WAIS®-5 and WMS®-5
Advanced Clinical Solutions
ACS

Demographically Referenced Scores Manual

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Introduction

The *Wechsler Adult Intelligence Scale* (5th edition; WAIS-5; Wechsler, 2024) and the *Wechsler Memory Scale* (5th edition; WMS-5; Wechsler, 2025) are the most recent revisions of some of the most widely used adult cognitive and memory measures (LaDuke et al., 2018; Rabin et al., 2016). The *WAIS-5 and WMS-5 Advanced Clinical Solutions* (ACS) is comprised of various methods to aid the clinician in making diagnostic, clinical, and intervention decisions. It provides WAIS-5 and WMS-5 embedded and stand-alone performance validity measures, estimates of premorbid cognitive and memory functioning, and demographically referenced scores (DRS). The ACS can be used in assessments detecting performance validity, determining decline in cognitive functioning, and estimating premorbid general ability and memory functioning. The scores, reports, and analyses that comprise the full suite of solutions in the ACS product are provided in separate manuals, each dedicated to one of the methods or clinical solutions. This organization supports the idea that most clinicians will use only specific components of the ACS during a given assessment. Most clinicians will choose one or two functions of the ACS to enhance the clinical sensitivity and utility of a standard WAIS-5 and/or WMS-5 assessment.

This manual describes the development, validity, and interpretation of the ACS demographically referenced scores. There are two options for the referenced scores: education-referenced and demographically referenced; however, the term *demographically referenced scores* is used throughout this manual to refer to both sets of scores unless it is referring to specific score results. This manual also details the appropriate use of the specified procedures, along with caveats on the application of the procedures and interpretation of results. Education- and demographically referenced scores are provided through Q-global, Pearson's online scoring and reporting platform, as a report option within the WAIS-5 and/or WMS-5 report menu. For the demographically referenced scores, the clinician uses the WAIS-5 and/or WMS-5 materials for administration and scoring; ACS does not provide administration materials, manuals, or scoring for the primary and secondary WAIS-5 subtests or primary WMS-5 subtests. Q-global scoring for WAIS-5 and/or WMS-5 is required for deriving the WAIS-5 and WMS-5 standard age-referenced, education-referenced, and demographically referenced scores. No additional testing is required for obtaining demographically referenced scores.

Demographically referenced scores enable clinicians to refine hypotheses about the degree to which a specific score is unexpected when compared to individuals with similar background characteristics (e.g., education level). These scores have a specific application and should be used only to answer appropriate clinical questions. Detailed information on the appropriate use of demographically referenced scores is provided later in this manual.

The ACS also provides tools to help the clinician evaluate performance validity within an assessment, which is provided in the ACS Performance Validity and Word Choice manual and materials. This type of information may be required for certain medical-legal and forensic evaluations. Combined with embedded measures on the WAIS-5 and WMS-5, the Word Choice test, an external performance validity measure, helps identify atypical performance in examinees. In addition, data for true clinical cases are compared to data for individuals simulating cognitive deficits, giving the examiner information related to performance validity.

The *Test of Premorbid Functioning* (2nd edition; TOPF-2; Holdnack, in press) is included in the ACS to provide estimates of premorbid intellectual and memory ability. The TOPF-2 Manual describes how to predict premorbid abilities by applying a regression equation using the examinee's ability to read words that have atypical grapheme to phoneme translations and/or the examinee's demographic characteristics. In addition, demographic information can be combined with TOPF-2 scores to increase the accuracy of the estimated scores.

Demographically Referenced Scores

Education, sex, race/ethnicity, and other background characteristics are related to performance on cognitive, memory, and neuropsychological measures. The standard norming model references cognitive test scores by age, as age has robust effects on cognition (Salthouse, 2010), resulting in scores that are relative to same-age peers. Age-referenced scores best represent general cognitive functioning and are highly correlated with academic and vocational success, as well as the ability to perform the expected tasks of daily living (Bergman et al., 2014; Sorjonen et al., 2015). Additionally, age-referenced scores have significant diagnostic value in the identification of intellectual disability, specific learning disorders and disabilities, intellectual giftedness, and cognitive impairment. Therefore, age-referenced scores are the primary level of interpretation for WAIS-5 and WMS-5.

There are some clinical situations in which age-referenced scores may not sufficiently capture the cognitive difficulties being experienced by the examinee. For example, obtaining a WAIS-5 Full Scale IQ (FSIQ) standard score of 90 indicates that an examinee is performing in the average range of ability relative to the general population of same-age peers. However, a standard score of 90 does not reflect the same level of performance for both an 85- and 30-year-old (i.e., different raw scores are required to obtain a standard score of 90 across ages); rather, it reflects the same performance in relation to same-age peers. There are situations in which it is important to know if a score is consistent with an examinee's ability to function in a narrower setting, such as in a specific occupation, or if a score represents a change from a previous level of cognitive functioning. For example, when evaluating for a change in ability, an FSIQ score of 90 may carry different implications for an individual with 8 years of education than the same score obtained by an individual trained as a brain surgeon with over 20 years of education. In both cases, the current level of performance is the same, but the background information suggests the performance should be different. By referencing the examinee's performance to their age and education (8 years versus over 20 years), the clinician is answering the question, "Is the examinee's current cognitive functioning consistent with what is expected for their background (e.g., education) and with the educational expectations of their job requirements and life circumstances?"

A discussion of the complexities of the assessment of educationally and ethnically diverse populations (see Brickman et al., 2006; Fujii, 2018; Judd et al., 2009) is beyond the scope of this chapter. This chapter provides the general background and application of demographically referenced scores within the ACS. For a comprehensive review on the topic of demographic score referencing, see American Academy of Clinical Neuropsychology (2021), Heaton et al. (2003), Heaton et al. (2009), Holdnack and Weiss (2013), the National Academy of Neuropsychology and Sports Neuropsychology Society (2022), Umlauf et al. (2023), and Weiss and Saklofske (2020).

