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AUTHOR	Jensen, Arthur R.; Figueroa, Richard A.
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ABSTRACT

The study sought to use Jensen's two-level theory of mental abilities to predict some hitherto unknown or unnoticed phenomena--facts about which the theory should yield clear-cut predictions and which are not as clearly predictable from other theories, though they may receive ad hoc explanations after the fact. From the two-level theory of mental abilities (Level 1: rate learning and memory, involving little or no transformation of the input; Level 2: complex cognitive processing involving transformation and mental manipulation of input) it was predicted that forward digit span (FDS) should correlate less with IQ than backward digit span (BDS), and age and race should interact with FDS-BDS, with the FDS-BDS difference decreasing as a function of age and a greater white-black difference in BDS than in FDS. The latter prediction is derived from the hypothesis that the magnitude of racial differences should be a function of the degree to which Level 2 predominates in the cognitive demands of the particular test. The predictions were substantiated at a high level of significance in large representative samples of white and black children of ages 5-12 years, who were given the Wechsler Intelligence Scale for Children (Revised). Supplementary studies found no support for rival hypotheses based on anxiety, task difficulty, and race of examiner. (Author/JM)

Forward and Backward Digit Span Interaction With Race and IQ: Predictions from Jensen's Theory

Arthur R. Jensen and Richard A. Figueroa

University of California, Berkeley

ABSTRACT

From Jensen's two-level theory of mental abilities (Level I: rote learning and memory, involving little or no transformation of the input; Level II: complex cognitive processing involving transformation and mental manipulation of input) it was predicted that forward digit span (FDS) should correlate less with IQ than backward digit span (BDS), and age and race should interact with FDS-BDS, with the FDS-BDS difference decreasing as a junction of age and a greater White-Black difference in BDS than in FDS. The predictions were substantiated at a high level of significance in large representative samples of White and Black children of ages 5 to 12 years, who were given the Wechsler Intelligence Scale for Children (Revised). Supplementary studies found no support for rival hypotheses based on anxiety, task difficulty, and race of examiner.

Forward and Backward Digit Span Interaction With Race and IQ: Predictions from Jensen's Theory[1]

Arthur R. Jensen[2] and Richard A. Figueroa

University of California, Berkeley

A philosopher of science, the late Imre Lakatos (197), built his theory of scientific progress on the central idea that the chief criterion for apprais-ing the progressiveness of theories or research programs is whether they can predict novel facts, as contrasted with merely concocting *ad hoc* interpretations of already established facts. If the predictions seem unlikely or defy common sense expectations, and then are borne out, so much the better for the theory.

In an attempt to apply this criterion to Jensen's two-level theory of mental abilities, we have sought to use the theory to predict some hitherto unknown or unnoticed phenomena--facts about which the theory should yield clear-cut predictions and which are not as clearly predictable from other theories, though they may receive *ad hoc* explanations after the fact. Whether the pre-dicted facts themselves are or are not of any immediate or practical consequence is irrelevant in this context. The aim is only to test the theory.

The original formulation of the two-level theory stated: "Level I involves the neural registration and consolidation of stimulus inputs and the formation of associations. There is relatively little transformation of the input, so there is a high correspondence between the form of the stimulus input and the form of the response output. . . . Level II abilities, on the other hand, involve self-initiated elaboration and transformation of the stimulus input before it eventuates in an overt response. . . . The subject must actively manipulate the input to arrive at the output," (Jensen, 1969, pp. 110-111). A later article (Jensen, 1970a, pp. 155-156) sharpened these definitions: "Level I ability is essentially the capacity to receive or register stimuli, to store them, and to later recognize or recall the material with a high degree of fidelity. . . . It is characterized by the lack of any need of elaboration, transformation or manipulation of the input in order to arrive at the output. . . . In human performance digit span is one of the clearest examples of Level I ability. . . . *Reverse digit span would represent a less pure form of Level I ability, since some transformation of the input is required prior to output* [italics added]. Level II ability . . . is characterized by transformation and manipulation of the stimulus prior to making the response."

