

SELECTED PERCEPTUAL NORMS



FOR THE LEARNING-DISABLED POPULATION AGES 6 THROUGH 9

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ABSTRACT

Norms of five perceptual tests (Grooved Pegboard Test, Divided Form Board Test, Audio-Visual Integration Test, Tachistoscope Test and the Developmental Test of Visual-Motor Integration) were established for a learning-disabled population of 6- to 9-year-old children. A comparison between these norms and norms previously obtained for "normal achievers" revealed a consistently poorer performance by the learning-disabled group. Our findings revealed that the level of performance was not equal among the five tests. Explanations as to the results of this study are provided.

KEY WORDS

perceptual tests, learning disability, scaled scores, Grooved Pegboard Test, Divided Form Board Test, Auditory-Visual Integration Test, Developmental Test of Visual Motor Integration, perceptual speed

Usually, in evaluating the learning-disabled (LD) child, his or her score on a selected perceptual test is compared to the norms obtained from a non-LD standardization population sample for that test. The purpose of this paper is to establish some comparable norms for the learning disabled. This information will enable the examiner to compare the child's score to both LD norms and those originally determined for the particular test. The advantages of comparing scores of an LD child to other LD children are twofold: first, one can more accurately estimate the severity of the problem and therefore the length of treatment. For example, knowing that an LD child scored at the 20th percentile compares him to normally achieving children. However, if you know that the same score represents the 30th percentile of the norms obtained for LD children, then, indeed, there is a more serious problem. Second, the clinician can then make a more realistic estimate of the professional care that will be required to bring the child to the 50th percentile of normal children in the skill measured by that particular test. One should keep in mind that these two considerations are not mutually exclusive and, on the contrary, they should both be utilized in evaluating the learning-disabled child.

METHODS

The subjects used for this study were between the ages of 72 and 108 months

(approximately grades one-three) with a mean age of 92.6 months (SD:8.5). There are some differences among the number and mean age of the subject grouping in the five tests analyzed. The exact number of subjects, as well as mean and standard deviation for each test, will be provided in the results section. Seventy percent of the subjects were males and 30% females, reflecting the reported trend of more males in the LD population.¹ All the subjects used in this study were previously diagnosed as learning disabled.

Five tests were analyzed. They were the Grooved Pegboard Test, Divided Form Board Test, Auditory Visual Integration Test (AVIT), Tachistoscope Exposure Test (Tachistoscope) and the Developmental Test of Visual Motor Integration (VMI).^a The administration instructions and scoring protocol for each of these tests is provided in Appendix A.

THE TESTS

The Grooved Pegboard Test requires the child to use visually-guided behavior in a fine motor task. Completing this test rapidly requires a high level of automaticity. Aside from visually-guided behavior, other necessary skills are directionality, left-right knowledge, fine motor planning and tactual-visual integration. Birch and Lefford² reported that the child who performs below his or her age-expected academic level usually has difficulty with intersensory and sensory-

motor integrative skills. Finally, this test can provide a measure of successive processing skills.

The Divided Form Board Test requires the subject to analyze spatial concepts of geometric forms. First the child sees the completed form board and then watches as it is disassembled. The child must then combine two partial geometric forms—for example, an oval and a crescent, to form a circle—in the appropriate inset of the puzzle board. Therefore, visualization skills are important. This is a timed test and has been standardized for ages 6 to 9 (grades K - two).³ Research has shown that as the time to complete this six-figure form board increases, the risk of the child having a learning or reading difficulty also increases.⁴ The examiner is able to observe a particular cognitive style, such as whether the child is primarily impulsive or reflective; the impulsive child is more likely to utilize a more tactical strategy, whereas the reflective child a more visual strategy. This is a function of the Visual Motor Hierarchy which states that as the child develops, there is a transition from gathering information primarily through the motor system to the visual system.⁵ Unlike the Grooved Pegboard Test, which is a successive task, the Divided Form Board Test requires more simultaneous processing. Because it is a timed test, automaticity of performance is factored into the score a subject achieves.

The AVIT assesses a child's ability to equate a temporally distributed (tapped) auditory stimulus to a spatially distributed (printed) visual match. Solan et al.⁶ have shown a significant correlation between the AVIT and reading in primary and elementary grades. This test requires auditory memory, spatial- simultaneous (printed dot sequence) and successive (the auditory taps) processing skills.

