Considerations for Providing a Non-Embedded Sign Language Accommodation for the Smarter Balanced Assessments of Listening and Mathematics

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The purpose of this White Paper is to address considerations for providing a non-embedded signing accommodation for the Smarter Balanced English Language Arts/Literacy (ELA/Literacy) and mathematics assessments. For the ELA/Literacy listening items[1] and mathematics items, Smarter Balanced provides embedded American Sign Language (ASL) videos to support the stimuli and items.[2] Smarter Balanced has received feedback from some states that there is a need for non-embedded, human-interpreter signing because not all students use ASL, and for some of those who do, the embedded ASL videos are sometimes challenging.

The need for this paper was identified by Smarter Balanced as it strived to ensure that all students, including those with disabilities,[3] could take each of its assessments of mathematics and ELA/Literacy (which includes Reading, Writing, Listening, and Research & Inquiry). Thus, in this paper, we address the opportunities and challenges that might be created if Smarter Balanced provided its listening and mathematics items through a human signer. We also identify procedures and requirements that should be considered if a non-embedded human signer (using ASL or another signing system) is allowed for the Smarter Balanced listening and mathematics items.

This White Paper is organized into five sections. First, we present information on the Smarter Balanced assessments of listening and mathematics, and the ways they provide access to the items for students who typically use sign language. Second, we describe the students who typically use sign language and the signing systems they use. Third, we review the history of providing accommodations for students who are deaf or hard of hearing. Fourth, we highlight the pros and cons of providing non-embedded (human-provided) signing of the listening and mathematics items. Fifth, we provide considerations and recommendations for Smarter Balanced if it decides to provide non-embedded signing for its assessments of listening and mathematics.

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[1] For the ELA/Literacy assessment, Smarter Balanced makes claims in four areas: reading, writing, speaking and listening, and research/inquiry. Based on the *Usability, Accessibility, and Accommodations Guidelines* (Smarter Balanced, 2015b), ASL is available only for listening items on the ELA/Literacy assessment.
[2] For listening items, Smarter Balanced also provides closed captioning to support the item stimuli.
[3] Students with the most significant cognitive disabilities participate in alternate assessments based on alternate achievement standards (AA-AAS). They are not included in the Smarter Balanced assessments.

Smarter Balanced Assessments of Listening and Mathematics

The Smarter Balanced assessments are based on the Common Core State Standards (CCSS). Embedded ASL is provided for the listening items in ELA/Literacy and for all mathematics items.

Smarter Balanced ELA/Literacy Assessment

ELA/Literacy includes standards for reading, writing, speaking, and listening in English.[4] Smarter Balanced developed the following claim for its assessment of listening:[5]

> Claim #3 – "Students can employ effective… listening skills for a range of purposes and audiences."

The assessment of listening skills, when consistent with the language in the CCSS, should allow for: "the widest possible range of students to participate fully from the outset and as permitting appropriate accommodations to ensure maximum participation of students with special education needs." Further, an example is provided: "…speaking and listening should be interpreted broadly to include sign language."[6]

The Smarter Balanced listening claim targets "Listen/Interpret," which varies somewhat by grade level from "interpreting and using information delivered orally" to "analyzing, interpreting, and using information presented orally." These targets reflect a focus on processing information presented "live," rather than simply targeting whether the student uses hearing and speaking as his or her receptive communication modality, and proposed developmental progressions across grades. The emphasis is instead on understanding information received "in the air," and then the types of inferences made about the content of the passage. The specific Smarter Balanced listening targets for each grade level are presented in Appendix A.

Smarter Balanced provides specifications for the stimuli for its listening items to ensure that the test development process adheres to the intent of the assessment design (see Appendix B for these specifications). Although these specifications address accessibility, bias, and sensitivity considerations, they do not address the specific designated supports or accommodations needed to ensure that the assessment is accessible for students who are deaf or hard of hearing. For example, the specifications do not address how materials presented in an audio file, with no visual information available, will be made accessible for students who are deaf or hard of hearing.