In another article Jensen (1970b, pp. 52-53) notes that the Level I-Level II distinction is not based on a difference in task difficulty *per se*. The crucial difference involves the complexity of the task's cognitive demands.

Given this conceptualization of the distinction between the two hypothetical classes of abilities called Level I and Level II, it is clear, as Jensen first noted in 1970a, that forward and backward digit span must differ in the degree to which they reflect Level I and Level II ability. The ability to repeat a string of digits just as they were heard involves less mental manipulation or transformation than the ability to say the digits in the reverse of the order of presentation--the so-called backward digit span (BDS). BDS depends upon the Level I ability involved in forward digit span (FDS), but also includes a small but essential element of Level II--transformation of the input prior to the output. Thus variance in FDS and BDS must involve different amounts of Level I and Level II abilities, with BDS reflecting Level II to a greater degree than FDS.

Since, according to the theory, the g factor which accounts for most of the variance in standard intelligence tests highly reflects Level II abilities, we should then predict that (Hypothesis 1) BDS is more highly correlated with IQ than is FDS.

Jensen (1969, 1971a, 1971b, 1973b, 1974b) has also argued that the magnitude of mean differences typically found between Whites and Blacks on a variety of mental tests and scholastic performances can be explained in terms of a hypothesized difference in the distributions of Level I and Level II abilities in the two races. Figure 1 depicts the hypothesis in a schematically idealized form. (In reality tests of Level I and Level II may not be pure measures of these abilities and samples may not always be truly representative of the respective racial groups.) Evidence favoring this hypothesis has been presented in

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Insert Figure 1 about here

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other studies (Jensen, 1971b, 1973a, 1973c, 1974a, 1974b). Given this hypothesis in connection with the essential Level I-Level II distinction, we should predict that (Hypothesis 2) the mean White-Black difference is greater in BDS than in FDS, or stated in statistical terms, there is a Race × FDS vs. BDS interaction.

Another prediction from the theory, which is not tested in the present study, is that there should be an interaction of race (i.e., White-Black) with visual vs. auditory digit span, and the interaction should be magnified under conditions of delayed recall (i.e., about 10-12 seconds after presentation), with mildly

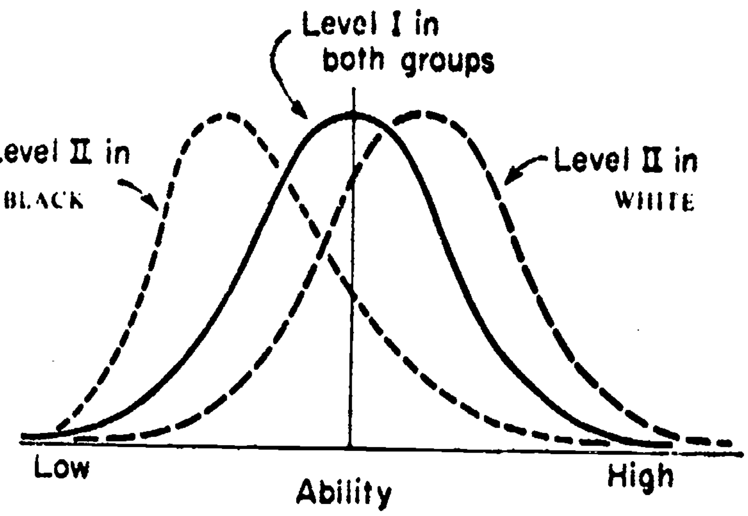

Fig. 1. Hypothetical distributions of Level I (solid line) and Level II (dashed line) abilities in White and Black populations.