The Tachistoscope Test provides a measure of a child's short term visual memory, visual processing, and rate (speed) of processing abilities. This test requires both accuracy and automaticity. According to Le Berge and Samuels,⁷ accuracy and automaticity are also required for good reading achievement. Bender⁸ describes performance on this test as a picture in time of the child's maturational stage. She points out that given a short enough exposure time, the adult will begin to process the information like the child. Speed of processing is not only an impor-

tant consideration in the evaluation of a patient but also in therapy. Since the stimulus is presented all at once, the Tachistoscope Test primarily probes simultaneous processing abilities. However, since some children may rehearse the response either aloud or sub-vocalize, the test is not always purely so.

The fifth and final test utilized was the Developmental Test of Visual Motor Integration (VMI). The child is consecutively presented with 24 model geometric shapes of increasing complexity and is asked to reproduce an exact copy of each in a space provided below the model. Primarily simultaneous, but also successive, processing skills are necessary to correctly execute the VMI. Adequate fine motor control, the ability to integrate subskills into a whole, and visual conceptualization skills are requisites to reproduce the geometric forms. Developmental- behavioral parameters such as motor overflow, segmentation, and body twisting or paper tilting can also be observed while the child is drawing the picture.

In order to compare the two groups, scaled scores were utilized. A scaled score is derived from a z score. The z score is defined as the raw score minus the mean divided by the standard deviation. A scaled score is calculated by the equation: scaled score = $10 + 3z$.⁹ When $z = 0$ (i.e., the raw score equals the mean score), the scaled score is 10. In a normal distribution, this corresponds to the 50th percentile. When $z = 1$, the scaled score is 13, representing a raw score that is one standard deviation above the mean and corresponding to the 84th percentile. In this study, scaled scores and corresponding percentiles were derived from our learning-disabled population, aged 6 - 9, and were compared to the curve of scaled scores of a normally-distributed population. These scores were taken from earlier studies in which these norms were established.¹⁰

The test results of the LD children have been plotted adjacent to the normal distribution for each test (see Figures 1 - 5). The normal distribution is independent of age. The ages of the LD subjects were taken into account in the calculation of the z score. Finally, when locating an individual patient's score on the LD curve, one must keep in mind that the comparison is to an LD population of 6 - 9 years.

RESULTS

Grooved Pegboard

Thirty-six learning-disabled subjects, average age 91.8 months (SD 9.78) with a range of 74 - 108 months, were used to compile the scoring curve for the Grooved Pegboard. In all of the graphs, the curves were "smoothed" to match the normally distributed S curve. This facilitates comparison between the two curves since the locus of the curves for the LD population is more linear. Since the LD population scored more poorly, a lower scaled score (in this case 8.2) corresponded to the 50th percentile, whereas a scaled score of 10 (the 50th percentile for normal children) places the LD child at the 67th percentile. One can also see that the child would need to improve approximately two scaled score units to be at the 50th percentile for normal achievers.

Divided Form Board

Thirty-eight subjects were used to analyze LD scores for this test. The average age was 92.2 months (SD 8.2) and the range was 77 - 103 months. The 50th percentile for the LD group was a scaled score of 8.5 as compared to 10 for the normal curve. The locus of the curve (see Figure 2) is linear from scaled scores 1 - 11. After 11, it closely follows the normal curve and actually fuses with it after a scaled score of 16. It is interesting to note that in this task the scaled scores of LDs who are high achievers in this test (scaled score >15) are equally as high as the normal population for the same age. One would have expected that the performance level of the LD group would be poorer even at higher scores.