Demographically referenced scores are not based on a fully stratified, national sample aligned to U.S. Census Bureau data, like age-referenced scores. Rather, they are based on more narrowly defined samples, and as such, when applied, they reflect an examinee's functioning in comparison to that narrowly defined group. For example, the education-referenced scores are not stratified by factors that may be relevant to differences within education groups (e.g., sex, race/ethnicity, geographic region) as would be the case in a standard normative sample; they are stratified

based only on self-reported educational attainment. Moreover, other educational factors are not stratified within education levels (e.g., types of colleges, degree type, types of high school, or grades). In addition, the number of individuals in each education level are not equal in size or stratified by other socioeconomic status (SES) factors; the age-referenced scores are relatively constant in number of individuals within an age group and are stratified by education, sex, race/ethnicity, and geographical region. Beyond those required by census proportions for the normative samples, additional African American and Hispanic individuals with high and low levels of education were tested in order to increase the sample size for less frequently obtained education levels (e.g., <12 years and >16 years) and for African American and Hispanic individuals for demographic referencing. Therefore, when applying demographically referenced scores do not refer to the scores as norms but state to which groups scores were referenced for a particular individual.

Age-referenced scores are a widely accepted way to interpret someone's performance; however, demographically referenced scores apply only to specific situations and must align with an individual's background. In the reference group, higher education levels typically relate to higher scores. Therefore, if an individual's education level does not accurately reflect their ability, education-referenced scores may not be appropriate. For example, consider an individual with 11 years of education who left school for financial reasons but works as a computer engineer. Using demographically referenced scores in this situation may be inappropriate and potentially misleading because their education level does not reflect their general ability due to their education being disrupted by economic factors. Education level can be influenced by economic and personal/family factors, as well as neurodevelopmental, neuropsychiatric, or neurological conditions that limit academic achievement. When using demographic reference groups, these individual background factors must be carefully considered.

Although the terms *low average* or *above average* are used when interpreting demographically referenced scores, their meaning differs significantly from their use in interpreting scores based on population age-based norms and should not be applied interchangeably. When used with demographic reference groups, these terms represent an estimation of the individual's relative standing on cognitive measures within the specified group, not at the population level as in age-referenced scores. Additionally, demographically referenced scores should not be the only indication of whether an individual's score is a sign of cognitive impairment. Clinicians must be familiar with how reference scores are derived, how they are interpreted, and how to use them appropriately.

Demographic Considerations

The relations between scores on cognitive tests and demographic variables are complex, and understanding these relations is important to accurately interpret scores from different reference populations. The demographic variables used in the ACS are based on those used for stratifying normative samples on both the WAIS-5 and the WMS-5: age, education, sex, and race/ethnicity. It is important to note that these stratification variables serve as proxies for more complex and less easily defined variables, many of which were evaluated before determining the final stratification variables. For example, education is defined by years of education completed, which does not directly capture information on the quality of the education, academic performance, the importance placed on education, literacy, or other variables influencing educational attainment. This section describes research on education, sex, and race/ethnicity in relation to cognitive test performance. It is important to understand how the different variables relate to performance, how education-referenced and demographically referenced scores adjust for these relations, and how these scores are appropriate for use in specific cases.

Education

Differential performance on cognitive tests as a function of educational attainment level is well-documented (Ardila et al., 2000; Heaton et al., 2003; Heaton et al, 2009). Research shows that education influences an individual's performance on certain tasks on ability measures but does not necessarily cause increases in general intelligence itself (Ritchie et al., 2015). Conversely, general ability influences the probability of obtaining higher levels of education (Bijwaard et al., 2015). Thus, education level and cognitive ability appear to have a reciprocal influence on one another. This reciprocal relationship is conceptually important when interpreting scores referenced for education level.

Not only is education level associated with differences in cognitive functioning, but it is also associated with overall health (Raghupathi & Raghupathi, 2020). Individuals with higher levels of education tend to live longer (Bijwaard et al., 2015) and exhibit a greater degree of cognitive reserve (Stern, 2012). The concept of cognitive reserve is based on the observation that individuals with brain injury or evidence of brain changes on imaging associated with dementia perform unexpectedly well on some cognitive tests (Barulli & Stern, 2013). Cognitive reserve is associated with educational attainment, such that high levels of education are related to greater preserved cognitive functioning in the presence of brain injury or neurological processes (Barulli & Stern, 2013). Conversely, low levels of educational attainment are associated with an increased risk of dementia at any age as well as increased risk for early-onset dementia (Lövdén et al., 2020). If an individual has low educational attainment and low cognitive ability, then less decline in functioning is required to exhibit symptoms of dementia, while those with relatively high levels of education and cognitive ability require a greater decline in functioning to meet the threshold for a diagnosis of dementia (Lövdén et al., 2020). In this respect, referencing an individual's education level may help identify changes in cognitive performance for individuals with high levels of education and reduce over-pathologizing low cognitive scores for individuals with lower levels of educational attainment.

Education level is related to most cognitive domains; however, the strength of the relation can vary significantly from one domain to another. Very large differences (effect size > –2.5 *SD*) are observed between individuals with 8 or fewer years of education versus those with more than 18 years of education on the *Wechsler Adult Intelligence Scale* (4th ed.; WAIS–IV; Wechsler, 2008) Verbal Comprehension Index (VCI; Holdnack & Weiss, 2013). Even individuals with a high school diploma, in comparison to those completing some college, score moderately and significantly lower on the VCI (Holdnack & Weiss, 2013). For measures of processing speed, the difference between individuals with very low and very high levels of educational attainment is large (effect size = –.97 *SD*), but is much smaller between adjacent educational groups (e.g., 12 years versus 13–15 years; effect size = .2 *SD*; Holdnack & Weiss, 2013).Therefore, a high level of education does not necessarily indicate that high scores are expected across all cognitive domains, because some domains, such as processing speed or memory, are not as highly related to educational attainment. Further, the difference between the highest and lowest ability individuals within an educational group is substantially larger than the observed difference between education groups. Therefore, having an average or even low average verbal ability score for someone with a high degree of education, while less typical, is not necessarily outside the expected range. Likewise, an individual with a low level of educational attainment with a very high ability score is not outside the expected range.