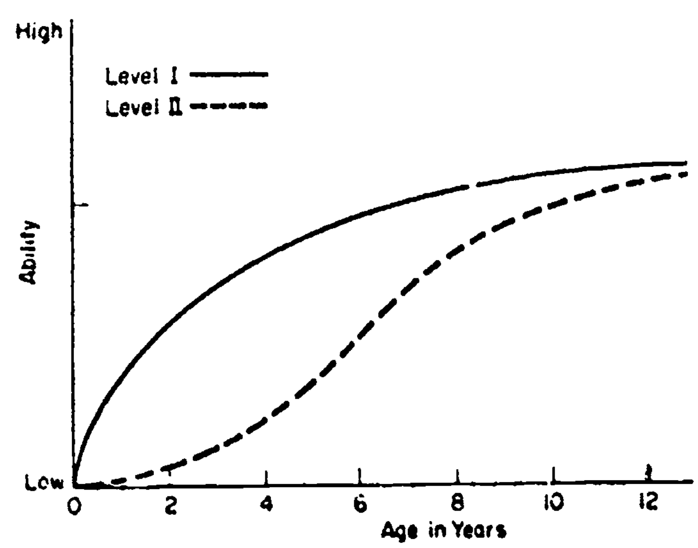

Fig. 2. Hypothetical growth curves for Level I and Level II abilities.

distracting stimuli interposed during the interval between presentation and recall. (The precise experimental procedures are detailed by Jensen, 1971.) Blacks should perform relatively less well on visual than on auditory digit span tests. This prediction is based on the theory, which is supported by many lines of evidence (see Jensen, 1971c), that visual digit span involves transforming or encoding the visual stimuli into an auditory short-term memory storage, while auditory stimuli go directly into the auditory storage without need of transformation. Thus visual memory span would involve slightly more Level II than auditory memory span, and therefore visual span should correlate more than auditory span with IQ. This prediction awaits an experimental test.

Jensen, (1969, pp. 115-116) has also hypothesized different growth curves as a function of age, for Level I and Level II, as depicted in Figure 2. It

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Insert Figure 2 about here

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can be seen that the disparity between Levels I and II decreases with increasing age between early childhood and maturity. From this we should predict that (Hypothesis 3) there is an interaction between age and FDS vs. BDS, with the difference between FDS and BDS decreasing with age. Since it has also been hypothesized that the Level II (but not Level I) growth curves of Whites and Blacks increasingly diverge from early childhood to maturity, with Whites having the more accelerated curve, we should expect to find a significant triple interaction of race × age × FDS vs. BDS. The simple interaction of race × age follows from the theory, but, as it is based on the combined FDS + BDS scores and is tested against the error term of subjects within race within ages, it should be very hard to detect in the present study. After all, BDS is a quite impure measure of Level II and could even be much more highly loaded on Level I. All we can be sure of from prior theoretical considerations is that BDS must involve Level II more than does FDS.

Method

Subjects

The data of the main study are based on large random and representative samples of White and Black children in approximately equal numbers from ages 5 years 0 months to 11 years 12 months in California schools. To achieve the random samples, 98 school districts were selected at random from among all the school districts in California. This sampling was done in such a way that the probability of any school district's being selected was related to the number of pupils of the particular racial group being sampled who were enrolled in that district. Within each district a single school was picked at random, and within each school one male and one female child was picked at random from each of the grades from K through 6. Thus the largest sample selected from any one school was 14. This entire randomization procedure was applied independently to the selection of the White and Black samples, with total Ns of 669 and 621, respectively. Other refinements of the sampling procedure used here to achieve highly representative samples of the child populations in the respective ethnic groups are described in detail elsewhere (Mercer, 1972; Figueroa, 1975).

Studies supplementing the main study were conducted with large representative samples of White and Black elementary school children in two California districts--Bakersfield and Berkeley.

Tests

The Wechsler Intelligence Scale for Children-Revised (WISC-R) was individually administered according to the standard procedures described in the test manual (Wechsler, 1974) by trained psychometrists to all Ss in the main study. The tests for forward digit span (FDS) and backward digit span (BDS) are supplementary subscales of the WISC-R. In FDS the tester reads aloud digit series of from three to nine digits, paced at one second per digit, and the child is asked to repeat the series. Two trials are given on each series and one raw score point is given for each series repeated correctly. BDS has series of from two to eight digits, which the S must repeat in reverse order, and is scored in the same manner.

Results and Discussion

The WISC-R raw scores on FDS and BDS were separately converted to standard scores, each scaled to a mean of 10 and standard deviation of 3 within each 4-month age interval from age 5 years 0 months to 11 years 12 months. With age-standardized scores, the statistical analyses can be applied to the total sample of all ages combined, thus making possible the most powerful tests of the first two hypotheses.