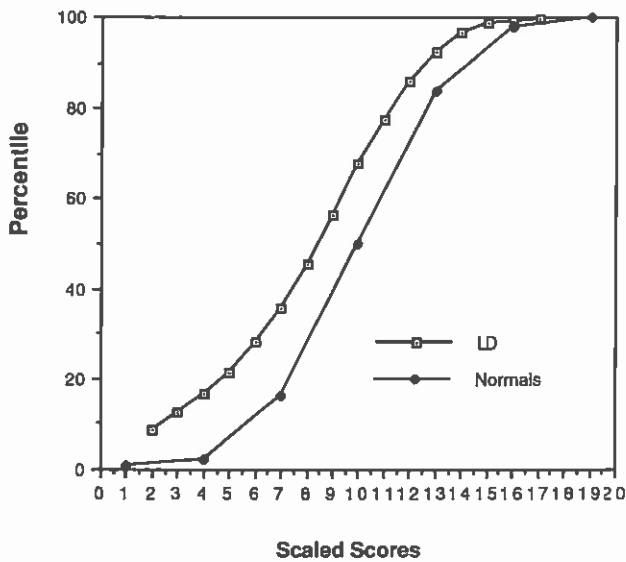
Auditory Visual Integration Test (AVIT)

Twenty subjects' scores were analyzed. The average age was 92.5 months (SD 7.8) with a range of ages between 76 and 107 months. The 50th percentile corresponded to a scaled score of 7.8. Unlike the other curves, the scores from the AVIT at the high end of the curve remained below the normal curve (see Figure 3).

Tachistoscope Test

Twenty subjects were used to formulate the LD scoring curve for the Tachistoscope Test. Mean age was 91.2 months (SD 8.0). The range of ages was 72 to 105

GROOVED PEG BOARD



DIVIDED FORM BOARD

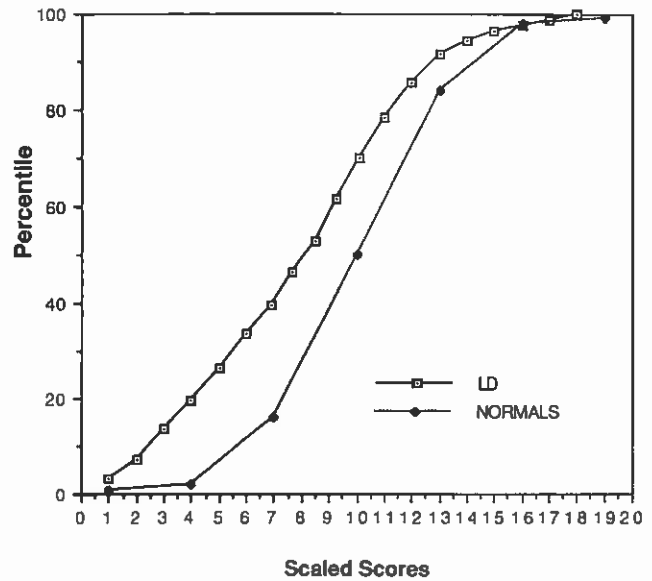


Figure 1. Results from Grooved Pegboard Test showing scaled score vs. percentile for LDs and normals.

Figure 2. Results from the Divided Form Board Test showing scaled score vs. percentile for LDs and normals.

Table 1. Data from Grooved Pegboard

scaled score (LDs)	percentile (LDs)	scaled scores (normals)	percentiles (normals)
1	3	1	1
2	10		
3	13		
4	17	4	2
5	19		
6	23		
7	33	7	16
8	47		
8.2	50		
9	57		
10	67	10	50
11	77		
12	90		
13	97	13	84
14	99		
15	99		
16	99	16	98
17	99.9		
18	99.9		

Table 2. Data from Divided Form Board

scaled score (LDs)	percentile (LDs)	scaled scores (normals)	percentiles (normals)
1	3	1	1
2	7		
3	10		
4	21	4	2
5	27		
6	33		
7	40	7	16
8	48		
8.5	50		
9	60		
10	67	10	50
11	83		
12	90		
13	93	13	84
14	95		
15	97		
16	98	16	98
17	99		
18	99.9		
19	99.9	19	99.9

Table 1. The exact scaled score and corresponding percentile for both groups on the Grooved Pegboard Test.

Table 2. The exact scaled score and corresponding percentile for both groups on the Divided Form Board Test

months. Ascaled score of 7.25 corresponded to the 50th percentile. There was a constant 2.5 - 3 scaled score units difference between the curves (see Figure 4).