Listening is included as part of the ELA/Literacy score for the Smarter Balanced assessment,[7] as well as reported as a separate score for Claim 3. A sample of a score report that shows how performance on the listening items is reported is included in Appendix C. The contribution of the listening items to the total score[8] is defined by the Smarter Balanced blueprints, which vary somewhat by grade bands.[9] In general,

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[4] The CCSS make clear that the intent of the ELA standards are to measure reading, writing, speaking and listening skills in the English language. See, for example page 6 of the ELA Standards at http://www.corestandards.org/ELA-Literacy/introduction/key-design-consideration/.
[5] Smarter Balanced included both speaking and listening in its Claim #3. The speaking component has been dropped from the example in the text. The full set of ELA claims is available at: http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/09/Smarter-Balanced-ELA-Literacy-Claims.pdf.
[6] See the Introduction to the ELA Standards at http://www.corestandards.org/ELA-Literacy/introduction/key-design-consideration/, point number 5.
[7] In its score reports, Smarter Balanced uses the term ELA/Literacy to refer to reading, writing, listening, and research/inquiry.
[8] See the *Smarter Balanced Scoring Specification*, which is available at http://www.smarterapp.org/deployment/TestScoringSpecs2014-2015.html.

less than 20% of the ELA score is determined by responses to listening items. For example, at grades 3-5, 8 to 9 of a total 43 to 47 items per grade are contributed by the listening items. At grades 6-8, 8 to 9 of a total of 42 to 48 items are contributed by the listening items, and at grade 11, 8 to 9 of a total of 44 to 47 items are contributed by the Listening items.

Smarter Balanced Mathematics Assessment

Smarter Balanced includes four claim areas that are measured through its assessment at each grade level:

> **Claim #1 – Concepts and Procedures**: "Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency."
> **Claim #2 – Problem Solving**: "Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies."
> **Claim #3 – Communicating Reasoning**: "Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others."
> **Claim #4 – Modeling and Data Analysis**: "Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems."

Each of these claims has several assessment targets, with the Concepts and Procedures claim having both priority and supporting targets.[10] For example, the Concepts and Procedures claim has seven major targets at Grade 3, as follows:

- Understand properties of multiplication and the relationship between multiplication and division.
- Multiply and divide within 100.
- Geometric measurement: understand concepts of area and relate area to multiplication and to addition.
- Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.
- Solve problems involving the four operations, and identify and explain patterns in arithmetic.
- Develop understanding of fractions as numbers.
- Represent and solve problems involving multiplication and division.

The assessment targets vary somewhat by grade level. The targets reflect a focus on mathematics, and not on *reading* mathematical problems. The specific mathematics targets for each grade level are presented in Appendix D.

Smarter Balanced addressed accessibility for each of its claims for mathematics.[11] None of the analyses of the claims in relation to accessibility indicate that it is inappropriate for a student who is deaf or hard of hearing to use an academic sign language such as ASL. The information on accessibility and each claim is provided in Appendix E.

Reporting of mathematics scores is similar to that for ELA/Literacy. In addition to the overall mathematics score, separate scores are reported for each of the claims. A sample score report is included in Appendix F.

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[9] See the ELA blueprints at http://www.smarterbalanced.org/wordpress/wp-content/uploads/2015/02/ELA_Blueprint.pdf.
[10] See the Mathematics blueprints at http://www.smarterbalanced.org/wp-content/uploads/2015/08/Mathematics_Blueprint.pdf
[11] See *Content Specifications for the Summative Assessment of the Common Core State Standards for Mathematics* at http://www.smarterbalanced.org/wp-content/uploads/2015/08/Mathematics-Content-Specifications.pdf.

Smarter Balanced Accessibility Features

Smarter Balanced expects that all students with disabilities in Smarter Balanced states, except those with significant cognitive disabilities, will participate in its assessment of ELA/Literacy and mathematics. Smarter Balanced considered the inclusion of students with disabilities from the beginning of the development process by working with experts and educators familiar with the needs of students with disabilities.[12] The Smarter Balanced assessments are computer-adaptive assessments, which means that items are chosen for presentation to the student based on an algorithm that selects items consistent with the content blueprint and the student's performance on previous items and are delivered via a computer-based system. In addition to ASL, Smarter Balanced embedded as many other features as possible in the design of its technology-based assessment.

