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■ **Factors in Performance on the  
Law School Admission Test**

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■ **Law School Admission Council  
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## **EXECUTIVE SUMMARY**

Typically, a test—such as the Law School Admission Test (LSAT), the primary focus of this study—employs more than one type of item and/or different kinds of content for a given item type. For these multi-faceted measures, the extent to which the different types of test questions tap different aspects of a particular ability, or in fact tap several different abilities, needs to be assessed. In the case of the LSAT, as presently constituted, this issue does not appear to have been resolved. As described in Section 1 of the main report, this study was undertaken to clarify the internal structure of the LSAT, and shed light on the nature of the ability or abilities measured by the three types of test items that make up the LSAT—that is, reading comprehension, logical reasoning, and analytical reasoning.

The study drew on data for two different forms of the LSAT, namely, the June 1991 form and the October 1991 form. For broader perspective, the study also used data from the same two LSAT administrations, for a subsample composed of LSAT examinees identified through file-matching procedures as having taken the Graduate Record Examinations (GRE) General Test, between October 1988 and December 1991, inclusive. Time interval between GRE and LSAT testing occasions, without regard to order, ranged from five days to 36 months.

Items of the same types as those used in the current version of the LSAT have been included in all editions of the GRE General Test since October 1981. Thus, it was possible to draw on the substantial body of evidence generated in the GRE context regarding relationships among these item types. This research is reviewed in Section 2 of the report. Section 2 also includes information pointing up (a) strong similarities in the "surface characteristics" of the three item types as reflected in descriptions of the three item types in testing program publications, and illustrative items from the LSAT and the GRE, as well as (b) differences between the LSAT and the GRE with respect to internal organization of test items, number of sections, and so on.

Within the joint LSAT/GRE sample it was possible to

- (a) conduct parallel within-test analyses of correlations among the three item types,
- (b) assess time-related attenuating effects in patterns and levels of between-test correlations involving scaled scores and specially computed item-type subscores for the three common item types, and ultimately, by using combined data from both the LSAT and the GRE,
- (c) assess the extent to which patterns of correlations involving parcels of items of three types common to both tests in the combined LSAT/GRE sample were similar to those identified in the two separate within-test analyses.

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A series of related analyses, was undertaken.

First, separate analyses were made of within-test correlations involving primarily scores on item-type parcels (sets of four to six items of the same type) using

- (a) LSAT data for a general sample of LSAT examinees and for the selected sample, alluded to above, of LSAT examinees who also took the GRE General Test (see Section 3), and
- (b) GRE data for the selected LSAT/GRE sample, as reported in Section 4.

A unique feature of the study was the method of pooling different items of the same type and position across multiple forms to create parcels used to generate correlations for analysis.

Findings were generally parallel for the separate exploratory within-test factor analyses based on parcels of items of the three types common to both tests. In each analysis, when two factors were extracted, LSAT logical reasoning and reading comprehension items defined one factor, while LSAT analytical reasoning parcels defined the other. In the case of the LSAT, findings for the selected sample who took the GRE were in all essential respects similar to those for the general sample.

These parallel within-test findings suggested in both tests these item types measure psychometrically distinguishable aspects of reasoning ability: aspects of general or informal reasoning, defined by reading comprehension items and logical reasoning items, on the one hand, and aspects of formal, deductive reasoning, defined by analytical reasoning items, on the other.

Next, analyses were made of between-test correlations involving reported, scaled scores and specially computed item-type section scores. These analyses (described in detail in Section 5) were designed in part to assess effects associated with the fact that the LSAT observations and the GRE observations were collected on different testing occasions separated by intervals ranging from less than 10 days to 36 months. The between-test analyses included assessment of time-related effects on between-test correlations involving the three item types common to both tests.

In these analyses, profiles of correlations involving LSAT item types and their GRE counterparts, computed for shorter-interval (between tests) and longer-interval subgroups (< 10 days versus 19-36 months) were found to be strikingly similar with respect to pattern. They differed only with respect to level.

Results of the analysis of between-test correlations—observed and corrected for attenuation due to the presence of measurement error—involving item types common to both tests were consistent with the findings of the separate within-test factor analyses. In both instances findings suggested psychometrically distinguishable differences between aspects of general or informal reasoning measured by reading comprehension and logical reasoning item types, on the one hand, and aspects of formal, deductive reasoning tapped by the analytical reasoning items, on the other.