The relationship between education and cognition is complex, with the effects of education varying by specific measures and across domains. For this reason, it is difficult to estimate an expected score on cognitive measures based solely on an individual's level of education. Education-referenced scores provide a standard way of evaluating whether an obtained score is within an expected range for that level of education. However, other factors are important to consider when interpreting these scores, such as overall academic performance, type of college, and any standardized testing that might provide additional insight into the examinee's previous level of functioning.

Sex

Research has also shown that sex is associated with performance on cognitive tests (Hirnstein et al., 2019), although effect sizes tend to be small and are inconsistent across age and education. It may be important to consider how sex differences in baseline performance may affect observed scores when using age- or education-referenced scores to determine the need for using demographically referenced scores. There is a substantial research literature documenting cognitive differences between males and females, although differences are much smaller than those observed for education (Holdnack & Weiss, 2013). A comprehensive review of the literature is beyond the scope of this manual, but key findings will be reported here.

Conceptually, sex differences in brain development occur from an early age due to a variety of biological and environmental factors (Miller & Halpern, 2014). Brain imaging studies reveal significant sex differences in the size and morphology of brains throughout development. For example, adolescent males have larger brain volume, on average, than females. Sex-related differences in basal ganglia and limbic system morphology are also observed (Lenroot & Giedd, 2010). Most observed differences for ages 18–59 show males having larger total brain volume overall and in specific brain regions, as well as greater gray matter density in the left amygdala, hippocampus, insula, pallidum, putamen, and claustrum, while females have greater regional sizes in specific areas of the frontal lobe, thalamus, parahippocampal gyrus, and insular cortex, among others (Ruigrok et al., 2014). A large study of middle-aged and older adults using multiple brain-imaging methods found that males generally had larger brain volume and surface area, whereas females had greater cortical thickness (Ritchie et al., 2018). Overall, *on average*, males consistently have larger total brain volume compared to females, even when adjusting for body size differences (van der Linden et al., 2017). However, there is considerable variability in regional brain sizes and morphology between males and females, and environmental and age factors also play a role. These specific differences are notable as they may relate to observed differences between males and females in cognition and/or differences observed in neurodevelopmental, neuropsychiatric, and degenerative conditions, or susceptibility to brain injury due to medical conditions.

Sex differences on cognitive tests have been identified across cognitive domains. Studies show that intellectual functioning is correlated with brain size, although effect sizes were small on the cognitive measures (van der Linden et al., 2017). The relationship between intellectual functioning and brain morphology indicates that males' cognitive performance is related to left hemisphere morphology, particularly in the inferior parietal lobe; however, for females, intellectual functioning was associated with the same region but in the right hemisphere. Both sexes show a pattern of brain connectivity that is associated with higher skills in different areas of cognitive function (Jiang et al., 2020). A large cohort of twins was studied longitudinally using various cognitive measures. These results showed that in early childhood, females scored higher than males on measures of verbal and nonverbal abilities. Subsequently, males showed higher scores than females on verbal problem-solving measures in late childhood, but no differences were observed in either domain in adolescence (Toivainen et al., 2017). In another large longitudinal study, females exhibited higher scores on measures of general cognitive, memory, and executive functioning in late middle age; however, their cognitive scores declined more quickly than males' between assessments (Levine et al., 2021). These findings suggest that differences between male and female performance on cognitive tests vary from study to study and across ages. Performance differences between males and females on specific tasks may switch, with females demonstrating higher performance than males during certain developmental periods and lower performance than males during other periods.

On measures relevant to the WAIS-5 and WMS-5, males obtain slightly higher scores compared to females on visual-spatial working memory tasks, though females demonstrate higher performance on spatial location recall tasks (Voyer et al., 2017). Conversely, females obtain higher scores on verbal working memory for free and cued recall tasks, while males obtain

slightly higher scores on complex span tasks (Voyer et al., 2021). On computerized cognitive tests, females scored higher on measures of visual and verbal memory, attention, social cognition, and reasoning speed, while males scored higher on motor and sensorimotor speed and spatial reasoning measures (Gur et al., 2012). On the WAIS–IV and *Wechsler Memory Scale* (4th ed.; WMS–IV; Wechsler, 2009), males scored higher on general intellectual functioning, verbal comprehension, and perceptual reasoning. However, while the differences were statistically significant, the effect sizes were quite small, ranging from .15 (FSIQ) to .24 (Perceptual Reasoning Index [PRI]; Holdnack & Weiss, 2013). At the subtest level, males demonstrated higher scores than females on Similarities, Information, Block Design, Visual Puzzles, and Arithmetic. Again, the effect sizes were small for all the subtests except Information, which was in the moderate range. Females showed a small but statistically significant effect on the Processing Speed Index (PSI) and both Coding and Symbol Search subtests, scoring higher than males. The WMS–IV data show that females achieve higher scores on the Immediate, Delayed, and Auditory Memory Indexes than males. Males had slightly higher performance on the Visual Working Memory Index. At the subtest level, females obtained higher scores on Logical Memory I and II and Verbal Paired Associates I and II, and males had higher scores on Spatial Addition and Designs II Spatial (Holdnack & Weiss, 2013). It should be noted that many of these tests show an interaction effect between education and sex such that, at different education levels, sex effects may be reduced or absent, or they may even reverse direction. To account for this effect, the WAIS–IV/WMS–IV demographically referenced scores adjusted scores by the interaction of sex and education. Likewise, the WAIS-5 and WMS-5 also account for this interaction in the derivation of demographically referenced scores.