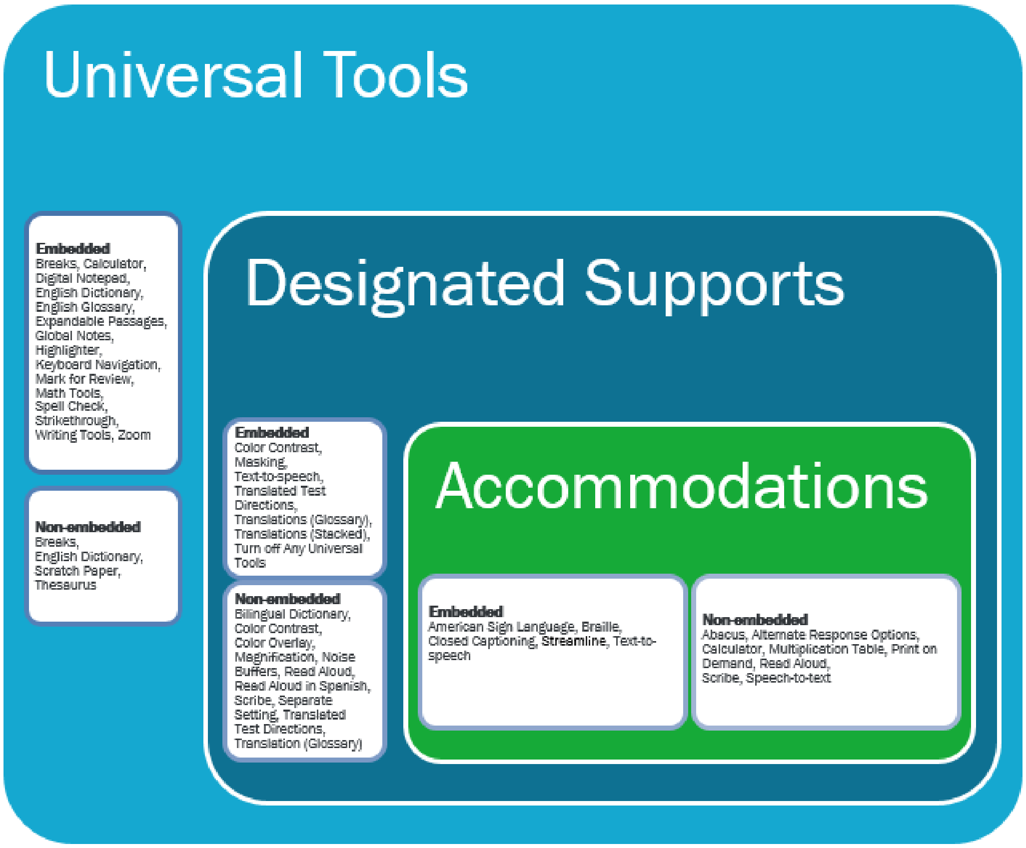
Smarter Balanced created a framework for its approach to usability, accessibility, and accommodations that included three levels of supports for students. Universal tools (e.g., highlighting, English glossary, strikethrough) are supports that are available to all students. Designated supports (e.g., masking, color contrast, translated test directions) are tools that are available to all students with a documented need. Accommodations (e.g., braille, closed captioning, ASL) are available only to students with disabilities who have Individualized Education Programs – IEPs, or 504 accommodation plans. These three levels are shown in Figure 1. Details on whether each of the Universal Tools, Designated Supports, and Accommodations is available for specific content areas are provided in the Smarter Balanced *Usability, Accessibility, and Accommodations Guidelines.*[13]

Although ASL is an embedded accommodation for Smarter Balanced ELA/Literacy listening items and mathematics items (see Figure 1, as well as Appendix A, p. 23, in the *Usability, Accessibility, and Accommodations Guidelines*), Smarter Balanced has been asked to provide additional signing accommodations via a human signer (i.e., non-embedded), and to allow signing systems other than ASL, such as Signed Exact English (SEE) or visual supports such as cued speech.

[12] For more information about the experts who were members of the Smarter Balanced Students with Disabilities Advisory Committee see: http://www.smarterbalanced.org/about/advisory-committees/#SWD

[13] Smarter Balanced, 2015b.

Figure 1. Conceptual Model Underlying the Smarter Balanced *Usability, Accessibility, and Accommodations Guidelines*



Source: Smarter Balanced Assessment Consortium *Usability, Accessibility, and Accommodations Guidelines.*

Characteristics of Students Who Are Deaf or Hard of Hearing

Not all students who use sign language as their primary communication mode are students who are deaf or hard of hearing. Further, not all students who use signing as their communication mode use ASL. Among the most frequently used languages, signing systems, and communication modes are American Sign Language (ASL), signed English, cued speech, speech reading, total communication, and bilingual-bicultural approaches. ASL has been described as a “complete, grammatically complex language,” and not a communication code designed to represent English. The focus of this section is on students who are deaf or hard of hearing.

