Research-Based Evidence Supporting *CogAT* Use Cases

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Claim:

Teachers can adapt instruction based on ability

Supporting Evidence:

Ability test data is useful for selecting differentiation strategies, including scaffolding (Brighton et al., 2005; Callahan et al., 2022). The goal is to build students' skills (aligned with learning objectives/standards) using a variety of strategies that allow students to access the material in the way they learn best. Understanding students' ability to reason or solve complex problems within a domain can be used to provide students with greater challenge in areas of strengths or greater support in areas they need to develop (Lohman, 2005; Olszewski-Kubilius & Clarenbach, 2012).

There's a fine line to walk between scaffolding strategies and "learning styles," which do not have research support (Pashler et al., 2008). All students learn best when provided content in a variety of modes (Mayer, 2005). Differentiation is based on (a) more objective measures of ability [not conscious preferences] and (b) supporting students in learning skills and abilities regardless of strengths [i.e., still building writing skills even if that is not an existing strength]).

Brighton, C. M., Hertberg, H. L., Moon, T. R., Tomlinson, C. A., & Callahan, C. M. (2005). The Feasibility of High-end Learning in a Diverse Middle School. *National Research Center on the Gifted and Talented.*

*Callahan, C. M., Azano, A., Park, S., Brodersen, A. V., Caughey, M., & Dmitrieva, S. (2022). Consequences of implementing curricular-aligned strategies for identifying rural gifted students. *Gifted Child Quarterly*, 66(4), 243-265.

*Lohman, D. F. (2005). The role of nonverbal ability tests in identifying academically gifted students: An aptitude perspective. *Gifted Child Quarterly*, 49(2), 111-138. https://doi.org/10.1177/001698620504900203

Mayer, R. E. (2005). Cognitive Theory of Multimedia Learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 31–48). Cambridge University Press. https://doi.org/10.1017/CBO9780511816819.004

Olszewski-Kubilius, P., & Clarenbach, J. (2012). Unlocking emergent talent: *Supporting high achievement of low-income, high-ability students*. National Association for Gifted Children.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological science in the public interest*, 9(3), 105-119.

Claim:

Teachers can contrast ability and achievement data to identify gaps in predicted and observed achievement

Supporting Evidence:

When academic achievement and cognitive ability scores are markedly different (comparing percentile ranks or comparable scale scores), further investigation is warranted to determine the root cause of the mismatch (Lohman, 2006). For example, a student with high verbal ability scores but average achievement scores or performance may have another exceptionality, a personal issue affecting his academic levels, or some other factor negatively impacting the learning outcomes. In cases where simple explanations for discrepancies are ruled out, educators may consider what motivational factors could lead to the observation of "underachievement" (Snyder & Wormington, 2020).

*Lohman, D. F. (2006). Beliefs about differences between ability and accomplishment: From folk theories to cognitive science. *Roeper Review*, 29(1), 32-40. https://doi.org/10.1080/02783190609554382

Snyder, K. E., & Wormington, S. V. (2020). Gifted underachievement and achievement motivation: The promise of breaking silos. *Gifted Child Quarterly*, 64(2), 63-66. https://doi.org/10.1177/0016986220909179

Claim:

Strengths and weaknesses inform instruction

Supporting Evidence:

Longitudinal studies of talent development have shown us that the areas of strength that youth demonstrate are associated with the domains they show expertise in as adults (Makel et al., 2016; Park et al., 2007). Hemmler et al. (2022) and Callahan et al. (2022) provide an excellent case study of how Verbal Battery scores can be used to identify students with talents in English Language Arts among rural and diverse student populations. Similarly, early spatial and quantitative skills predict later STEM eminence (Lubinski & Benbow, 2006).