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Last in the series of analyses, as described in Section 6, intercorrelations involving the combined set of LSAT and GRE logical reasoning, reading comprehension, and analytical reasoning item-type parcels were analyzed. The sets of LSAT and GRE parcels used in the two separate analyses were combined to produce intercorrelations for these analyses. The eigenvalues suggested that two factors, one defined primarily by LSAT and GRE logical reasoning and reading comprehension parcels and the other by LSAT and GRE analytical reasoning parcels, sufficiently characterized the correlational structure for the combined parcels.

### Some Implications

In essence, the study findings suggest a common underlying structure for logical reasoning, reading comprehension, and analytical reasoning item type regardless of the test (LSAT or GRE) in which they are used. The structure appears to involve two dimensions. One dimension is represented by logical reasoning and reading comprehension item types measuring general reasoning skills that appear to be associated with the analysis of extended discourse. The other dimension represents a more narrowly constrained, formal-deductive aspect of reasoning, measured by the analytical reasoning item type.

For the LSAT, which currently reports only a single score to summarize performance involving three different item types, perhaps the most central conclusion supported by the findings is that

- the logical reasoning, reading comprehension, and analytical reasoning item types included in the LSAT, have potential to generate more information than is now being conveyed by the single LSAT scaled score.

That potential is suggested by the finding that the LSAT item types measure psychometrically distinguishable aspects of reasoning ability. This raises the attendant possibility that the information provided by item-type subscores might prove to be useful for predictive or diagnostic purposes in the LSAT context.

Questions concerning differential and/or incremental validity of subscores that might be computed are of immediate interest. For example, one score based on logical reasoning and reading comprehension items and a second score based on the analytical reasoning items would be consistent with the basic two-factor outcomes. Would the use of two scores, or perhaps a score for each LSAT item type, result in improved prediction of first-year law school grades generally, grades in particular courses or clusters of courses, grades in second-year courses?

A study of the comparative validity of LSAT subscores such as those noted above, for predicting such criteria—in general samples, and in samples defined by ethnic group membership, age, gender, undergraduate major, and so on—would contribute toward resolution of academically, psychometrically, and socially important "differential validity" questions in the current LSAT context.

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Closely related to the foregoing are questions concerning incremental validity. For example, does differential weighting of item-type subscores result in better prediction of pertinent criteria (for example, grades in successive years of legal education), than is provided by a total scaled score based on a simple sum of section scores, in general samples of law students? In subgroups defined by ethnicity, gender, age, undergraduate major, and so on?

Study findings indicate that between-test correlations involving LSAT reading comprehension, logical reasoning, and analytical reasoning subscores and corresponding GRE subscores are differentially resistant to time-related attenuating influences. These findings suggest the possibility of differences in relative stability for the abilities involved. In the present study, inferences about relative stability, of course, are based on between-test correlations for the respective item-type subscores. It seems important to make a direct assessment of test-retest stability, short- and long-term, for LSAT item-type subscores.

These and other study findings have incidental implications for the GRE context. For example, the findings tend to confirm and extend conclusions based on GRE studies, namely, that logical reasoning items and analytical reasoning items are measuring psychometrically distinguishable aspects of reasoning ability. Thus, research questions such as those raised above for the LSAT, also have implications for continued research in the GRE context.

That LSAT logical reasoning, reading comprehension, and analytical reasoning items and their GRE counterparts have a common factor structure is important because this finding suggests that future research involving these item types in the LSAT context can draw on relatively extensive GRE research findings (such as those summarized briefly in Section 2 of the main report) both for formulating working hypotheses and for evaluating LSAT research outcomes. It also follows that as LSAT research findings involving these item types accrue, the LSAT findings in turn can usefully inform research in the GRE context.

Jointly planned research projects involving item types common to both tests might expedite attainment of objectives common to both testing programs—for example, clarifying distinctions between logical reasoning and reading comprehension.

In this connection, given the observed affinity between logical reasoning and reading comprehension—combined with hints of distinctiveness—it is noteworthy that the version of the logical reasoning item type considered in this study for both the LSAT and the GRE involves heavy reading comprehension requirements.