Students who are deaf or hard of hearing account for just over 1% of the total student population.[14] Unless they live in a large urban area, and sometimes even then, most of them are the only deaf or hard of hearing student in his or her class, school, or school district.[15] This level of low-incidence, in turn,

[14]U.S. Department of Education (2014).
[15] Gallaudet Research Institute (2011).

creates challenges in providing appropriate services and supports to these students because there is less likely to be a qualified educator to address their communication needs.[16]

Although low in incidence, students who are deaf or hard of hearing are a diverse group, a factor that also contributes to the difficulty in finding qualified educators to address their needs. They vary in terms of the cause and degree of hearing loss, home language, typical communication mode, other disabilities, educational experiences, and cultural identification. Students who are deaf or hard of hearing, similar to other individuals, vary in the extent to which they use contextual information to support their communication, regardless of whether they are relying in part on residual hearing or on sign language. Visual cues and lip reading are among the contextual information that they may use. Although there is evidence that some degree of decibel loss indicates a severe/profound loss in mainstream classrooms that would require support services such as sign language or text to speech, for example,[17] the degree of hearing loss cannot indicate how much audio information a student will be able to process, with or without visual information.

Although students who are *deaf* and students who are *hard of hearing* are addressed together, and they both denote hearing loss, “deaf” is usually used to refer to a more severe degree of hearing loss.[18] The IDEA definition for “deafness” is: “Deafness means a hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification that adversely affects a child’s educational performance” (20 U.S.C. 1401(3); 1401(30)). Hearing impairment is defined as “an impairment in hearing whether permanent or fluctuating that adversely affects a child’s educational performance” (20 U.S.C. 1401(3); 1401(30)). These definitions are those used for IDEA eligibility for services, and provide only a small indication of what it means to be deaf. The definitions do not specifically recognize the Deaf community, its culture, and its members who have grown up in the Deaf culture and who use ASL as their first language.

Eligibility for an IDEA disability category does not indicate anything about a student’s primary communication modality or the student’s preferences for communication. Some students may rely on residual hearing, and some may use auxiliary aids in the classroom, such as assistive listening systems or real-time captioning. Some students may have surgically placed cochlear implants that receive signals from an external device that stimulates electrodes in the cochlea.[19] All of these impact the quality of the student’s access to orally presented information and conversations. Although there have been dramatic increases in the numbers of students who have cochlear implants, the implants have not solved, and actually may in many cases have exacerbated, the challenges that these students face.[20]

[16] See, for example, Thomas (2010).
[17] 70+ DB loss was identified by Action on Hearing Loss (see Http://www.actiononhearingloss.org.uk/your-hearing/about-deafness-and-hearing-loss/glossary/levels-of-hearing-loss.aspx). Decibel loss is generally documented via an audiogram, which is a graphic record of the results of a hearing test, but which does not indicate how much information a person will be able to process.
[18] Citing Clark (1981), the American Speech-Language-Hearing Association (ASHA, undated-b) describes the degree of hearing loss in terms of decibels, from slight (16-25) to profound (91+).
[19]From Thurlow et al. (2009): Owens & Kessler (1989) indicated that research on cochlear implants has concluded that the effectiveness of the implants is related to the age of the individual at age of onset of deafness, the residual hearing before the implant, and a child’s learning environment (Geers, 2002). Children with cochlear implants who were born with severe to profound hearing loss are not as likely to achieve the kind of proficiency in spoken language as their hearing peers (Mayberry, 2000), but can focus on developing skills that enable them to take full advantage of the sound they are able to access (Power & Leigh, 2000).
[20] Laurent Clerc National Deaf Education Center. (2012). Also see Davis & Atcherson (2009).

For about one-quarter of students who are deaf or hard or hearing, their hearing loss is congenital (present at birth); for others it is acquired after birth.[21] Hearing loss that occurs before or during the time when children are developing their language and communication skills can have significant implications for learning "vocabulary, grammar, word order, idiomatic expressions, and other aspect of verbal communication."[22] The later students are exposed to and learn ASL, typically the greater the negative effect on their proficiency level in ASL.[23] Lower ASL proficiency also creates challenges for teachers as they work to figure out how to modify instruction to include advanced academic content but lower levels of language proficiency; it is also likely to affect performance on an assessment that relies on ASL.[24] Further, as previously described, the use of sign language is complex and nuanced. There are regional variations in how ASL is signed, ASL can be signed at varying speeds, and it is sometimes augmented using other communications modes. In addition, many students use signed systems other than ASL.[25]

