

NDIT

Numerical Data Interpretation Test™

Harnessing the Power of Numerical Reasoning: A 21st Century Skill

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In a rapidly changing world, replete with an explosion of technology and an emphasis on data-driven organizations, numeracy and mathematical skills have become important for a wider range of jobs than ever. For decades, educators have made a strong argument that math is important, and the more recent focus on the Science, Technology, Engineering, and Mathematics (STEM) workforce has reenergized interest in mathematics education.

Of course, STEM focuses on only a subset of the occupations in which math is important for success. Math is also important in a variety of executive, managerial, supervisory, professional, sales, administrative, and technical roles across a variety of industries. As data and technology are used to address an ever-increasing range of organizational challenges, math is likely to become even more important in a wider variety of occupations and roles in the future.

Numerical Reasoning: A distinct, higher-order ability that goes beyond basic math calculations

When you think of math, numerical calculation is likely the first thing that comes to mind: the act of adding, dividing, multiplying, or subtracting numbers of various magnitudes and in various formats (e.g., integers, decimals, fractions). This is what many numerical assessments measure—the rote application of formulas and rules to make calculations, sometimes referred to as number facility.

Numerical Reasoning, on the other hand, goes beyond simple calculations and involves higher-order math skills. It focuses on determining how to approach and solve problems that have numerical content. It includes the ability to evaluate a situation, select problem-solving strategies, draw logical conclusions, develop and describe solutions, and recognize how those solutions can be applied. Numerical Reasoning also includes reflecting on solutions to problems to make sure they make sense. It is a critical skill that enables people to use all of their other math skills. This sort of reasoning and sense-making is at the heart of mathematics. For example, deciding whether or not there is sufficient information to solve a problem is an example of higher-order Numerical Reasoning skill.

Basic Numerical Calculation ability is necessary but not sufficient for Numerical Reasoning

Numerical Reasoning is distinct from number facility (e.g., Geary & Widaman, 1992). However, it is impossible to measure Numerical Reasoning without using basic math content, because it is the manipulation and application of this content that enables test takers to demonstrate their Numerical Reasoning skill. A knowledge base of fundamental math concepts and procedures is necessary, but not sufficient, for quantitative reasoning (e.g., Glaser, 1984). A recent study found scores on Pearson's newest Numerical Reasoning assessment—the Numerical Data Interpretation Test (NDIT™)—to be moderately correlated ($r = .55$) with a Pearson assessment that focuses on conducting mathematical calculations (Numerical Calculation; Pearson, 2017), which confirms that these two abilities are related but not identical. In addition, this same study found that fewer than 1% of those who scored below average in number facility subsequently performed above average on NDIT.

Numerical Reasoning is related to, but distinct from, other higher-order skills

Numerical Reasoning is also distinct from other kinds of reasoning. In a classic book that provides the foundation for our current understanding of the structure of human abilities, Carroll (1993) concludes there are only three major reasoning abilities: deductive, inductive, and quantitative (numerical). Numerical Reasoning (NDIT scores) correlates only moderately ($r = .47$) with the Watson-Glaser™, a classic measure of verbal deductive reasoning. This is consistent with the view that Numerical Reasoning is a distinct higher-order ability that can provide additional, useful information beyond

that available from traditional deductive reasoning assessments alone. Numerical Reasoning tests can be combined with other cognitive ability tests (e.g., Watson-Glaser) to provide enhanced insight about job candidates. Research using Pearson's other Numerical Reasoning assessment, the Advanced Numerical Reasoning Appraisal™ (ANRA), has shown that Numerical Reasoning can provide incremental validity beyond deductive reasoning (i.e., Watson-Glaser) for predicting supervisor ratings of job performance (Ejiogu, Rose, Yang, & Trent, 2007).

Numerical Reasoning is important for more than 30% of occupations in the O*NET database.

Numerical Reasoning is important for work success

Numerical Reasoning ability is important for success in a variety of jobs. For example, for more than 30% of the over-900 occupations in the O*NET national job description database, Numerical Reasoning ability is rated as important or higher. For 22 of these occupations, Numerical Reasoning is rated very or extremely important (onetonline.org). Employers seek candidates who can use the math they have learned constructively and critically, rather than simply by rote.



Figure 1. Sample of occupations from the O*NET database with Numerical Reasoning rated as important or higher.