More detail:

CogAT is designed with three distinct batteries. The first reason for this is that research indicates fluid reasoning cannot be adequately measured using only figural tasks (Carroll, 1993). The ability to reason, problem-solve, and learn is not independent of the content (we can't measure problem solving without a problem to solve!) Therefore, measuring students reasoning across different content gives us a better measure of fluid reasoning. An important second reason is that the broad abilities measured by each battery are useful in understanding students' cognitive development alongside the general reasoning ability (reflected by the composite score. Lohman et al. (2008) showed that *Ability Profile*s can be classified by how extreme the differences in the three battery scores are. These relative strengths and weaknesses are valuable in planning instruction. Extreme profiles are more common among very high and very low performing students.

VanTassel-Baska et al. (2007) demonstrated the importance of considering domain scores when identifying academic potential among students from low-income families. Students from low-income families that participated in their study were much more likely to have one area of cognitive strength rather than uniformly high ability across all of the domains of the tests they studied. In a three-year follow-up, these students' achievement scores were highest in the same domain where they had high ability scores previously. Longitudinal studies of talent search data similarly demonstrate that areas of strength in youth are associated with the domain of expertise as adults (Makel et al., 2016; Park et al., 2007)

Claim:

Strengths and weaknesses inform instruction

*Callahan, C. M., Azano, A., Park, S., Brodersen, A. V., Caughey, M., & Dmitrieva, S. (2022). Consequences of implementing curricular-aligned strategies for identifying rural gifted students. *Gifted Child Quarterly*, 66(4), 243-265.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge University Press.

*Hemmler, V. L., Azano, A. P., Dmitrieva, S., & Callahan, C. M. (2022). Representation of Black Students in rural gifted education: Taking steps toward equity. *Journal of Research in Rural Education*, 38(2), 1-25.

*Lohman, D. F., Gambrell, J., & Lakin, J.M. (2008). The commonality of extreme discrepancies in the ability profiles of academically gifted students. *Psychology Science*, 50(2), 269-282.

Lubinski, D., & Benbow, C. P. (2006). Study of mathematically precocious youth after 35 years: Uncovering antecedents for the development of math-science expertise. Perspectives on *Psychological Science,* 1(4), 316-345. https://doi.org/10.1111/j.1745-69-16.2006.00019

Makel, M. C., Kell, H. J., Lubinski, D., Putallaz, M., & Benbow, C. P. (2016). When lightning strikes twice: Profoundly gifted, profoundly accomplished. *Psychological Science*, 27(7), 1004-1018.

Park, G., Lubinski, D., & Benbow, C. P. (2007). Contrasting intellectual patterns predict creativity in the arts and sciences: Tracking intellectually precocious youth over 25 years. *Psychological Science*, 18(11), 948-952.

VanTassel-Baska, J., Feng, A. X., & Evans, B. L. (2007). Patterns of identification and performance among gifted students identified through performance tasks: A three-year analysis. *Gifted Child Quarterly*, 51(3), 218-231.

Claim:

CogAT can be used to flag potential learning difficulties

Supporting Evidence:

While *CogAT* is not designed to diagnose specific learning disabilities, the results can signal that additional testing or observation is needed (Foley-Nicpon et al., 2013; Hajovsky et al., 2022). For example, although many students have relative strengths and weaknesses (Lohman et al., 2008), a marked weakness in one domain could be a sign that the student has a difficulty with that content that could be addressed through services for specific disabilities. Even nonverbal/figural skills have associated learning disabilities (Fisher et al., 2022).

Fisher, P. W., Reyes-Portillo, J. A., Riddle, M. A., & Litwin, H. D. (2022). Systematic review: Nonverbal learning disability. *Journal of the American Academy of Child & Adolescent Psychiatry,* 61(2), 159-186.

*Foley-Nicpon, M., Assouline, S. G., & Colangelo, N. (2013). Twice-exceptional learners: Who needs to know what?. *Gifted Child Quarterly*, 57(3), 169-180. http://doi.org/10.1177/0016986213490021

Hajovsky, D. B., Maki, K. E., Chesnut, S. R., Barrett, C. A., & Burns, M. K. (2022). Specific Learning Disability Identification in an RtI Method: Do Measures of Cognitive Ability Matter?. *Learning Disabilities Research & Practice*, 37(4), 280-293.