Many students who are deaf or hard of hearing have other disabilities, such as learning disabilities (LD) and attention deficit hyperactivity disorders (ADHD).[26] Some students who are deaf or hard of hearing come from homes where English is not the first language and some also are from minority or ethnic groups.[27] These additional characteristics have implications for the need for accessibility supports and accommodations.[28]

History of Providing Accommodations

Since the early 1990s, when standards-based assessments were first included in the Elementary and Secondary Education Act (ESEA), there has been a concerted effort to include all students with disabilities in state and national assessments. For students who are deaf or hard of hearing, early research[29] focused primarily on how students with hearing impairments performed on college entrance exams and other standardized tests of ability. The little research conducted since that time has focused on the participation of students who are deaf or hard of hearing in content assessments, primarily reading and mathematics.

Most of the ASL research in the area of mathematics has focused on the most frequently allowed accommodations, of which ASL is one.[30] Experimental studies generally have indicated no differences between ASL and non-ASL provided mathematics assessments, nor between human-provided ASL and avatar-provided ASL.[31] Nevertheless, students have individual preferences for the way in which ASL is used to present assessment items.[32]

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[21]ASHA (undated-a).
[22]NICHCY (2010, p. 4).
[23]See http://www.sciencedirect.com/science/article/pii/0749596X9190018F and http://jslhr.pubs.asha.org/article.aspx?articleid=1780041
[24] Cawthon & Leppo (2013); Qi & Mitchell (2012).
[25] ASL is the most widely used sign language in the United States. Nevertheless, there is controversy about whether ASL, cued speech, or other modes of communication (signed exact English – SEE, etc.) is preferred. See, for example, Petty (2011).
[26]Cawthon, Leppo, & pepnet 2 (2013).
[27] Gallaudet Research Institute (2011). Although there were missing data for these variables, it appeared that only about 45% of respondents were Caucasian, and that approximately 20% had a language other than English spoken at home.
[28] Cawthon (2015).
[29] See, for example, Willingham, Ragosta, Bennett, Braun, Rock, & Powers (1988).
[30] See Anjourn (2009); Cawthon, 2010; Cawthon, Leppo, Ge, & Bond, 2015, for example.
[31] See Cawthon, Leppo, Ge. & Bond, 2011; Russell, Kavanaugh, Masters, Higgins, & Hoffman, 2009.
[32] See Shyyan, Christensen, Rogers, & Kincaid, 2014.

For the ELA/Literacy listening claim, the construct is listening, which differs from a test where the construct is hearing. Limited research has focused on the assessment of *listening skills* in students who are deaf or hard of hearing,[33] although many researchers do note the importance of ensuring that the language of an assessment be consistent with the language of instruction.[34] The one study that examined a state's listening test found that only the videotaped native ASL speaker provided the relevant information needed for a successful response; both a live ASL interpreter and an SEE presentation had issues, either omitting pertinent information required to answer successfully or misrepresenting the passage by introducing word errors.[35]

Expert and Policymaker Suggestions

Because of the lack of research related to accommodations for students who are deaf or hard of hearing when listening skills are being assessed, approaches to the assessment of these students have relied on expert input and policymakers' judgments. These generally reflect careful consideration of the construct being assessed and the need for access to the assessments for students who are deaf or hard of hearing.

A consistent message from experts has been that listening to process information in English and interpreting sign language to process information are largely *parallel* processes.[36] When the intent of an assessment is to interpret or use information, whether it is done via hearing spoken words or viewing the live presentation of information via sign language, does not matter in terms of the task tapping into a linguistic reception and processing skill. What is important is that there is high quality delivery of sign language within the context of an assessment. This perspective reflects the differentiation between construct and delivery, confirming that the language of delivery should not be equated with the construct being measured.[37] Experts further suggested that an assessment of listening for students who are deaf or hard of hearing should be presented via a language (i.e., ASL and closed captioning) rather than some other non-linguistic communication mode.

State Practices

State practices provide an insight into how students who are deaf or hard of hearing have been included in state assessments of reading and mathematics. Most of these students take the general assessment, and typically use accessibility features and accommodations so that they are able to meaningfully access the tests.

