: No. The patient makes the selection by his performance on the PICA. We took each patient's nine best subtests as his nine highs and his nine poorest subtests as his nine lows, and we hoped the two added to 18.