In addition, a growing body of literature links Numerical Reasoning to important work outcomes. For example, Perkins and Corr (2005) found a positive correlation between the Numerical Management Graduate Item Bank 1 and managerial competency in a sample of managers. Numerical Reasoning has also been connected to improved processing speed and error reduction on multi-tasking challenges (Bühner, König, Pick, & Krumm, 2006) and creativity (Furnham & Nederstrom, 2010). Other authors found a positive relationship between Numerical Reasoning and adaptive job performance, which reflects handling clerical tasks, the ability to learn tasks, an employee's confidence in learning, and flexibility at work (Allworth & Hesketh, 1999).

Numerical Reasoning scores are significantly related to performance in jobs and tasks that require math.

Numerical Reasoning is related to job performance

It is important to note that Numerical Reasoning is only expected to relate to important work outcomes for jobs and tasks that require math. NDIT Numerical Reasoning scores are significantly related to self-rated job performance for those jobs ($r=.32$) and tasks ($r=.52$) that require math (Pearson, 2017). In addition, Numerical Reasoning has been found a better predictor of job performance than assessments of other math-related skills (e.g., Numerical Calculations and Numerical Sequences).

Individuals in higher-level jobs tend to have stronger Numerical Reasoning skills

Examining the scores of those in the NDIT normative data samples shows that as the responsibility level of positions increase, average Numerical Reasoning scores increase as well. (See Figure 2.) This suggests that Numerical Reasoning is important for obtaining jobs with higher levels of responsibility.

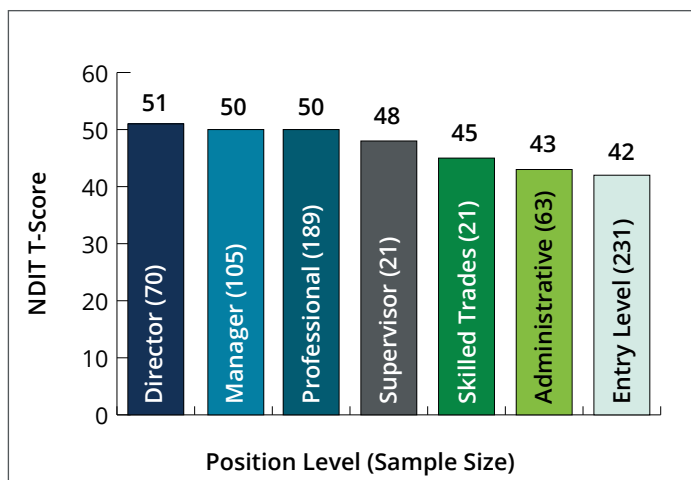


Figure 2. Average NDIT T-Score by position

Numerical Reasoning skills can be improved with practice

We would expect individuals who have completed higher levels of education to score higher on tests of Numerical Reasoning. Numerical Reasoning is taught in many higher education programs and students with stronger math skills are also more likely to attend college. As Figure 3 shows, those in the NDIT normative samples who had completed a Bachelor’s degree had substantially higher NDIT scores—almost a full standard deviation higher—than those with a high school diploma or an Associate’s degree.

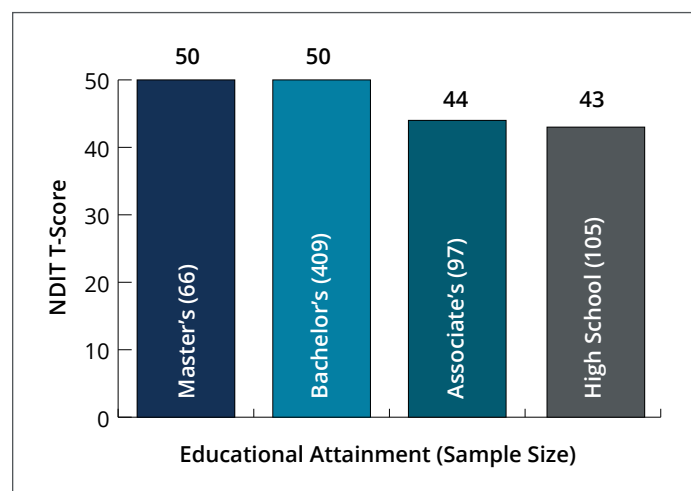


Figure 3. Average NDIT T-Score by educational attainment

Those with positive attitudes toward math (e.g., enjoy math problems, seek out math tasks) also tend to score higher on Numerical Reasoning assessments such as NDIT. In fact, the correlation between NDIT scores and a measure of these math attitudes is moderately high (.43). One reason for this could be that people who have positive attitudes toward math are more likely to take the time to build stronger Numerical Reasoning skills. That is, by investing more energy in learning to use math, either through formal education or other means, people build stronger skills. To the extent that Numerical Reasoning is a learned skill, job performance should be enhanced by relevant training and development, particularly for jobs that involve a good deal of math. In addition, those with positive attitudes toward math may be more likely to take advantage of and learn from these opportunities.