For students who primarily use sign language instead of English for instruction (either via a teacher who uses sign or an interpreter in the classroom), one of the most frequently allowed assessment accommodations is sign language interpretation.[38] Historically, there has been variation across states in when sign language interpretation was permitted, but it was generally allowed for the interpretation of directions only. Many states also allowed its use for the interpretation of items on math assessments (and for reading/ELA items when the construct of interest would not be violated; for example, signing may not

[33] See Johnson, Kimball, & Brown (2001).
[34] See Cawthon, Leppo, & pepnet2 (2013) and Qi & Mitchell (2012).
[35] See Johnson et al. (2001).
[36] The research is still emerging on the extent of parallel processing in the brain. It is not clear that a deaf person who has a different cognitive profile and who uses sign language is participating in exactly parallel assessment processes (with the same cognitive load) as a hearing person using either language.
[37] This statement was made with the assumption that the language of delivery was that defined in the standards, which is English.
[38] See Christensen, Braam, Scullin, and Thurlow (2011). Sign language interpretation is used here to encompass ASL, cued speech, SEE, and any others that states recognize.

be allowed if the construct of interest is decoding). A few states allowed sign interpretation of reading passages. Generally either no specific language or sign system was specified when sign interpretation was listed as an accommodation, or ASL as the specified language for use in assessment was named in states' policies. In the years prior to the implementation of Smarter Balanced and other consortia-developed assessments, some states' policies specifically allowed the use of cued speech, signed English, or oral transliteration.[39]

Other accessibility features and accommodations commonly used by deaf or hard of hearing students included extended time, amplification, preferential seating, and small group or individual administration.[40] Often several of these accommodations are used in combination. For example, a student who uses the sign interpretation accommodation may also be provided extended time and small group or individual administration.

The development of guidelines for presenting assessment directions and items via sign language are an important aspect of state policies that has emerged over time. These guidelines emerged out of the growing realization about the need for greater consistency in how signing was conducted, so that constructs being measured were not compromised, and so that test security was maintained.

A study of the impact of different guidelines for representing the same content in computer-based assessments indicated that students who typically receive ASL performed better on items provided with ASL than on items without ASL.[41] In addition, cognitive labs that were held to examine the ASL presentation preferences of students who are deaf or hard of hearing found that they preferred (a) items with non-textual content (e.g., equations, graphics) signed rather than not signed; (b) items using a diamond structure; and (c) mathematical terms to be signed or signed and fingerspelled rather than only fingerspelled.[42]

Pros and Cons of Non-Embedded Signing

Both pros and cons have been identified about using human signers for anything other than the directions associated with standardized assessments. Similarly, pros and cons have been identified about the use of signing systems other than ASL (e.g., SEE).

Using Human Signers

When all assessments were paper-and-pencil tests rather than technology-based assessments, sign interpretation by a human signer was the most common approach used for students who are deaf or hard of hearing. In some research, to ensure uniformity, signing was presented via a video of a signer included on a DVD.[43] Other research compared a video of a human signer on DVD and an avatar signer.[44] In all of this research, ASL was used, and not other signed systems.

[39] According to data presented in Christensen et al. (2011), six states allowed the use of a cued speech accommodation. In addition, one state allowed Local Education Agencies (LEAs) to use "a standard video presentation of a test using American Sign Language, signed English, cued speech, or oral transliteration [to] increase quality, consistency, pacing and accuracy" (p. 165).
[40] See Christensen et al. (2011).
[41] See Measured Progress (2015a, 2015b).
[42] There are not standardized ASL signs for some mathematical terms (see Measured Progress, 2015; Shyyan, Christensen, Rogers, & Kincaid, 2014).
[43] Cawthon, 2011; Cawthon, Winton, Garberoglio, & Gobble (2011); Higgins, Famularo, Bowman, & Hall (2015); Johnson, Kimball, & Brown (2001).
[44] See Russell, Kavanaugh, Masters, Higgins, & Hoffman (2009).

Researchers have noted that sign interpretation during assessments by a live human interpreter (often referred to as "on-the-fly" sign interpretation) can compromise the assessment by providing answers to the student or hinting at correct answers, or at times, making the items more difficult than their written counterparts.[45] Many concerns are raised about on-the-fly signing of an assessment. When paper and pencil tests were used, a recommendation often was that the assessment items be reviewed prior to the administration of the assessment. But when the assessment is adaptive, as is the Smarter Balanced assessment of Listening, it is not possible to review items before the time of the assessment. It would only be possible if the assessment changed to a non-adaptive assessment, which would potentially have its own negative consequences for the students taking the assessment.