Accordingly, logical reasoning and reading comprehension are "linked" to some degree by heavy reading demands. To the extent that it is possible to measure "logical reasoning" using item types with limited reading demands, progress may be made in clarifying distinctions between "logical reasoning" and "reading comprehension," by cooperative research projects involving experimental logical reasoning and analytical reasoning items, and operational items from both tests, along lines followed in GRE research conducted by Emmerich, Enright, Rock, and Tucker (1991), for example.

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In reaching decisions regarding score definition and score reporting, the results of this study involving data from both tests, suggest that both testing programs might benefit from research projects capitalizing on the common structure that appears to underly performance on the three types of items that are common to both the LSAT and the GRE General Test.





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## ABSTRACT

This study was undertaken to clarify the internal structure of the Law School Admission Test (LSAT), and shed light on the ability or abilities measured by the three item types that make up the test (logical reasoning, analytical reasoning, and reading comprehension). The study used data for two forms of the LSAT in (a) general samples of LSAT examinees, and (b) a subsample of LSAT examinees identified as having also taken the GRE General Test (GRE), which includes the three item types that make up the LSAT.

Within the joint LSAT/GRE sample, it was possible to conduct separate, parallel factor analyses of parcels of item types common to both tests, assess time-related effects on between-test correlations, and analyze factor structure underlying performance on combined LSAT and GRE parcels of logical reasoning, analytical reasoning, and reading comprehension items. Unique features of the study were (a) the use of data from both the LSAT and the GRE General Test to assess structure in item types common to both tests, and (b) the method of pooling different items of the same type and position across multiple test forms in order to create parcels used to generate correlations for analysis.

Study findings suggested a similar structure for logical reasoning, analytical reasoning, and reading comprehension item types, regardless of the test (LSAT or GRE) in which they are used. The structure entails two dimensions—one involving aspects of general reasoning as measured by logical reasoning and reading comprehension item types, and the other more narrowly constrained, formal-deductive aspects of reasoning tapped by the analytical reasoning item type.

Implications of the findings are discussed.



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At ETS, several colleagues contributed to the project. The critical task of matching LSAT files with GRE files in order to identify LSAT examinees who also had taken the GRE was completed by Nancy Robertson. James Ferris provided "common structure" for a file containing differentially ordered sets of GRE items from 37 different test administrations involving 21 generic forms of the GRE General Test. Ned Walthall and Manfred Steffen provided internally generated LSAT-related materials; Elana Broch, Raymond Thompson, and Karen Wisnia provided a variety of GRE-related materials. Very helpful reviews of a draft of this report were provided by Neil Dorans and Spencer Swinton.

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# FACTORS IN PERFORMANCE ON THE LAW SCHOOL ADMISSION TEST

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## SECTION 1. INTRODUCTION

The Law School Admission Test (LSAT) is described (Law School Admission Services, 1991, p. 2) as being designed

". . . to measure skills that are essential for success in law school: the ability to read and comprehend complex texts with accuracy and insight, organize and manage information and draw reasonable inferences from it, reason critically, and analyze and evaluate the reasoning and argument of others. These skills are typically developed over a long period of time. The LSAT provides candidates and law schools with a useful measure of a candidate's ability to handle new information, using well-developed reading skills and careful and logical thought as the principal tools."

The skills alluded to above are assessed operationally by three different types of multiple-choice test questions or items, labelled, reading comprehension, analytical reasoning, and logical reasoning, described (for example, LSAT, 1991), as follows:

- Reading comprehension questions require test takers to read carefully and accurately, to determine the relationships among the various parts of the passage, and to draw reasonable inferences from the material in the passage.
- Each logical reasoning question requires the examinee to read and comprehend the argument or the reasoning contained in a short passage, and then answer one or two questions about it. The questions test a variety of abilities involved in reasoning logically and critically (including, for example,) drawing reasonable conclusions from given evidence or premises.
- Analytical reasoning items are designed to measure the ability to understand a structure of relationships and to draw conclusions about the structure. The examinee is asked to make deductions from a set of statements, rules, or conditions that describe relationships among entities such as persons, places, things, or events.