Developmental Test of Visual Motor Integration (MVI)

Thirty-four subjects were tested. The

mean age was 91.6 months (SD 9.1). Two scales are presented on the abscissa in Figure 5. We deemed this necessary because raw scores are converted to standard scores in the VMI age-normed tables. The upper numbers allow for comparison of the LD and normal curves using standard scores (which is represented by 100 + 15

z), while the lower set is a comparison of the VMI scores after they have been converted to scaled score units. The use of the upper scale allows the practitioner to compare his or her LD patient's standard score to that of the normative population, and the second permits comparison with the other curves we have presented (see Figures

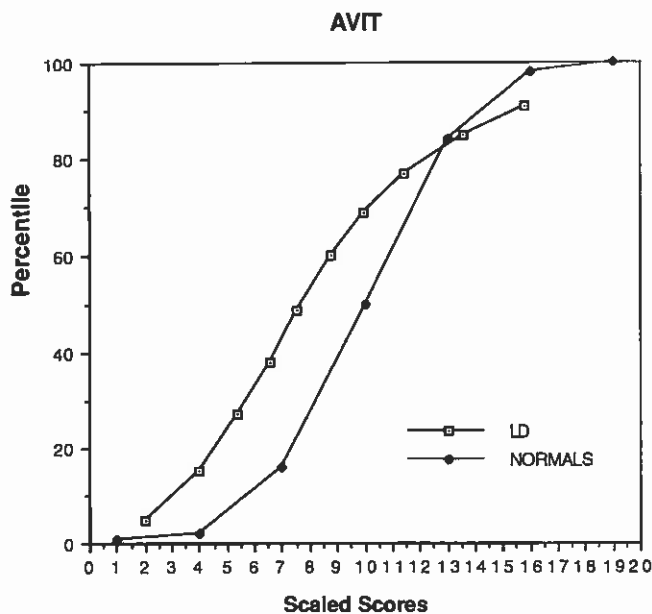


Figure 3. Results from the Auditory Visual Integration Test showing scaled score vs. percentile for LDs and normals.

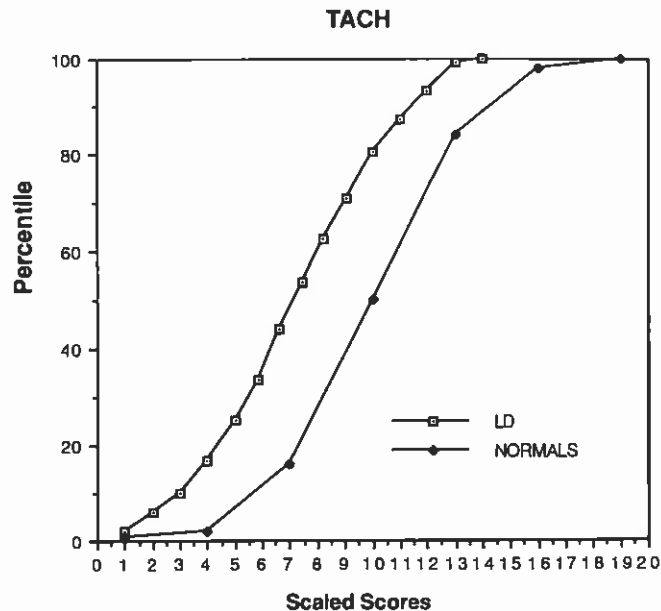


Figure 4. Results from the Tachistoscope Test showing scaled score vs. percentile for LDs and normals.

Table 3. Data from AVIT

scaled score (LDs)	percentile (LDs)	scaled scores (normals)	percentiles (normals)
		1	1
2	5		
4	15	4	2
6	25		
7	40	7	16
7.8	50		
8	60		
9	70		
		10	50
12	80		
13	85	13	84
15	90		
		16	98
18	99.9		
19	99.9	19	99.9

Table 3. Results from the Auditory Visual Integration Test showing scaled score vs. percentile for LDs and normals.

Table 4. Data from Tachistoscope Test

scaled score (LDs)	percentile (LDs)	scaled scores (normals)	percentiles (normals)
1	2	1	1
2	5		
3	8		
4	13	4	2
5	22		
6	35		
7	48	7	16
7.25	50		
8	65		
9	70		
10	78	10	50
11	91		
12	98		
13	99	13	84
14	99.9		
		16	98
		19	99.9

Table 4. The exact scaled score and corresponding percentile for both groups on the Tachistoscope Test.