Sex differences in cognition, while small, are important to understand and have diagnostic implications, particularly in the identification of a change in cognitive status due to progressive (Ferretti et al., 2018; Levine et al., 2021; Li & Singh, 2014) or acute acquired brain injury (Bazarian et al., 2010; Mikolic et al., 2021; Styrke et al., 2013). Sex differences in cognition are small but are found in domains important to the assessment of adults with various conditions that impact brain and cognitive functioning. Again, it is important to remember that the differences between the highest and lowest performers within each group are substantially greater than differences observed between groups. Demographically referenced scores provide a means to adjust for sex factors that may be influencing the observed test scores and potentially masking a cognitive deficit. This is particularly difficult to assess without using the demographically referenced scores because the interaction between education level and sex must be considered.

Race/Ethnicity

Race/ethnicity may also be related to performance on cognitive tests. Many factors must be considered when interpreting test results of different racial/ethnic groups. Performance on cognitive tests relates to several socioeconomic factors that differentially affect racial/ethnic groups, such as rates of premature birth, quality of prenatal health care, exposure to violent crime, and quality of education (McDaniel, 2006). Other socioeconomic factors that relate to cognitive test scores vary among racial/ethnic groups, such as parents' occupation and education level and early educational experiences (Byrd et al., 2006). It may be important to consider how racial/ethnic differences in baseline performance affect observed scores when using age- or education-referenced scores.

Terminology for race and ethnicity may vary between general descriptions of groups and discussions specific to WAIS-5 and WMS-5 score interpretation. The introductory sections use the language recommended by APA in identifying groups: Black or African American (Black/African American), Asian, Hispanic or Latino (Hispanic/Latino), and White (American Psychological Association, 2020). In the descriptions of the ACS samples, administration, and results, including the abbreviations in tables, the terms used to reference groups in the WAIS-5 are applied: African American, Asian, Hispanic, and White to align terminology across the

WAIS-5, WMS-5, and all ACS manuals and systems. We acknowledge this inconsistency across the manuals and scoring platforms and that preferred language may change during the time that the WAIS-5 and WMS-5 ACS is in use.

The research described within each racial/ethnic group can also be applied across groups. For example, bilingualism is described in the section on Hispanic/Latino people because this is where much of the research on bilingualism and cognition has been conducted, but the research described is applicable to any individual who speaks multiple languages. Similarly, SES variables are discussed within the section on Black/African American people, but poverty, literacy, and other SES variables influence cognition across all racial/ethnic groups. It is important to understand how cognition relates to these variables in terms of resilience factors (e.g., high education rates, access to healthcare) and risk factors (e.g., low quality of education, experience of discrimination) both within and across racial/ethnic groups.

A comprehensive review of the research literature on cognitive test performance across racial/ethnic groups is beyond the scope of this manual (see Rea-Sandin et al., 2021), but key findings based on studies with U.S. populations related to the groups reported in the ACS (i.e., African American, Asian, Hispanic, and White) are reported here.

Research with Black/African American Individuals

Black/African American individuals, at the group level, obtain lower scores compared to White individuals on some cognitive measures (Baird et al., 2007; González et al., 2007; Manly, 2005). Heaton et al. (2003) reported that Black/African American individuals score lower than White individuals on measures of general cognitive functioning and memory. The study noted that when standard age-referenced norms are applied, up to 35% of healthy Black/African American individuals may be misidentified as having general cognitive or memory dysfunction compared to 10%–14% of White individuals and 15%–20% of Hispanic/Latino individuals. On the WAIS–IV, significant and large differences were observed on all index scores, with the largest difference observed between the Black/African American group in comparison to other racial/ethnic groups on the PRI (>1 *SD*). Large, significant differences were observed on all WAIS–IV subtests except for Digit Span, which had a moderate effect size. Notably, the largest subtest differences were observed on Block Design and Visual Puzzles (Holdnack & Weiss, 2013). On the WMS–IV, Black/African American individuals, at the group level, obtained moderately lower scores on all subtest and index scores. The largest subtest differences were observed on Logical Memory I and II, Symbol Span, and Spatial Addition (Holdnack & Weiss, 2013). Lower scores are not observed on all tests; for example, lower scores are observed on recognition memory for faces but not for words (O'Bryant et al., 2003). The degree to which race/ethnicity influences performance varies from test to test, as does the influence of other variables.

The observed differences between racial/ethnic groups are influenced by several socioeconomic factors. In a longitudinal study evaluating the impact of demographic variables and cognitive change over time, results showed lower initial test scores for Black/African Americans and Hispanic/Latino individuals in relation to White individuals, and education was related to initial scores with individuals with lower education levels obtaining lower scores than those with higher levels of education; however, the rate of cognitive change was not impacted by these variables (Early et al., 2013). Baseline differences in cognition across groups were associated with differences in life experiences, and controlling for these differences reduced between-group differences on test scores (Brewster et al., 2014). SES variables, such as parent education level, poverty, and family income, are associated with brain development. Individuals from families with lower SES are the most impacted by these variables in terms of brain development (Noble et al., 2015). Specifically, poverty-related reductions in temporal and frontal lobe development account for a small but significant difference in academic test scores (Hair et al., 2015; Mani et al., 2013). Family income also has a strong relation to brain surface area. Small increases in

income for a low-income family have a relatively large impact on the development of brain surface area; however, similar increases in income have little impact on brain surface area in higher income families (Noble et al., 2015).