These three item types have been used in all forms of the LSAT developed since 1982, and are treated operationally as measuring related aspects of one general underlying ability. For example, test performance is summarized by a single, LSAT scaled score based on the total number of correct responses to test items, without regard to type.

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## Purpose of the Present Study

If a test employs more than one type of item and/or different kinds of content for a given item type, the extent to which the different types of test questions tap different aspects of a particular ability, or in fact tap several different abilities, needs to be assessed. In the case of the LSAT as presently constituted, this issue does not appear to have been resolved.<sup>1</sup>

The present study was undertaken to clarify the internal structure of the LSAT, and shed light on the ability or abilities measured by LSAT reading comprehension, logical reasoning, and analytical reasoning item types. The study drew on data from two regularly scheduled LSAT administrations, namely, the June 1991, and October 1991 administrations.

For broader perspective, the study also draws on data for a subsample from the same two LSAT administrations, composed of LSAT examinees identified as having also taken the GRE General Test (for example, ETS, 1990) between October 1988 and December 1991. Using data for this selected sample it was possible to conduct parallel within-test analyses involving item types common to both tests, examine between-test correlations involving scaled scores and specially computed item-type subscores, and ultimately to identify factors underlying performance on parcels of items of three types that are common to both tests, using combined LSAT and GRE data.

The study also drew on the substantial body of evidence regarding relationships among these item types based on research in the GRE context (to be reviewed later) involving GRE reading comprehension, logical reasoning, and analytical reasoning items similar to those used in the LSAT. These three item types have been included in all editions of the GRE since October 1981.

Detailed descriptions of study data and the analytical procedures used to attain study objectives, as well as related findings, are provided in the remaining sections of this report. A general overview of the organization of the report and the general analytical approach employed in the study, is provided below.

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<sup>1</sup> A review of Volumes I-IV of Reports of LSAC Sponsored Research (LSAC, 1976a, 1976b, 1977, 1984) reveals only one study (Carlson, 1976b)--authorized by the LSAC in 1966 and reported in 1970--concerned with identifying the factor structure of an extant version of the LSAT in order to answer the question: What are the abilities being measured by LSAT items? According to Carlson (p. 12), "It was hoped that a classification of items based on abilities would provide a useful supplement or alternative to the present classification based on item type . . ." Carlson factored matrices of interitem coefficients for items of the eight different types included in the 1966 version of the LSAT, and identified seven factors. The first factor, called "verbal ability," was defined primarily by reading comprehension items; the second factor, called "verbal inductive reasoning," was defined primarily by a subset of "Principles and Cases" items. The "Principles and Cases" item type used until June 1982, was ". . . developed to test the candidate's ability to reason logically" (McPeck, Pitcher, and Carlson, 1976b, emphasis added). During the course of the present study, another LSAC-sponsored factor analytic study (Camilli, Wang, and Fesq, 1992) involving several forms of the LSAT used between June 1989 and October 1990--the same version of the LSAT as that under consideration herein--was reported. Findings reported herein for LSAT forms used in the June 1991 and October 1991 administrations are consistent with those reported by Camilli, Wang, and Fesq (1992) for the forms used earlier.

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## Overview

Section 2 provides (a) a detailed review of previous research findings regarding the internal structure of the GRE General Test, and the nature of its constituent item types, especially GRE logical reasoning, reading comprehension, and analytical reasoning, and (b) a brief comparison of the composition of both the LSAT and the GRE.

### Analyses of the Internal Structure of the LSAT

Section 3 describes analyses of the internal structure of the LSAT—that is, its dimensionality, the principal concern of the present study. Dimensionality was assessed by analyzing intercorrelations of subscores based on LSAT reading comprehension, logical reasoning, and analytical reasoning items, and smaller subsets (parcels) of LSAT items within each item type. For example, exploratory factor analyses were conducted using data for (a) general LSAT samples taking different forms of the LSAT used in the June 1991 and October 1991 test administrations, and (b) the selected subsample from those two test administrations for whom GRE data were also available.

Analyses involving LSAT performance for the selected subsample of LSAT examinees (those who also took the GRE) yielded results that were consistent with the outcomes observed for the general LSAT samples. The similarity in outcomes suggested, among other things, that data for the selected LSAT sample also provide a sound basis for drawing inferences about LSAT dimensionality.