Hypothesis 1 states that BDS is more highly correlated with IQ than is FDS.

Table 1 shows the correlations of the WISC-R Verbal IQ, Performance IQ, and Full Scale IQ with FDS and BDS in the White and Black samples. Hotelling's t test (one-tail) for nonindependent correlations was used to test the significance of the predicted difference between BDS-FDS (Walker & Lev, 1953, pp. 256-257). (The digit span subtests are not included in the IQs.) The Verbal,

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Table 1

Correlations of Forward (FDS) and Backward (BDS) Digit Span with WISC-R IQs

	White			Black		
IQ	FDS	BDS	*t*[1]	FDS	BDS	*t*[1]
Verbal	.33	.39	1.38	.28	.40	2.84**
Performance	.22	.28	1.52	.26	.40	3.43***
Full Scale	.31	.38	1.69*	.30	.45	3.61***

[1] Hotelling's *t*. (See Walker & Lev, 1953, pp. 256-257.)

One-tail test:

* $p < .05$

** $p < .01$

*** $p < .001$

Performance, and Full Scale IQs all show higher correlations with BDS than with FDS, in both White and Black samples, though the correlational differences are nonsignificant at the .05 level for the Verbal and Performance IQs in the White group.

The larger differences between the correlations in the Black than in the White sample were not predicted but are consistent with previous findings that Level I and Level II abilities (in this case FDS and IQ, respectively) are less highly correlated in the Black than in the White population (Jensen, 1973a, 1974a). Thus one should expect the correlations of FDS and BDS with other variables to behave more independently of one another in the Black than in the White population. In the present samples, however, the White and Black correlations (.31 and .30, respectively) between FDS and Full Scale IQ, though in the expected direction, are not significantly different.

A corollary hypothesis is that the difference BDS-FDS should be positively correlated with IQ. This was found to be the case, although because difference scores for such short tests are highly unreliable, the correlations between the scaled scores BDS-FDS and Full Scale IQ were found to be low. For Whites the correlation is +.06, 1-tailed $\underline{p} < .05$, for Blacks, +.12, $\underline{p} < .001$. Thus in the Black as well as in the White group, the difference between backward and forward digit span is positively correlated with IQ.

It is instructive to look at the correlations of FDS and BDS with IQ when each span is held constant (i.e., statistically partialed out). When this is done, the partial correlations of FDS and BDS with Full Scale IQ are .22 and .31 ($\underline{t} = 2.13$, $\underline{df} = 666$, 1-tail $\underline{p} < .02$) for Whites and .18 and .39 ($\underline{t} = 4.59$, $\underline{df} = 618$, 1-tail $\underline{p} < .001$) for Blacks. Thus in both groups BDS is significantly more correlated with IQ than is FDS, in accord with the hypothesis. (The partial correlation between FDS and BDS, holding IQ constant, is .23 for Whites and .24 for Blacks, a nonsignificant difference [$t < 1$].)

Hypothesis 2 states that Blacks show a greater difference between BDS and FDS than Whites. Table 2 gives the means and SDs of the digit spans and IQs in the Black and White samples, and the group differences expressed in σ units (i.e., mean difference/square root of the within-groups variance), to permit direct comparisons. The IQ scales show the approximately one standard deviation White-Black difference typically found, with a negligible difference

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Insert Table 2 about here

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between the Verbal and Performance scales. As predicted, BDS shows a larger (more than double) White-Black σ difference than FDS. FDS is less than one-fourth the magnitude of the IQ difference, while BDS is greater than one-half the IQ difference between the races. To test the significance of this interaction of forward and backward digit span with race an analysis of variance was performed on the scaled scores. The sources of variance in this ANOVA are: Race, Subjects Within Race, Race × FDS vs. BDS, and Residual (i.e., Subjects × FDS vs. BDS within Race). (Since the scaled score means are the same for FDS and BDS, there can be no main effect for digit span; and of course age is eliminated as a factor.) The hypothesis is tested by the Race × FDS vs. BDS interaction term, which turns out to be highly significant ($F = 14.05$, $df = 1, 1289$, $p < .001$). Thus the second hypothesis is strongly confirmed. An ANOVA was also performed on the raw scores for digit span, which then includes the factors of age (7 groups in 1-year intervals) and FDS vs. BDS, and their interactions. For raw scores, the predicted interaction of Race × FDS vs. BDS is highly