Literacy has been shown to relate to differences in cognitive test performance across racial/ethnic groups (Baird et al., 2007). Differences in cognitive test scores between Black/African American individuals and White individuals have been associated with differences in literacy levels. Likewise, controlling for literacy levels significantly reduces differences between groups on cognitive test scores (Manly et al., 2002). Notably, education level may not always be a good indicator of literacy for Black/African American individuals, particularly among older adults (O'Bryant et al., 2007), due to historical disparities in educational quality (Lucas et al., 2005). The Mayo's Older African American Normative Studies (MOAANS; Lucas et al., 2005) noted significant differences in the amount of money historically invested in education between Black/African American and White children; these differences have had a significant effect on the educational experiences of older Black/African American individuals (Lucas et al., 2005). It is important to note that Black/African American individuals are a heterogeneous group; educational experiences, SES, health, and environmental factors vary widely and must be considered when evaluating test performance.

Research with Asian Individuals

Cognitive studies of Asian populations in the United States are less prevalent than studies involving other racial/ethnic groups. For a comprehensive review of performing psychological assessments with Asian individuals, see Benuto et al. (2014) or Li et al. (2015). Asian individuals generally obtain higher levels of education and perform better on standardized academic tests compared to White individuals (Hsin & Xie, 2014). Some research suggests that White individuals achieve higher scores on measures of executive functioning (Rea-Sandin et al., 2021) and on some aspects of memory (Millar et al., 2013) compared to Asian individuals. On the WAIS–IV and WMS–IV, Asian individuals obtained higher scores on average than other racial/ethnic groups on all WAIS–IV measures except Digit Span (Holdnack & Weiss, 2013). The differences were generally small, with the largest effects observed for Coding and the PSI. On the WMS–IV, Asian individuals achieved higher scores than other groups on all subtests except Logical Memory I and II. Moderate effects were observed for Designs I and II and Spatial Addition. At the index level, Asian individuals achieved higher scores than other racial/ethnic groups on the Visual Memory and the Visual Working Memory Indexes with moderate effect sizes (Holdnack & Weiss, 2013). Asian individuals also exhibit lower rates of dementia compared to other racial/ethnic groups (Mayeda et al., 2016; Mehta & Yeo, 2017).

While there is less research evaluating cognitive performance of Asian individuals compared to other racial/ethnic groups, there is an overall trend of obtaining higher scores on many cognitive measures. Also, Asian individuals may be less likely to develop dementia, though the apparent performance discrepancy may mask cognitive difficulties experienced by Asian adults. It is important to note that Asian individuals are a heterogeneous group; educational experiences, SES, immigration and cultural experiences, language, and environmental factors vary widely and must be considered when evaluating test performance.

Research with Hispanic/Latino Individuals

Heaton et al. (2003) reported that Hispanic/Latino individuals, as a group, obtain lower scores on measures of general cognitive functioning and memory compared to White individuals. The study noted that when standard age-referenced norms are applied, 15%–20% of healthy Hispanic/Latino individuals may be misidentified as having general cognitive or memory dysfunction, compared to 10%–14% of White individuals. Hispanic/Latino individuals obtain significantly lower scores on the WAIS–IV Verbal Comprehension Index (VCI) and the Working Memory Index (WMI), as well as on the Vocabulary and Arithmetic subtests at the group level

(Holdnack & Weiss, 2013) with large effect sizes. Overall, they obtain significantly lower scores on all indexes and subtests, with most subtest differences having moderate effect sizes, except for Symbol Search, which had a small effect size (Holdnack & Weiss, 2013). On the WMS–IV, the differences are notably smaller, with significant but small to medium effect sizes at the subtest and index levels. Specifically, the Immediate Memory and Visual Working Memory Indexes and Logical Memory I and Symbol Span subtests showed moderate effect sizes between groups (Holdnack & Weiss, 2013). On the NIH Toolbox, Hispanic/Latino individuals, both English- and Spanish-speaking, performed significantly lower on nonverbal cognitive measures of inhibitory control, processing speed, and working memory, but not on measures of cognitive flexibility or memory, compared to non-Hispanic Whites (Flores et al., 2017). Clinically, it is important to consider that the within-group variance is substantially greater than the difference between groups; therefore, the observed differences are based on average performance.

As a group, Hispanic/Latino individuals tend to obtain lower test scores; however, research suggests that several factors must be considered when interpreting test results for these examinees. Hispanic populations within the United States are highly heterogeneous, and variables such as language, education, and level of acculturation can affect test performance (Mendoza et al., 2022; Pontón & Ardila, 1999). The number of years an examinee has lived in the United States also relates to performance on some cognitive variables (Boone et al., 2007). Bilingualism, both generally and specifically among Hispanic Americans, introduces additional complexities in understanding between-group differences observed on cognitive tests (Ardila et al., 2018; Calvo et al., 2016; Gasquoine & Gonzalez, 2012). In some domains, such as executive functioning and theory of mind, there is strong evidence that bilingual individuals score higher on certain measures (Barac et al., 2014). However, in many cognitive domains, research on the influence of bilingualism on performance remains conflicting or limited (Barac et al., 2014). Likewise, the concept of "cognitive reserve" shows inconsistent findings and likely requires a different approach or conceptualization for bilingual individuals (Calvo et al., 2016). Examinees who report English as their first language tend to outperform those who report English as their second language on cognitive tests (Boone et al., 2007), although this relationship is influenced by factors such as years in the United States, age at acquisition of English conversational language, and other acculturation factors. However, bilingual examinees may score lower than expected when tested in either English or Spanish using corresponding norms (Gasquoine & Gonzalez, 2012). For bilingual individuals, it is important to understand their language proficiency when administering tests in either English or Spanish (Gasquoine & Gonzalez, 2012).