1 - 4). A standard score of 82 and a scaled score of 6.4 corresponded to the 50th percentile for the LD group. Because the VMI test primarily measures sensory motor integration, a score that significantly deviates from the norm may indicate a child at risk for academic delays as well as an overall sensory integrative dysfunction.¹¹

DISCUSSION

We have compared scores of LD children ages 6 - 9 to those of normal achievers for five selected perceptual tests. Results show that the LD group performs poorer than the normal group in all five tests (see Table 6).

Also an average of the five LD means (i.e., 7.63) shows a little less than one standard deviation difference between the overall performance of the LD group as compared to the normal group. A comparison of the five tests reveals that the LD group scored the highest (i.e., closest to the norm) in the Grooved Pegboard and

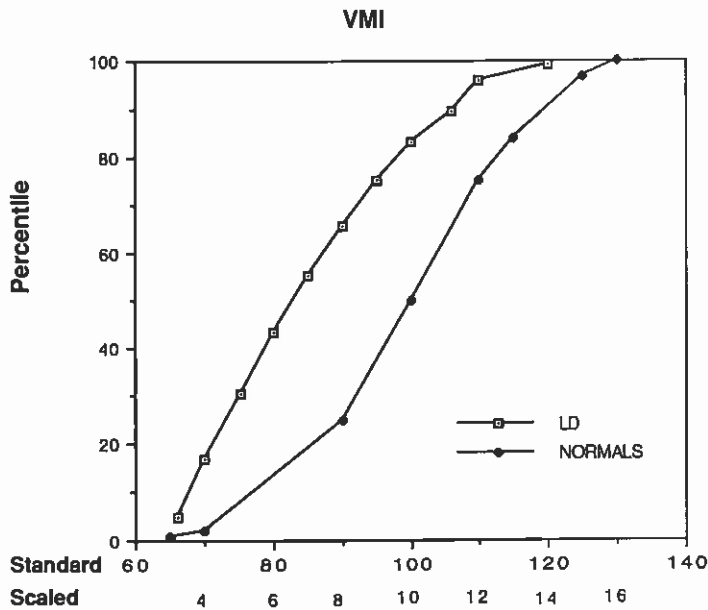


Figure 5. Results from the VMI showing scaled score vs. percentile

MEANS OF LD SCORES FOR THE FIVE TESTS

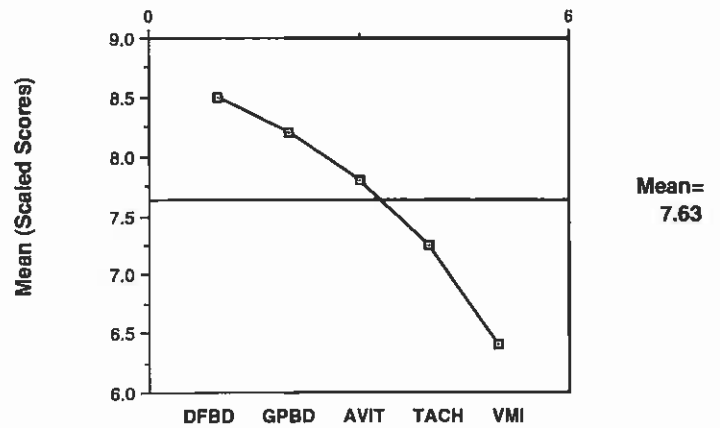


Figure 6. The mean of the scaled scores for the LD population (7.63) and the scores from each individual test.

Table 5. Data from VMI

standard score (LDs)	scaled score (LDs)	percent (LDs)	standard score (normals)	scaled score (normals)	percent (normals)
66	3.2	4	65	3	1
70	4	16	70	4	2
75	5	32			
80	6	44			
82	6.4	50		7	
85	7	56	85	8	16
90	8	68	90		
95	9	76			
100	10	84	100	10	50
105	11	92			
110	12	96	110	12	75
120	14	99.9	115	13	84
			130	16	98

Table 5. The exact scaled score, standard score and corresponding percentile for both groups on the VMI.

Table 6. Scaled Score Representing 50th Percentile of LD Group.