Table 2

Means, Standard Deviations, and Sigma (σ) Differences

Between Whites and Blacks on Digit Span[1] and IQ

	Forward DS		Backward DS		Verbal IQ		Performance IQ		Full Scale IQ	
Race[2]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
White	10.75	3.01	11.01	2.99	102.13	14.44	103.99	13.64	103.24	13.79
Black	9.98	3.01	9.32	2.97	88.00	13.58	89.63	13.58	87.77	13.07
σ Difference	0.25		0.57		1.01		1.05		1.15	

[1] Scaled Scores, $\bar{X} = 10$, $\sigma = 3$.

[2] White $N = 669$, Black $N = 621$.

significant ($F = 8.38$, $df = 1, 1276$, $p < .001$).

Hypothesis 3 states that forward and backward digit span interact with chronological age in such a way that the difference between BDS and FDS decreases with age. This prediction is substantiated. The mean raw score differences of BDS-FDS over seven age groups in one-year intervals from age 5-0 to 11-12 are: 2.71, 2.48, 1.84, 2.14, 2.08, 1.94, 1.77. The ANOVA shows a highly significant decreasing linear trend ($F = 4.04$, $df = 6, 1276$, $p < .001$). The overall Race × Age interaction is nonsignificant ($F < 1$), i.e., the races are roughly parallel in the growth curves of total digit span. The triple interaction of Race × Age × FDS vs. BDS, however, is significant ($F = 2.22$, $df = 6, 1276$, $p < .05$), and reflects the Blacks' relatively lesser convergence of forward and backward digit span with increasing age.

Supplementary Studies

Anxiety Hypothesis. A possible rival hypothesis is that the observed effects are the result of greater anxiety or distractability in the Black children, which could differentially interfere with performance on forward and backward digit span. If (*a*) BDS is more adversely affected by anxiety than FDS, and (*b*) if IQ test performance is also hindered by anxiety, and (*c*) if Blacks are generally more anxious than Whites, then we should predict that (*a*) Whites exceed Blacks in total digit span, (*b*) Blacks are relatively lower in BDS, and (*c*) Blacks show a higher correlation than Whites between digit span and IQ and a relatively higher correlation for BDS than for FDS. This is what was found. The interaction of Age × FDS vs. BDS can be predicted from the anxiety hypothesis if we make the additional assumption that anxiety decreases between ages five and twelve.

So how are we to decide between the Level I-II theory and the anxiety theory in interpreting these results?

It has been reported frequently in the clinical literature that anxiety has a greater adverse effect on digit span than on any of the other subtests of the Wechsler (e.g., Payne, 1961, p. 233). In fact, a low digit span score, relative to the other Wechsler subscales, is generally interpreted as an anxiety indicator. This being the case, if Blacks were more anxious than Whites one should expect Blacks' performance on digit span to be among their lowest scores, whereas in fact they do better on digit span than on any of the other subtests which are less affected by anxiety.

Are Blacks in general more anxious than Whites? In a large sample of school children in grades 4 to 8 Jensen (1973d) found a small but significant White-Black difference in the *N* scale of the Junior Eysenck Personality Inventory, which is an anxiety scale similar to and highly correlated with Taylor's Manifest Anxiety Scale. But the Whites had the slightly higher score (less than 1 point). Moreover, the *N* scale showed nonsignificant and negligible correlations with verbal and nonverbal IQ in both racial groups. But a review of research on the relationship between anxiety and performance on the Wechsler scales found little consistent evidence of a relationship between digit span and the kind of trait anxiety measured by questionnaires; however, the literature shows quite consistently that digit span performance is related to *state* anxiety (Matarazzo, 1972, pp. 445-6). "State anxiety" (also called "situational anxiety") is anxiety aroused in a specific situation, as contrasted with a more or less chronic disposition (called "trait anxiety"). If this is the case, the anxiety hypothesis cannot be properly tested by using a self-report inventory of trait anxiety. There is another possible drawback to scores on a personality inventory: they can be adventitiously correlated with IQ without there being any direct causal connection between the personality trait and intelligence test performance. For example there is a significant negative correlation between IQ and the Lie scale of the Eysenck Personality Inventory (Jensen, 1973d); and Gough (1953) has devised a "nonintellectual intelligence test" wholely out of personality inventory items which correlate with IQ without any implication that changing the personality traits involved would alter the IQ.