Additional issues arise when the sign language interpreters used by the schools are not as qualified as they should be for signing a standardized assessment.[46] Considerable efforts would have to be put toward ensuring that signers both understood the signing system or language they would use, and also were competent in their grade-level listening skills. When items are signed, care must be used to ensure that the level of inferencing that is in the original tasks is maintained. This requires the signer to know what the target responses are, so as not to change the degree of inferences in choices about the signs and ways of presenting the sentences. One possible way to do this is for the sign interpreter to copy what was done in the embedded version, and follow the same structure as the embedded accommodation. It would be almost impossible to ensure that a non-embedded version of ASL has construct validity without an external check on the interpretation process. An English-based, word for word representation that has the same structure, vocabulary, and flow of the audio tape could also be largely a parallel administration.

ASL Versus Other Signing Systems

ASL is the most widely used sign language in the United States. In one study, ASL was used most often by 75% of respondents. Percentages of respondents using ASL varied by setting (with 91% of respondents using ASL in classrooms and 53% using ASL at home).[47] Nevertheless, there continues to be controversy about whether ASL or some other mode of communication (e.g., SEE) is preferred for standardized assessments.[48] Yet, ASL is the official language that is parallel with other language translations (e.g., Spanish, etc.), and for students who have been taught using ASL during instruction, its use in the assessment will match how they have been taught. Any live sign interpretation is going to be problematic. For example, signing forms that are not based in English as a language fail to make English visible.

Considerations and Recommendations for Assessing Listening and Mathematics Skills of Students Who Are Deaf or Hard of Hearing Through Non-Embedded Signing

Several factors would need to be considered if Smarter Balanced were to present its listening and mathematics items via non-embedded signing. Some of these emerge from the Smarter Balanced signing guidelines[49] for its provision of ASL within the computer delivery of its mathematics assessment, and

[45] Personal communication on cognitive laboratory study conducted by Johnstone, Bottsford-Miller, & Thompson (2006). See also Higgins et al. (2015).
[46] Schick, Williams, & Kupermintz (2006), in a study of 2,100 educational interpreters, found that "approximately 60% of the interpreters evaluated had inadequate skills to provide full access" (p. 3).
[47] See Cawthon et al. (2011). Cawthon et al. documented that other languages were also used in classrooms, including SEE (20%), and spoken English (16%); respondents could select more than one language.
[48] See Petty (2011).
[49] See Smarter Balanced (2012).

others emerge from recent research on guidelines and current practice. These considerations and recommendations based on them for the Smarter Balanced assessments of listening and mathematics for students who are deaf or hard of hearing are presented here.

Identifying Students Who May Benefit from a Signing Accommodation

Students who may benefit from the use of a sign interpretation accommodation for an assessment of listening skills or mathematics are those students who use ASL or another signing system in the classroom[50] and who have demonstrated proficiency in ASL or the signing system. Determination of proficiency in ASL or other signing system may be made by educators who are familiar with the student's learning needs and preferences in collaboration with the student's family and the student himself or herself, if appropriate. Administering new assessments of ASL comprehension skills also might be useful for determining ASL proficiency.[51]

Recommendation. **Identify a procedure for decision makers to use to determine the ASL proficiency of students who are deaf or hard of hearing.** For those students who typically rely on residual hearing and visual cues or who use a signing system other than ASL it is particularly important to evaluate ASL proficiency before administering an assessment in ASL. The determination of whether ASL is appropriate for an individual student should depend on the student's knowledge of ASL and be made by the student's IEP team, which should include parents and students, as appropriate, as well as an ASL specialist.

Signer Qualifications

If the use of a locally provided, non-embedded sign language accommodation were to be permitted by Smarter Balanced, considerable attention would need to be given to the qualifications of signers. Signers are adults who are fluent in ASL or another signing system who have expertise in interpretation and translation services. Those signers who are familiar with the student, such as sign interpreters or sign support specialists who regularly work with the student in the classroom, possibly could provide the non-embedded signing accommodation in a way that reflected the context of ASL and other signing system regional and dialectal variability, which the student may use in responding to items, and students' individual preferences.[52] But, for a standardized assessment, it is vital that variability does not compromise the validity of the Smarter Balanced assessment.[53] Signers are expected to meet their state's qualifications for educational sign interpreters or sign support specialists. Signers for Smarter Balanced assessments should be expected to have extensive training, practice, and familiarity with the Smarter Balanced *Usability, Accessibility, and Accommodations Guidelines* document, test administration manuals, and related documentation. They also should view practice listening items in ASL prior to