### Assessing GRE Dimensionality in the Selected LSAT/GRE Sample

Section 4 describes (a) an analysis of factors underlying performance on a full array of GRE item-type parcels, designed in part to shed light on the extent to which the GRE data adequately represent the GRE test taking population, and (b) an analysis of factors underlying performance on parcels of items of the three types common to both the LSAT and the GRE.

The possibility of unrepresentative findings due to selected samples is a pertinent consideration generally. Questions regarding representativeness are especially germane here because the members of the selected LSAT/GRE sample took some 21 different generic forms of the GRE, on over 30 different testing occasions spanning a total of 42 months.

GRE data for a general (unselected) sample of GRE examinees were not included in the study. Thus it was not possible to assess directly the issue of representativeness of findings based on the selected GRE data set, as was done in the case of the LSAT data. Accordingly, the issue was addressed indirectly by evaluating the results of exploratory analyses designed to identify factors underlying performance on GRE items of all nine types, in the selected sample, in light of previous research. These analyses were based on pooled within-form correlations in data aggregated across 21 generic forms of the GRE.

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Results of the exploratory analyses, involving a full array of GRE item-type parcels, conformed generally to previously reported patterns, especially that identified by Emmerich, Enright, Rock, and Tucker (1991) in research involving both operational and experimental logical reasoning and analytical reasoning GRE item types. The orderly nature of GRE findings in the selected sample indicated that data for this sample provided a sound basis for drawing inferences regarding GRE dimensionality generally, as well as the dimensionality of the three item types that are common to both the LSAT and the GRE.

Based on the foregoing, analyses of factor structure involving parcels of GRE reading comprehension, logical reasoning, and analytical reasoning items were conducted. These analyses parallel those involving the three LSAT counterparts, alluded to above, and the findings of the two within-test analyses also were generally parallel.

Section 4 also provides information regarding the characteristics of the joint LSAT/GRE sample, the nature of the GRE data involved and the procedures that were used in aggregating data across forms and testing occasions, as well as the factor analyses outlined above.

#### Evaluation of Between-Test Correlations

The correlational findings reported in Section 3, involving LSAT data only, and Section 4, involving GRE data only, reflect concurrent, within-test relationships involving parcels of test items—including, in the case of the GRE, sets of concurrent, within-test observations based on different forms of the test, taken on 37 separate testing occasions.

Among other things, these findings suggested that outcomes of correlational analyses involving GRE data only, as well as those involving LSAT data only, were not unduly influenced by (potentially interesting and probably complexly interacting) variables associated with selection into the LSAT/GRE sample.

However, as described in detail in Section 5, in all instances, the LSAT and the GRE were taken on separate testing occasions under different testing conditions. The time interval between the two tests ranged from less than 10 days to approximately 36 months, and the order of test taking was not the same for all members of the joint sample.

Thus, correlations between LSAT and GRE scores (total scores, item scores, parcel scores, and so on) may be affected to some extent by factors such as the following:

- (a) conditions affecting performance on one testing occasion but not the other (anxiety, luck, illness, preparation or lack of preparation, shifts in motivation, and so on),
- (b) differential change (growth or decline) in the abilities being tapped by both tests, due to individual differences in experiences (over periods of up to three years between tests),

- 
- (c) "short-term practice effects," due to proximity of test dates; and so on.

Analyses of between-test correlations reported in Section 5, revealed time-related trends in correlations involving both scaled total scores and specially computed subscores for reading comprehension, logical reasoning, and analytical reasoning items. For example, observed between-test relationships were stronger in data for subgroups taking the two tests within 10 days, than in data for subgroups in which time between testing occasions was 19-36 months. In addition, when classified according to time interval between test occasions and sequence of testing, subgroups differed significantly with respect to average test performance—true for both the LSAT and the GRE.

The between-test correlational findings involving item-type subscores from the LSAT and the GRE suggested the possibility of differences in relative stability over time of the abilities tapped by the three item types—for example, the possibility of differential change in the abilities being measured. Explicating the observed time-related trends and/or evaluating the relative influence of particular variables that may have affected observed relationships between LSAT and GRE scores is outside the scope of the present study.