The only satisfactory recourse is to rely on the construct validity of state anxiety for devising a test situation in which the effects of state anxiety should be manifested and then see if the predicted effects are borne out. This was our approach. Reviews of the literature on the effects of state anxiety on test performance (e.g., Matarazzo, 1972, pp. 443-8) suggest that it operates through such mechanisms as emotionality, excitability, inattentiveness, and distractability. The anxious subject's emotions interfere with his giving his full attention to the immediate required task, and his efficiency is thereby reduced. State anxiety therefore especially affects timed tests in which the efficiency of the subjects' mental activity in utilizing the time available is an important aspect of performance.

Our aim, then, should be to administer the very same Level I test, such as forward digit span, under two different conditions, one of which should magnify the interfering effect of state anxiety. In a previous study (Jensen, 1965) it was found that any enforced delay in the recall of a series of digits resulted in fewer digits being recalled than if recall immediately followed the presentation of the digit series; this was true only if a distracting stimulus was interposed during the delay interval between presentation and recall. Without interposed distraction, subjects use the delay interval for rehearsal and consolidation of the presented material, and this improves recall. Under non-distracting delay in recall, provided the delay is not too long, the short-term memory trace is protected to some degree from "output interference," i.e., the loss of the latter part of the digit series as a result of having to recall the first part.

Since state anxiety is manifested as distractability in the test situation, it should act as an interposed interference in delayed recall, and consequently one should predict that the digit span performance of more anxious subjects should benefit less from delayed recall (as compared with immediate recall) than the performance of less anxious subjects. The hypothesis that Blacks are more anxious than Whites thus yields the prediction that the White-Black difference in digit recall should be greater under the condition of delayed recall than under immediate recall.

This prediction was tested on large random samples of White and Black children in two California school districts, Bakersfield and Berkeley, henceforth called Districts A and B. The data from the two districts can be viewed as independent replications of the experiment. District A provided a total of 1,852 White and 1,476 Black Ss about equally apportioned in Grades 2 through 8. District B provided a total of 2,615 White and 2,134 Black Ss about equally apportioned in Grades 2 through 6.

A group-administered FDS test, given by means of a tape recording to insure uniformity of pacing, etc., presented digit series of 4 to 9 digits. Ss wrote their responses on specially prepared answer sheets. (Each digit recalled in the correct position is scored 1 point. Thus the highest possible score on the test is $4 + 5 + \ldots + 9 = 39$.) Both the immediate (I) and the delayed (D) recall tests were preceded by three practice series of 3 digits each. Every S received both I and D conditions. A "bong" signaled the beginning of every series and also the time for recall. In the immediate recall condition the "bong" always came 1 second after the last digit in the series. In the delayed recall condition the "bong" came 11 seconds after the last digit. Ss were required to keep "pencils up" during the interval between the initial and final "bongs."

The main digit recall scores and the White-Black differences for the two school districts are shown in Table 3. Since all of the differences, though

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Insert Table 3 about here

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of practically negligible magnitude, are opposite to what is predicted by the anxiety hypothesis, no statistical tests of significance are called for. In both school districts, the White-Black difference is slightly less under delayed than under immediate recall. (The populations in the two districts show marked demographic differences which are undoubtedly related to the absolute size of the White-Black differences, but these factors are not relevant to the hypothesis under consideration.) These data, then, contradict the hypothesis that memory span is more affected by anxiety in Blacks than in Whites.