*Lohman, D. F., Gambrell, J., & Lakin, J.M. (2008). The commonality of extreme discrepancies in the ability profiles of academically gifted students. *Psychology Science*, 50(2), 269-282.

Claim:

CogAT can be used for gifted identification or advanced academic placement

Supporting Evidence:

CogAT is widely used for gifted identification. We encourage educators to consider students verbal, quantitative, and nonverbal scores or their *CogAT Ability Profile* as appropriate rather than simply focusing on the composite score. Research shows that there are different predictors of academic excellence depending on the domain. This has been shown for mathematics (Cormier et al., 2017), verbal or ELA achievement (Vanderwood et al., 20002), and STEM achievement (Wai et al., 2009).

Multiple indicators are valuable when used to create multiple pathways to identification and differentiated services (Olszewski-Kubilius & Clarenbach, 2012; Siegle et al., 2016). The methods of combining and using the battery scores affects both the size and diversity of students identified (Lakin, 2018)

Cormier, D. C., Bulut, O., McGrew, K. S., & Singh, D. (2017). Exploring the relations between Cattell–Horn–Carroll (CHC) cognitive abilities and mathematics achievement. Applied Cognitive Psychology, 31(5), 530-538.

*Lakin, J.M. (2018). Making the cut in gifted selection: Selection decisions and their impact on program diversity. *Gifted Child Quarterly*, 62(2), 210-219. http://doi.org/10.1177/0016986217752099

Olszewski-Kubilius, P., & Clarenbach, J. (2012). *Unlocking emergent talent: Supporting high achievement of low-income, high-ability students.* National Association for Gifted Children.

Vanderwood, M. L., McGrew, K. S., Flanagan, D. P., & Keith, T. Z. (2002). The contribution of general and specific cognitive abilities to reading achievement. Learning and individual differences, 13(2), 159-188.

Wai, J., Lubinski, D., & Benbow, C. P. (2009). Spatial ability for STEM domains: Aligning over fifty years of cumulative psychological knowledge solidifies its importance. Journal of Educational Psychology, 101, 817–835.

Claim:

Schools can use multiple measures for identification to broaden participation

Supporting Evidence:

Research has shown that a more representative pool of students can be identified when multiple measures are used for identification, so long as they are not used as “multiple hurdles.” Lakin (2018) showed that allowing students to qualify on any one *CogAT* battery (the “OR” rule) led to the largest number of students and most diverse pool of students being identified. Having multiple ways to qualify means that multiple services should be offered as well, aligning the services to the area of talent identified.

For students scoring strongest on the Verbal battery, their academic strengths are more likely to manifest in ELA or history, depending on their interest and motivation. Students with strong Quantitative scores are more likely to perform well in mathematics. When predicting scientific achievements, we find that a combination of Q+N is the best predictor (Lakin & Lohman, 2011). Other work finds similar patterns of prediction (Cormier et al., 2017; Vanderwood, 2002). Research that measures spatial reasoning also finds that those measures predict STEM success.

Cormier, D. C., Bulut, O., McGrew, K. S., & Singh, D. (2017). Exploring the relations between Cattell–Horn–Carroll (CHC) cognitive abilities and mathematics achievement. Applied Cognitive Psychology, 31(5), 530-538.

*Lakin, J.M. (2018). Making the cut in gifted selection: Selection decisions and their impact on program diversity. *Gifted Child Quarterly*, 62(2), 210-219. doi: 10.1177/0016986217752099

*Lakin, J.M., & Lohman, D.F. (2011). The predictive accuracy of verbal, quantitative, and nonverbal reasoning tests: Consequences for talent identification and program diversity. *Journal for the Education of the Gifted*, 34(4), 595-623. https://doi.org/10.1177/016235321103400404

Vanderwood, M. L., McGrew, K. S., Flanagan, D. P., & Keith, T. Z. (2002). The contribution of general and specific cognitive abilities to reading achievement. Learning and individual differences, 13(2), 159-188.