Numerous factors contribute to score differences within Hispanic/Latino populations, and there is considerable heterogeneity within Hispanic/Latino populations. Clinicians should be familiar with factors that may influence observed scores in this population when interpreting test results. For a comprehensive review of psychological assessment of Hispanic/Latino individuals, see Benuto (2016), or Judd et al. (2009).

Influence of Other Variables on Racial/Ethnic Group Differences

Test score differences across racial and ethnic groups are related to many SES and literacy-related variables for which race/ethnicity serves as a proxy. During the development of demographically referenced scores, the author conducted an extensive analysis of the WAIS–IV/WMS–IV and WAIS-5/WMS-5 to determine whether self-reported measures of childhood and current SES, along with experiences of discrimination and literacy level, could sufficiently reduce group differences to replace race/ethnicity as a reference variable. Background variables that maximize the prediction of cognitive functioning (i.e., maximizing the R^2 in the prediction equation) tend to replicate the pattern of observed group differences and do not effectively reduce these differences. Using background variables that have lower correlations with cognitive functioning but better differentiation among groups (e.g., feeling unfairly treated by banks, wealth of childhood neighborhood) was more effective at reducing between-group differences, but the variables were not consistent across groups. Equations that reduce between-group differences for

Black/African American populations were less effective for Hispanic/Latino populations. Thus, reducing group differences using these background variables requires different equations based on self-reported race/ethnicity. Adding reading scores to the equations (a direct measure of literacy) resulted in most background predictors becoming nonsignificant at the group level, meaning those variables only marginally reduced differences between groups beyond literacy level alone.

The use of variables such as reading level, experience of discrimination, experience of crime, current SES, and childhood SES did not sufficiently reduce observed between-group differences to replace the use of race/ethnicity as a reference variable. Many measures of poverty, childhood SES, current SES, and literacy exhibit a high degree of multicollinearity, meaning that adding variables resulted in only minimal improvements in reducing between-group differences. It is unlikely that adding additional, perhaps superior, poverty measures would significantly reduce the variance already accounted for by literacy and current SES measures, as the impact would be incremental rather than additive. The best equations utilizing background variables for reducing between-group differences required 35 data points to be collected from examinees to generate the score adjustment equation. These equations yielded a 30% to 50% reduction in between-group differences compared to using race/ethnicity as a variable. For example, Block Design, which shows the largest between-group difference for Black/African American individuals compared to other groups, saw only a 30% reduction in differences using the best equation with background variables. Further research is necessary to better understand the variables underlying racial/ethnic group differences and to develop more nuanced and effective equations to replace race/ethnicity as a key demographic variable.

As noted, Black/African American and Hispanic/Latino individuals obtain lower scores as a group on cognitive tests compared to non-Hispanic White individuals (Avila et al., 2020; Manly et al., 1998) in both healthy controls (Manly, 2005) and clinical populations (Boone et al., 2007). Black/African American individuals have lower test scores than White individuals across a broad range of cognitive domains, including language, memory, executive functioning, and visual-spatial processing (Lucas et al., 2005; Norman et al., 2011). To account for the observed differences in test performance among racial/ethnic groups, many tests provide race/ethnicity reference scores, including the Alzheimer Disease Center Neuropsychological Battery, NIH Toolbox, the Expanded Halstead-Reitan Neuropsychological Battery, the WAIS–IV, and the WMS–IV (Casaletto et al., 2015; Heaton et al., 2004; Holdnack & Weiss, 2013; Sachs et al., 2020). Test scores are referenced to racial/ethnic groups on these tests to avoid misdiagnosis of cognitive impairment based on test scores.

The use of demographically referenced scores is important not only to avoid over-pathologizing test scores in Black/African American and Hispanic/Latino individuals, but also to increase sensitivity to cognitive impairment in Asian and White individuals (Nielson et al., 2010; Taylor & Heaton, 2001). Primary research sources have attempted to identify base rate differences in dementia and cognitive impairment in underrepresented groups. One study reports that the highest rates of dementia are observed for Black/African American adults, intermediate rates for Hispanic/Latino adults, and lower rates for White and Asian adults (Mayeda et al., 2016). Another study shows that rates of dementia do not differ between Black/African American and White adults, although Black/African American adults show a higher risk for being identified with nonamnestic mild cognitive impairment (Katz et al., 2012). Other studies indicate that Black/African American and Hispanic/Latino individuals have higher rates of mild cognitive impairment (MCI; Manly et al., 2008; Wright et al., 2021). The question of true base rate differences in cognitive impairment is still under study. The possibility that differential rates of dementia or MCI occur across different racial/ethnic groups indicates that adjusting for race/ethnicity may potentially underestimate true cognitive impairment. Clinicians must use clinical judgment to determine whether a true deficit may be masked by using demographically referenced scores or whether not using such scores over-pathologizes observed test scores. To the extent possible, indications of cognitive impairment outside of test scores should reflect changes in other aspects of daily living to support the diagnosis of a true change in functioning.

Historical and Appropriate Use of Demographically Referenced Scores

In response to research demonstrating performance differences related to education, sex, and race/ethnicity, researchers have developed alternate scores for subgroups of examinees. These test scores have been described as "corrections" (Heaton et al., 1996) or demographic "adjustments" to norms (Holdnack & Weiss, 2013). The term "correction" implies that there is some error in the use of standard age-referenced scaled scores and that scores must be "corrected." However, the age-referenced scores are the only true norms, because these are derived from a stratified sample of the population with correct percentages of individuals crossed by age, education, race/ethnicity, and region, with sufficient sample size to provide robust normative data. The term "adjusted norms" was introduced to clarify that the scores are not a correction to the standard norms but an adjustment to those norms (e.g., the age-adjusted scores are adjusted to education level and additional demographics). Further discernment of the true properties of the development of all demographic scores indicates that these are a form of reference group scores. The scores are derived by referencing the performance of specific groups to the age-referenced norms. For descriptive accuracy, the naming convention was changed to demographically referenced scores.