Task Difficulty. It might be argued that anxiety is aroused specifically by more difficult tasks, regardless of their loadings on Level I and Level II processes. But in Jensen's theory there is an important conceptual distinction between difficulty and complexity. Complexity implies the need for more mental manipulation and transformation of the input. We may ask, do Blacks perform relatively poorly on BDS because it involves more Level II than does FDS, or simply because it is more difficult, in the sense that there is lower probability of success? In this sense a long FDS series is more difficult than a short FDS. If difficulty *per se* were the cause of the interaction of Race × FDS vs. BDS, we should expect a similar interaction between Race and short vs. long FDS series.

We have looked at this by scoring FDS performance separately for digit

Table 3

Mean Digit Recall Under Immediate and Delayed Recall Conditions

	District A[1]: Grades 2-8		District B[2]: Grades 2-6	
Race	Immediate Recall	Delayed Recall	Immediate Recall	Delayed Recall
White	20.29	20.74	20.80	21.98
Black	19.28	19.78	16.77	18.02
W-B	1.01	0.96	4.03	3.96

[1]*N* = 1,852 Whites, 1,476 Blacks.

[2]*N* = 2,615 Whites, 2,134 Blacks.

series lengths 4, 5, 6 vs. series lengths 7, 8, 9 in the records of 100 Black and 100 Whites *Ss* selected at random from the 11-12 age group of District A. The mean White-Black difference for digit series of 4, 5, 6 is 0.12; for series of 7, 8, 9 the White-Black difference is 0.13. The interaction of race × series length is nonsignificant ($F < 1$). But since the variances of short and long series differ, the White-Black differences should be expressed in units of the average standard deviation within each series length. The White-Black differences for the short and long series then are .089 and .075, respectively. Though nonsignificant, the race differences are in the opposite direction to the corresponding differences found for FDS and BDS. Therefore, it does not appear that difficulty level *per se* is a determining factor in the interaction of race and forward-backward digit span.

Race of Examiner. Being tested by a person of a different race from one's own is a conceivable cause of anxiety. Yet studies have failed to demonstrate any significant interaction of race of tester × race of subject on either intelligence tests or digit memory tests (Jensen, 1974c). To investigate this point specifically for individually administered digit span, which was the case in the WISC-R used in our main study, a Black and a White psychometrist individually administered FDS tests with immediate and delayed recall to equal numbers of White ($N = 93$) and Black ($N = 80$) children taken at random from District B classrooms in Grades 2 through 6, with roughly equal *Ns* in every grade. An ANOVA was performed within each grade level to test the significance of the Race of Tester × Race of Subject interaction. In every grade the interaction was quite insignificant ($F < 1$). It therefore seems very unlikely that the race of the testers had any significant influence on the WISC-R data of the main study.

Summary

Jensen's two-level theory of mental ability gives rise to the rather unlikely predictions that, since backward digit span involves more mental manipulation or transformation of input than forward digit span, BDS should be more loaded on Level II and therefore should be more highly correlated with general intelligence as indexed by IQ; and, since Level II ability is later in developing than Level I ability, the difference between forward and backward digit span should decrease with age over the range from 5 to 12 years. These predictions were fully borne out in large representative samples of White and Black children. In addition, since many studies have shown Whites and Blacks to differ in measures of general intelligence (e.g., Shuey, 1966), and Jensen has argued that the magnitude of such differences is a function of the degree to which Level II processes predominate over Level I processes in the cognitive demands of the particular test, it was hypothesized that Whites and Blacks should differ more in backward digit span than in forward digit span. This predicted interaction of race and forward vs. backward digit span proved highly significant.

Supplementary data were brought to bear on the possibility that this outcome might be due to greater situational anxiety in the Blacks. But no evidence for this hypothesis was found in a test situation in which such anxiety, if it existed, could reasonably be expected to have a significant effect. Moreover, a difference in task difficulty *per se* was shown to be an unlikely explanation of the results. Nor was there evidence of a significant influence of the race of the tester on memory span scores. The interactions of certain other WISC subtests with race might be explained in terms of differences in the experience or cultural background of Blacks and Whites. But it is hard to imagine how that kind of explanation would apply to forward and backward digit span.

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