Claim:

Use *CogAT* data in acceleration decisions or special school placement

Supporting Evidence:

Acceleration is one of the relatively few practices in gifted education that has consistently positive research support (Plucker & Callahan, 2014). Building from this support, researchers at The University of Iowa developed the *Iowa Acceleration Scale* (Assouline et al., 2004) which is a guide for parents and educators to use while making the decision to place a student in a higher grade level. Their decision-making guide emphasizes the importance of having measures of ability alongside measures of achievement and subject-specific aptitude in order to make these decisions.

*Assouline, S.G., Colangelo, N., Ihrig, D., Forstadt, L., & Lipscomb, J. (2004) Iowa Acceleration Scale validation studies. In N. Colangelo, S.G. Assouline, & M.U. Gross (Eds.), *A nation deceived: How schools hold back America's brightest students*. (Vol. 2, pp. 167-172).

Connie Belin & Jacqueline N. Blank International Center for Gifted Education and Talent Development. https://www.accelerationinstitute.org/nation_deceived/nd_v1.pdf

Claim:

Local norms can be used to create an equitable identification process

Supporting Evidence:

Hemmler et al. (2022) worked with rural school districts with substantial Black student populations to create an identification process based on universal screening with the *CogAT* Verbal battery using local norms as well as teacher ratings from SRBCSS (reading, motivation, and creativity scales). Previous district identification tools predominantly focused on referral and matrix scoring, and almost all used NNAT as their ability screener. When local norms were used with the researcher-designed process, Black and white students showed no significant differences in *CogAT* Verbal scores. They found that there were statistical differences in teachers' ratings of Black and white students' creativity and motivation. Overall, they found that Black students were three times more likely to be identified by the researcher-designed identification using *CogAT* Verbal, locally normed scores compared to the prior district processes.

Here's how they summarize their findings: "Implementing universal screening and comparing *CogAT* scores to local instead of national norms, we found no statistically significant differences between the scores of Black and white students. In other words, comparing students with similar experiences and opportunities to learn resulted in a greater number of qualified Black students being identified for gifted education and thus effectively being granted access to a space from which they have long been excluded." (p19)

Hemmler, V. L., Azano, A. P., Dmitrieva, S., & Callahan, C. M. (2022). Representation of Black Students in rural gifted education: Taking steps toward equity. *Journal of Research in Rural Education*, 38(2), 1-25.

Claim:

Ability tests provide unique information from achievement tests

Supporting Evidence:

The validity argument for a test should begin with a clear theory of the underlying concept being measured. For *CogAT*, we began with a model of human abilities that is well established in the research (McGrew & Schneider, 2008). *CogAT* is intended to measure fluid reasoning skills as defined in the Cattell-Horn-Carroll (CHC) theory of cognitive abilities.
Carroll's (1993) work built on previous work showing that there are two, correlated general abilities: *fluid-analytic* reasoning (usually designated Gf) and crystallized reasoning (usually designated Gc). Other broad abilities are also present but are generally less useful than fluid and crystallized abilities (Carroll, 1993). Crystallized abilities are reflected in many tests of achievement while ability tests like *CogAT* seek to measure the fluid-analytic reasoning skills (McGrew & Schneider, 2018).

Cattell's *investment theory* (Kvist & Gustafsson, 2008) holds that cognitive ability or fluid intelligence is *invested* by the learner to cultivate various types of achievement or crystallized intelligence. Therefore, fluid ability can be considered to reflect readiness to learn, being able to profit from advanced instruction, while crystallized intelligence more reflects the product of instruction (Ackerman & Beier, 2005).

Ackerman, P. L., & Beier, M. E. (2005). Knowledge and intelligence In O. Wilhelm & R.W. Engle, *Handbook of understanding and measuring intelligence* (pp. 125-139). Sage.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge University Press.