The development and use of demographically referenced scores for cognitive tests are based on decades of research. As noted previously, some level of demographic score referencing (e.g., education or education and sex, or education, sex, and race/ethnicity) is available for many commonly used adult cognitive tests and test batteries. For example, the Delis-Kaplan Executive Functioning System Advanced (D–KEFS Advanced; Delis & Kaplan, 2025), California Verbal Learning Test (3rd edition; CVLT 3; Delis et al., 2017), Alzheimer Disease Center Neuropsychological Battery (Sachs et al., 2020), NIH Toolbox (Casaletto et al., 2015), Expanded Halstead-Reitan Neuropsychological Battery (Heaton et al., 2004), Repeatable Battery for Assessment of Neuropsychological Status (RBANS; Duff et al., 2003), and Advanced Clinical Solutions for WAIS–IV and WMS–IV (NCS Pearson, 2009) provide a method for referencing education level. In fact, demographically referenced scores have been available for past editions of the WAIS and WMS, indicating a long history of clinical use.

Demographically referenced scores can be helpful when used appropriately. Data across a broad spectrum of tests indicate that between-group differences exist, whether by education level, sex, and/or race/ethnicity. Therefore, the use of scores adjusted for age without consideration of other demographic factors will yield a higher percentage of individuals with low education levels or from specific racial/ethnic groups being classified as "cognitively impaired," regardless of actual cognitive impairment, depending on the cut-off scores applied. Therefore, there is a risk of over-diagnosis of dementia or cognitive impairment in some groups and a reduced sensitivity to dementia/cognitive impairment in other groups. Using only age-referenced scores (e.g., not accounting for education level, sex, or race/ethnicity) decreases the specificity of cognitive tests and may result in false positives, with examinees being incorrectly identified as having brain injury or dysfunction (Heaton et al., 1999; Heaton et al., 2003; Norman et al., 2000). In addition to improved diagnostic specificity, the use of demographically referenced scores improves diagnostic sensitivity (Morgan et al., 2008). Demographically referenced scores show good sensitivity and specificity for a number of clinical populations (NCS Pearson, 2009; Taylor & Heaton, 2001).

Caution is warranted when using scores referenced for racial/ethnic group differences, as scores may be misunderstood or inappropriately interpreted. No scientific models exist for accurately classifying race and ethnicity (i.e., these are primarily social/political constructs), and the underlying factors for which race/ethnicity serve as a proxy are poorly understood (Manly, 2005). Manly and Echemendia (2007) observed that using scores that reference race/ethnicity may result in minority examinees not receiving needed services (e.g., increasing their scores above cutoffs). In addition, the use of race/ethnicity referencing ignores the underlying cultural, health,

and educational factors that result in disparities in test performance; subsequently, adjustments are made based on group membership, which may not fully represent the experiences and characteristics of a specific individual (Manly, 2005; Manly & Echemendia, 2007). Within any education, sex, or racial/ethnic group, there is a significant degree of variability that is substantially greater than between-group variability. Clinicians using demographically referenced scores must be cautious in how they interpret and present these scores to clients and the general population.

Determining When to Use Demographically Referenced Scores

When determining whether to use demographically referenced scores, first determine the purpose of the evaluation. If the clinical question relates to functioning in the general population (e.g., holding any type of job, communicating effectively, living independently, understanding social conventions), using standard age-referenced norms is most appropriate. If the clinical question relates to a specific environment (e.g., "Can the examinee return to their job as a nuclear engineer?"), education-referenced scores may be appropriate (e.g., comparing the examinee to individuals with a similar education level). Alternatively, if you are trying to identify whether an examinee's performance is atypical and indicative of brain dysfunction, cognitive impairment, or decline, it may also be appropriate to use demographically referenced scores. However, these scores are not appropriate for diagnosing intellectual disability, learning disability, or other disorders that are diagnosed relative to the general population (i.e., diagnosing a learning disability requires comparison to the general population, not comparison to a demographically similar group or to other people with similar levels of education).

The use of demographically referenced scores requires that certain assumptions hold true. The primary assumption is that the individual's demographic background, as compared to the reference group, is truly representative of their personal experiences and is a good estimate of their premorbid ability. There are no simple rules that can be applied to answer this question; however, some factors should be considered.

The first consideration is whether the examinee's education level reflects their ability. In cases where the examinee has a chronic medical, neurological, or psychiatric condition, their education level may have been disrupted by the condition itself. Individuals with chronic epilepsy from childhood, a history of brain tumors and treatment during childhood, or any chronic disease that may influence brain development may also experience limitations in academic potential. Some psychiatric conditions, such as schizophrenia, have an initial onset of symptoms in adolescence and can negatively impact educational attainment. Similarly, individuals with learning disabilities may never achieve academically at a level consistent with their cognitive abilities. In these and similar situations, the examiner must consider whether the attained level of education is a good proxy for an individual's premorbid intellectual functioning (Holdnack & Weiss, 2013).