NDIT provides high-quality measurement of Numerical Reasoning

Pearson TalentLens introduced the NDIT—the Numerical Data Interpretation Test—in order to help organizations ensure that their employees have the Numerical Reasoning skills needed for success in crucial roles. NDIT focuses on the interpretation and manipulation of the types of numerical data routinely encountered in the workplace. NDIT is based on sophisticated approaches to test development, administration, and scoring.

It is an item-banked test with a pool of more than 100 questions. This means it is rare for two candidates to ever receive the same test. An item-banked test also enables candidates to take the test in an unsupervised setting and improves test security. To ensure consistency across test administrations, items are selected from the bank systematically, based on item stimulus type (e.g., bar graphs, data tables), data technique (e.g., costs and revenue, percentages, ratios), and other relevant characteristics. NDIT is timed because an important aspect of Numerical Reasoning ability is the speed with which an individual can work with data, including approximating and calculating quickly.

NDIT item content is highly relevant to the numerical problems encountered at work. In fact, Figure 4 shows that 62% of a sample of working adults found the items job relevant and 63% found the items realistic. The business relevant items that comprise NDIT focus on real-world scenarios such as maintaining inventory,

costing out marketing campaigns, or forecasting budget shortfalls. In a sample of hiring managers, 93% found the ability measured by NDIT to be important for the job. Overall, Figure 4 shows that reactions to NDIT content are very positive. It is interesting to note that some respondents found the items frustrating, but there was a strong relationship between finding NDIT items frustrating and more generally finding math frustrating ($r = .58$). This sort of content relevance can improve applicants' testing experience and fairness perceptions.

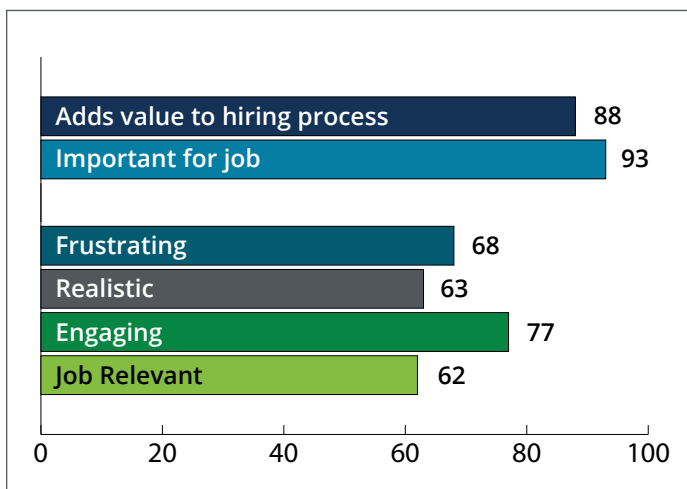


Figure 4. Employer and employee reactions to NDIT

NDIT also differs from many other math-related assessments by including free response items because real world math is not multiple choice. NDIT also permits the use of a calculator during test administration, which simulates how math is approached in most work settings, where employees have computers, phones, or calculators readily accessible.

Pearson research to evaluate the “construct validity” of NDIT scores as measures of Numerical Reasoning has shown that NDIT is a valid and potentially useful assessment of Numerical Reasoning (Pearson, 2017; Hanson & Dodge, 2018). It has the expected pattern of correlations with other ability measures, including a very high convergent correlation with another measure of Numerical Reasoning (ANRA, $r = .84$ corrected for unreliability). NDIT provided better prediction of performance than any of the other math assessments included in this research.

NDIT AT A GLANCE

- Measures the ability to analyze and interpret numerical information at work
- Contains 21 items drawn from a bank of items
- 30-minute time limit
- Available in English; French and Spanish planned for 2018
- Administered online or paper-based
- Norms include working adults, professionals/individual contributors, and financial roles

Numerical Reasoning will be increasingly important for jobs of the future

It is important to emphasize that Numerical Reasoning is expected to predict success in jobs and occupations in which math is important (and those aspects of jobs that require math), and research using NDIT has confirmed this expectation. As the use of data becomes increasingly important in the future, the importance of Numerical Reasoning ability will likely expand to more and more jobs. In a world that abounds with “big data” and dashboards, it is likely Numerical Reasoning will become increasingly important. Data without interpretation is just numbers.

Real world math is not multiple choice.

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