Kvist, A. V., & Gustafsson, J.-E. (2008). The relation between fluid intelligence and the general factor as a function of cultural background: A test of Cattell's investment theory. *Intelligence*, 36(5), 422–436. https://doi.org/10.1016/j.intell.2007.08.004

McGrew, K.S., & Schneider, W.J. (2018). *CHC theory revised: A visual-graphic summary of Schneider and McGrew's 2018 CHC update chapter*. MindHub publication #4 v1.2. http://www.iapsych.com/mindhubpub4.pdf

Claim:

Three formats across three batteries is the most psychometrically valid measure of reasoning abilities

Supporting Evidence:

To better measure each of the broad abilities (Verbal, Quantitative, and Nonverbal), three formats are used to measure the broad abilities (nine total). Our validity research reported in the Research and Development Guide includes factor analysis supporting the intended structure of CogAT with nine internally consistent subtests, three broad abilities, and a correlation between broad abilities strong enough to support the use of a composite score.

The specific item formats chosen were based on psychometric research showing which item formats are the best measures of the key cognitive processes underlying reasoning (Lohman, 2000). From the ***CogAT Research & Development Guide***:

"Carroll's reanalysis also helped to identify major aspects of individual differences in reasoning. He showed that the reasoning factor may be separated into three sub-factors:

- Sequential reasoning—verbal, logical, or deductive reasoning
- Quantitative reasoning—inductive or deductive reasoning with quantitative concepts
- Inductive reasoning—inductive reasoning, especially with figural tasks

Importantly, he did not find that Gf could be adequately measured using only figural-reasoning tasks that require inductive reasoning. CogAT is unique among ability tests in that it is explicitly designed to measure all three aspects of general fluid reasoning ability. Attempting to measure Gf with only one of the three batteries (such as only the Nonverbal Battery) seriously underrepresents the construct."

We measure general reasoning ability most effectively by averaging performance across a large number of different tasks (item formats or problem types) so that we can "average out" the specific skills measured by each test format (Süß & Beauducel, 2005). For example, verbal analogies require general ability, but they also call on verbal reasoning skills as well as specific knowledge and skills for solving analogies (Conway et al., 2021). We need to ask students to solve other item formats—like verbal classification and figural analogies—to remove effects of verbal reasoning or specific analogy skills from our test scores that are intended to reflect general cognitive ability

Claim:

Three formats across three batteries is the most psychometrically valid measure of reasoning abilities

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge University Press.

Conway, A. R., Kovacs, K., Hao, H., Rosales, K. P., & Snijder, J. P. (2021). Individual differences in attention and intelligence: A united cognitive/psychometric approach. *Journal of Intelligence*, 9(3), 34.

Lohman, D. F. (2000). Complex information processing and intelligence. In R. J. Sternberg (Ed.), *Handbook of human intelligence* (2nd ed., pp. 285–340). Cambridge, UK: Cambridge University Press.

Süß, H.-M., & Beauducel, A. (2005). Faceted Models of Intelligence. In O. Wilhelm & R. W. Engle (Eds.), *Handbook of understanding and measuring intelligence* (pp. 313–332). Sage Publications, Inc. https://doi.org/10.4135/9781452233529.n18

Claim:

Ability changes over time

Supporting Evidence:

CogAT scores are stable in the short-term and do not vary greatly with retesting. However, students' cognitive abilities, especially as compared to their peers, can change over time. Just like with growth spurts and relative height, students can make sudden gains in cognitive ability over the course of years. For this reason, Lohman and Korb (2006) looked at the stability of students' scores over time. Based on these findings, we recommend using scores for no more than two years before retesting students.

*Lohman, D. F., & Korb, K. (2006). Gifted today but not tomorrow? Longitudinal changes in ability and achievement during elementary school. *Journal for the Education of the Gifted*, 29(4), 451-484. https://doi.org/10.4219/jeg-2006-245