The second consideration is whether to use adjustments for race/ethnicity. As stated previously, racial/ethnic status cannot be determined by any scientific means, and the clinician must use the examinee's own conceptualization of their race/ethnicity; all individuals in the reference sample self-reported race/ethnicity. The clinician must also determine if the individual's background is representative of the factors for which race/ethnicity serves as a proxy (e.g., neighborhood wealth, parent education and occupation, quality of schools, experiences of discrimination). In other words, do the adjustments made to the normative data accurately reflect the individual's background? It has been hypothesized that socioeconomic disadvantages, health care disparities, poor educational experiences, and other potential discriminatory factors may account for the differences between groups. However, if none of these factors is present for a specific individual, does it make sense to adjust for race/ethnicity? There is no simple answer to this question. In some cases, the answer may be yes (e.g., level of acculturation, effects of racism limiting opportunities), while in other cases, it may be no (e.g., background is not consistent with the

examinee's specified racial/ethnic groups). In general, on the WAIS-5 and WMS-5, Black/African American and Hispanic/Latino individuals obtained lower scores than Asian and White individuals (see Chapter 3). Therefore, if a specific examinee does not likely fall into this pattern based on their personal background, demographic adjustments are not likely appropriate. The clinician must use their judgment to determine when it is appropriate to adjust for racial/ethnic differences (Holdnack & Weiss, 2013).

To make sound judgments on when to use education-referenced or demographically referenced scores, the clinician must understand how scores change across reference groups and what the consequences are of reporting a lower or higher score for an individual. Patterns of performance in relation to education, sex, and ethnicity are provided in Chapter 3. The clinician must carefully consider the use of demographically referenced scores and the effect it may have on the examinee and society. The key facts to remember when determining whether to use demographically referenced scores are as follows:

- Scores are only available for ages 20–90 years.
- Scores are not used to determine an individual's "ability" on specific cognitive measures or domains.
- Scores are not used to diagnose disorders that require reference to the general population, such as intellectual disability.
- Scores are used to identify an unexpected level of performance that *may* indicate cognitive difficulties.
- Scores show minimal differences from age-referenced scores when the individual has an education level of 12 years and identifies as White.
- Scores show the greatest impact for individuals whose demographic variables align to the highest and lowest range of scores for a variable, such as those in the highest or lowest education level groups. When education levels are high, education-referenced scores tend to be lower than age-referenced scores. Conversely, when education levels are low, education-referenced scores are consistently higher than age-referenced scores.
- If a low score results in a benefit (e.g., eligibility for a service), there is a potential risk of denying an examinee benefits if demographically referenced scores are used. This does not prohibit their use or make them inappropriate; instead, it may be appropriate for diagnostic purposes to compare the examinee's performance to a specific group. However, the impact of higher or lower scores must be considered when applying these alternate scores.
- If having a higher score results in negative consequences (e.g., death penalty cases, competency evaluations), the application of demographically referenced scores may have significant consequences. In these instances, comparing the individual to others with similar backgrounds may not be appropriate. Using demographically referenced scores must be carefully considered, and their use must specifically address this question: Is it likely that there has been a loss of cognitive ability due to brain injury, medical disorder, neurological condition, or degenerative process?
- There are rare situations in which a specific diagnosis may provide some "benefit"; however, in most cases, a diagnosis or misdiagnosis of dementia or brain injury will result in negative consequences for an individual (e.g., loss of independent living status, driving privileges, or control over finances and medical decision-making). The best clinical practice is to use data that provides the most accurate representation of the individual's current clinical status.

- The clinician must evaluate the appropriateness of demographically referenced scores for each individual case. Low educational attainment or membership in a racial/ethnic group does not automatically indicate that demographically referenced scores are the most appropriate reflection of an individual's performance. For example, if there is evidence of high intellectual functioning in an individual who chose not to pursue higher education for personal reasons or other considerations, adjusting for education level may not be appropriate. Similarly, an evaluation of an individual who self-identifies as belonging to a particular racial/ethnic group but whose background does not align with the reference group scores for that group may not benefit from using demographically referenced scores.

User Responsibilities

The ethical and legal responsibilities of test users for the WAIS-5 and WMS-5 Advanced Clinical Solutions are consistent with those outlined in the WAIS-5 and WMS-5 administration and scoring manuals.

In light of the complexities of test administration, diagnosis, and assessment, WAIS-5 and WMS-5 Advanced Clinical Solutions users should have training and experience in administration and interpretation of standardized clinical instruments. They should also have training or experience testing individuals whose ages; linguistic backgrounds; and clinical, cultural, or educational histories are similar to those of the examinees they will be evaluating.

In most cases, WAIS-5 and WMS-5 ACS users should have completed formal graduate- or professional-level training in psychological assessment. Although a trained technician can administer the subtests of the WAIS-5 and WMS-5 and score the responses under supervision, results should always be interpreted by individuals with appropriate training in assessment. Furthermore, test users should follow the *Standards for Educational and Psychological Testing* (*Standards*; American Educational Research Association [AERA] et al., 2014).

In line with Pearson Clinical Assessment legal policies (please refer to the local Pearson Clinical Assessment website for the most up-to-date content), it is the responsibility of the test user to ensure that test materials, including completed assessment protocols, remain secure and are released only to professionals who will safeguard their proper use. Although review of test results with examinees or parents/caregivers is appropriate and encouraged when legally and ethically permitted, this review should not include disclosure or copying of test items, protocols, or other test materials that would compromise the security, validity, or value of the WAIS-5 and WMS-5 Advanced Clinical Solutions as a measurement tool. Under no circumstance should test materials be resold or displayed in locations where unqualified individuals can purchase or view partial or complete portions of the test. This restriction includes personal and educational Internet websites and Internet auction sites. Because all test items, norms, and other testing materials are copyrighted, Pearson must approve, in writing, the copying or reproduction of any test materials. One exception to this requirement is the copying of a completed record form for the purpose of conveying an individual's records to another qualified professional. In addition, copying and printing of specific pages of test materials marked with a reproducible copyright notice is permitted. No part of the test materials may be collected, used, or reproduced in any manner or for any purpose in connection with the development, deployment, or use of artificial intelligence technologies or similar technologies. These user responsibilities, copyright restrictions, and test security issues are consistent with the guidelines set forth in the *Standards* (AERA et al., 2014) and are required by the WAIS-5 and WMS-5 ACS licensing agreement.