An evaluation is made of both observed correlations between LSAT variables (scaled scores, item-type section scores, and so on) and GRE variables, and correlations after correction for attenuation due to measurement error.

#### Exploratory Factor Analyses Involving Parcels of Item Types Common to Both Tests

Apart from their substantive implications, the findings reported in Section 5 indicate clearly that the interpretation of between-test relationships is complicated by the fact that performance on the two sets of test items was observed at different times and under different conditions.

Factor analyses involving the combined parcels of items of the three types that are common to both the LSAT and the GRE—that is, the parcels that were used in the separate within-test analyses—are reported in Section 6. Despite the interpretive complications alluded to above, the analyses shed additional light regarding the classification, according to ability domain, of reading comprehension, logical reasoning, and analytical reasoning item types for both the LSAT and the GRE.

Findings of the analysis of combined parcels of the three item types were generally similar to the findings of parallel within-test analyses. On balance, these findings suggest that a common factor structure underlies performance on the three types of items that are common to the LSAT and the GRE, regardless of the test for which they are developed.

Section 7 summarizes study findings and suggests some implications for both the LSAT and the GRE contexts.

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## SECTION 2. REVIEW OF RELATED RESEARCH IN THE GRE CONTEXT

As indicated in Section 1, reading comprehension, logical reasoning, and analytical reasoning items, similar in type to the corresponding LSAT item types, are used in forms of the Graduate Record Examinations (GRE) General Test. In the GRE context, these item types are treated operationally as belonging to two different ability domains, namely, an analytical ability domain and a verbal ability domain, respectively.

For the GRE, "analytical ability" is defined operationally by the logical reasoning and analytical reasoning item types, which are characterized as measuring somewhat different aspects of ". . . the ability to think analytically" (ETS, 1990, p. 41). "Verbal ability" is defined by the reading comprehension item type and three other verbal item types—analogy, antonym and sentence completion questions—characterized collectively as measuring aspects of ". . . ability to reason with words in solving problems . . . (that is) the ability to discern, comprehend, and analyze relationships among words or groups of words and within larger units of discourse such as sentences and written passages (and so on)" (ETS, 1990, p. 31).

Separately scaled number-right scores are reported for GRE analytical ability and GRE verbal ability, respectively, as well as for GRE quantitative ability.<sup>2</sup>

GRE "quantitative ability" is defined by quantitative comparison, regular mathematics, and data interpretation item types which are characterized as measuring . . . basic mathematical skills, understanding of elementary mathematical concepts, and ability to reason quantitatively and to solve problems in a quantitative setting" (ETS, 1990, p. 36).

Results of factor analyses involving GRE verbal, quantitative, and analytical items or item parcels, summarized in Table 2.1, generally tend to support a three-factor hypothesis, corresponding to divisions of the test for which separate scores are reported. That is, the items appear to measure psychometrically distinguishable verbal, quantitative, and analytical abilities—more clearly so for items in the GRE verbal domain and the GRE quantitative domain, than for items in the GRE analytical ability domain.

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<sup>2</sup> In contrast to legal education, in which the first-year curriculum tends to be relatively uniform from school to school, graduate education is "notoriously" diverse. This fundamental difference is reflected in the different approaches to admissions testing for graduate education and legal education. The GRE General test, which reports three scores, must be appropriate for disciplines that differ on a number of grounds, e.g., the extent to which they are verbally or quantitatively oriented. The LSAT, not being constrained in this way, summarizes performance on three different item types in a single score in order to measure a more general reasoning ability.