Test	Scaled Score
Grooved Pegboard Test	8.2
Divided Form Board Test	8.5
Auditory-Visual Integration Test	7.8
Tachistoscope Test	7.25
Devel. Test of Visual-Motor Integration	6.4
Overall Mean of five tests	7.63

Table 6. The mean (50th percentile) score for LDs for each of the five tests used with resultant mean.

the Divided Form Board Tests, with poorer performances on the AVIT, Tachistoscope Test, and VMI, respectively (see Figure 6).

The Divided Form Board and the Grooved Pegboard are the most basic of the five perceptual tests analyzed. They are primarily sensory-motor tasks and involve the least cognitive ability

of the five. The AVIT involves inter-sensory functions that are more complex than the first two. The Tachistoscope Test incorporates visual memory and perceptual speed and, finally, the VMI requires visual-motor integration with increasing cognitive demand as the test progresses. As the cognitive demands increase in the five tests and the tasks involve integration and higher level processing skills, the scores of the LD group become poorer in comparison to normal achievers.

This information confirms earlier studies¹² which suggest that in this age group, and for the LD population, simultaneous processing has not completely developed. Performance was poorest on the Tachistoscope and VMI because these two tasks demand high levels of spatial/simultaneous processing.

Lastly, we must stress that it would be inappropriate to think that an LD child is performing adequately because he or she falls in the average range for the learning disability population. The child is learning disabled and still needs to be evaluated with regard to performance on the normal curve. It also should be remembered that although the authors of this paper have elected to discuss integrative skills they are aware that numerous other motor, auditory and visual processing tasks are necessary for efficient classroom learning.

In conclusion, the data presented indicated that not only do differences exist between the LD and normal population in certain perceptual tests but also that the gap between the two groups increases as the cognitive demand increases. The comparisons between the two groups in this paper will allow the practitioner not only to compare the scores of LD children with normals but also, for the first time, be able to compare the scores with other LD children in the same age range. This permits the examiner to make a more careful assessment of the severity of the deficit and to estimate more accurately the degree of improvement necessary to bring the child to normal functioning in the particular perceptual skill. The curves also provide the doctor with the opportunity to show parents graphically the progress of their child before and after therapy.

APPENDIX A

METHODS AND PROCEDURES

1. GROOVED PEGBOARD TEST

Prior to the administration of this test, hand dominance was determined. The Pegboard (25 holes, 5 x 5 array) was placed on the table directly in front of the child, who was then shown the keyed pegs and how they fit into the grooved holes. The child was told to pick up and place one peg at a time and use only the dominant hand. The examiner pointed out the pattern of placement which was a sequential left to right placement for right-handers and right to left for left-handers. Each task was timed. The children were told to place the pegs in as fast as they could and timing began when the instructor said "Go."

2. SIX FIGURE DIVIDED FORM BOARD TEST

The child was first given the opportunity to see the board assembled and watch as the instructor disassembled the 12 pieces. A special effort was made to separate complementary pieces. No practice was provided. The child was told "Place all the pieces back in the board as fast as you can." The child's performance was timed and if timing exceeded three minutes, the test was discontinued and scored as 180+ seconds.

3. AUDITORY-VISUAL INTEGRATION TEST

The auditory stimulus was generated by tapping a pen on the edge of the table. Care was taken to insure the child could not see the examiner's hand move. One half-second pause was given between the short pauses and a full second for a long pause. The visual-spatial matches, after the first three trial cards, were not available for the child to look at until the auditory pattern was completed. The child was then shown the card and asked which dot pattern corresponded to the taps they heard.

4. THE TACHISTOSCOPE TEST

Each child was given a piece of paper with two columns labeled A and B with numbers 1 - 10 down the page. The children were tested, using a Tach-X tachistoscope located eight feet from the screen. The tachistoscope flashed two, three, or four digits. First the digits were exposed for 0.1 seconds (column A) and then for 0.01 seconds (column B). The children were instructed to look at the screen and write down in the exact order the digits flashed. Each digit recorded in the proper sequence was scored as one point.

5. DEVELOPMENTAL TEST OF VISUAL-MOTOR INTEGRATION

The child is given a pencil, preferably without an eraser. The test booklet is placed in front of the child directly centered with the child's body midline. The child is shown the first page and is told to exactly copy each figure seen in the appropriate blank space below the figure. The test may be discontinued after three consecutive failures. Further directions and scoring are provided in the VMI manual.

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Source Note

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for more information about
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