Table 2.1. Summary of Factor Analytic Studies of the GRE General Test

Study	Sample	Test Version*	Methods	Major Results
Powers, Swinton, & Carlson (1977)	Two random samples each consisting of 8,000 examinees who took the two operational test forms given in October 1975.	Version used until October 1977.	Exploratory analysis of item-level data, analysis of tetrachoric correlation matrices, orthogonal rotation.	Three major uncorrelated factors were extracted from each of the two test forms analyzed: a general quantitative factor, a reading comprehension factor, and a vocabulary factor. Several other much less prominent dimensions were also noted.
Powers & Swinton (1981)	Two random samples--one of 4,000 and the other of 6,000--who took two forms of the restructured test in October 1977.	Version used from October 1977 until October 1981.	Exploratory analysis in two stages, the first using item-level analyses of tetrachoric correlations and the second using clusters (parcels) of related items. Both orthogonal and oblique rotations were employed.	Three major uncorrelated factors emerged: verbal reasoning/reading comprehension, quantitative reasoning, and vocabulary. An analytical factor emerged as one of several other less prominent factors. Using an oblique rotation, four prominent factors were extracted: reading comprehension, general quantitative, vocabulary, and analytical. The correlations among these factors ranged from .37 for vocabulary with quantitative to .66 for reading with analytical.
Rock, Bennett, & Jirele (1986)	Three groups of disabled students: two groups of visually impaired examinees (N=188 and N=151)--one of which took a large-type, extended time administration--and one group of physically disabled examinees (N=108).	Version used after October 1981.	Confirmatory factor analysis.	A three-factor model--verbal, quantitative, and analytical--provided the best fit for each of the three handicapped groups. However, analytical scores did not have quite the same meaning for two disabled groups as they did for nondisabled examinees.
Rock, Werts, & Grandy (1982)	3,500 social science majors taking the test in September 1978.	Version used from October 1977 until October 1981.	Confirmatory factor analysis based on odd and even halves for each item type.	Several alternative models were fit. A three-factor solution (verbal, quantitative, and analytical) indicated that the analytical factor correlated .92 with the quantitative factor and .77 with the verbal factor. The correlation between the verbal and quantitative factors was .64. A slightly better fit was obtained when reading comprehension was considered as a fourth factor.

Study	Sample	Test Version*	Methods	Major Results
Stricker & Rock (1987)	Three samples each of 1,000 examinees at different age levels who took the GRE General Test in December 1982.	Version used after October 1981.	Confirmatory factor analysis based on parcels of items of the same type, using LISREL VI (Joreskog & Sorbom, 1981) as the method of analysis.	A three-factor solution provided the most acceptable fit. Factors were termed verbal, quantitative, and analytical abilities. At the three different age levels the verbal and quantitative factors correlated .53 to .63, the verbal and analytical .76 to .84, and the quantitative and analytical .74 to .80.
Schaeffer & Kingston (1988)	Several samples, each consisting of 1,000 examinees, were selected from five undergraduate majors (education, engineering, English, psychology or mathematics). These examinees took one form of the test that was administered in October 1984, April 1985, and December 1985.	Version used after October 1981.	Full-information factor analysis using the program TEST-FACT, which generates IRI parameters to estimate interitem correlations, which are in turn used as the basis for a principal factors analysis.	Prominent verbal and quantitative factors were extracted for each of the undergraduate major samples. A third less prominent, but significant, analytical factor also emerged for each sample. Correlations between verbal and quantitative factors ranged from .48 to .68; correlations between verbal and analytical factors ranged from .46 to .67; correlations between quantitative and analytical factors ranged from .52 to .78.
Emmerich, Enright, Rock, & Tucker (1991)	Two samples of approximately 370 examinees each, taking batteries with both operational and experimental GRE items, tested in April 1989. The study was designed to evaluate a number of experimental item types that might serve to clarify the analytical ability measure.	Version used after October 1981.	Confirmatory and exploratory factor analysis.	In confirmatory analyses, parcels of scores on operational GRE item types were constrained to have nonzero loadings only on factors they were expected to identify. In these analyses, loadings for logical reasoning on the analytical factor were considerably lower than were loadings for analytical reasoning. In an exploratory analysis involving both operational and experimental items, logical reasoning parcels tended to have higher loadings on the verbal factor than on the analytical factor, defined primarily by operational analytical reasoning parcels.

\*The test used until October 1977 reported verbal and quantitative scores based on the following verbal and quantitative item types: verbal analogies, antonyms, sentence completion, reading comprehension, regular math (arithmetic, algebra, and geometry), and data interpretation. In October 1977 the analytical measure, which contained analysis of explanations, logical diagrams, and analytical/logical reasoning items, was introduced. An additional item type, quantitative comparisons, was introduced into the quantitative measure, and some shorter reading passages were substituted for larger ones in the verbal measure. In October 1981 the analytical measure was revised by deleting analysis of explanations and logical diagrams, and substituting greater numbers of analytical reasoning and logical reasoning items.