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[50] Students need to have an opportunity to use accommodations during instruction, and new accommodations should not be introduced for the assessment that have not been previously been used during instruction (NCEO, 2015).
[51] For example, see Hauser, Paludneviciene, Riddle, Kurz, Emmorey, & Contreras (2015). Additional research needs to be done on the predictive value of scores on tests administered with the ASL accommodation (e.g., resultant scores on tests administered in English and in ASL, proficiency thresholds, etc.).
[52] See Stamp (2015).
[53] There are content area issues (especially in areas like math) that affect the understanding of what each item is trying to get at, and how to do it without changing the construct. For listening, items are a combination of a passage and the questions asked, requiring that the student go back and forth between the stimuli and the items.

testing. Signers also are expected to be familiar with state administration and security policies and procedures.[54]

Recommendation. **Ensure that all signers sign test security and confidentiality agreements prior to test administration.** Since signers would have access to the assessments, they need to affirm that they will not compromise the confidentiality and security of the assessment. Prior to signing the agreement, they should have completed security training that includes information that specifically addresses sign interpretation. The use of signed affidavits for sign interpreters *after* test administration, which require them to indicate that they did not violate any procedures, can also play a role in improving security practices.

Recommendation. **For individual administrations, there should be a second adult viewing the administration who has also signed a test security agreement. Individual administrations can pose some unique security risks.** This risk can be reduced by having a second adult in the room or by videotaping the session.[55] Whether a second adult is in the room, or a videotape is reviewed later, the other adult must be a highly qualified signer of ASL or whatever signed system is being used for the test administration.[56] In addition, arrangements must be made to either shred the videotape after verification or return it to the state department of education.

Standardization Principles and Requirements

ASL, similar to other languages, is characterized by regional and stylistic variations. To adhere to standardized practices and avoid compromising the assessment construct, signers should be familiar with assessment guidelines and rely solely on ASL for interpretation. In addition, they should follow the conventions of academic ASL rather than social ASL.[57] Although limited research is available on standardizing signing guidelines, a recent study[58] found that the diamond presentation of an assessment item, with the question presented first, the information from the problem next, and then a repeat of the question was preferred over other an English text order (no diamond). The study had less consistent findings about fingerspelling (alphabetically signing terms that may not be familiar to students), although some students preferred to have key vocabulary items presented using both an ASL sign and fingerspelling.

Recommendation. **Signers should copy what was done in the embedded ASL-signed version, and follow the same structure as the embedded accommodation instead of relying on the audio file for ASL or using a non-embedded interpretation through a human signer.** Although it would be useful for signers to see all items before the assessment, the adaptive nature of the Smarter Balanced test makes this impossible.[59] Reliance on the ASL signed adaptive items thus would be all that is available, but very important to use.

Recommendation. **Ensure that standard ASL conventions are followed.** The signer should use academic ASL, and avoid using regional signs, slang terms, and other non-standard vocabulary items. For example, the verb is preceded by the subject, regardless of the order presented in English. The

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[54] See Lazarus & Thurlow (2015) for considerations when developing test security policies.
[55] See Lazarus & Thurlow (2015).
[56] Or other signing system, if Smarter Balanced decides to allow another signing system.
[57] For example, the American Sign Language Teachers Association (ASLTA) supports the development and use of standards for learning for ASL (ASLTA, 2014).
[58] Measured Progress (2015a); Shyyan et al. (2014).
[59] If Smarter Balanced were to allow a signing system other than ASL, it would also be beneficial for the signer to see both the ASL embedded video and the transcript and audio file for items, but again, seeing these before the assessment is administered is not possible because of the adaptive nature of the assessment.

signer should be someone who is fluent in ASL and in the language used at the grade level of instruction. This will help to align student language levels with assessment delivery.

Recommendation. **Allow the signer to fingerspell words when it would help clarify what is being signed or when requested by the student.** This will ensure clarity of interpretation and provide additional clarification on signs that may not be familiar to the student. Additionally, there are cases where the signer really needs to use fingerspelling so that the student understands the connection between the concept introduced in the item and the concept introduced in the stimulus. Given that it is possible that fingerspelling might be used for terms where it would be inappropriate to do to (e.g., when a student has low print literacy in English), a set of guidelines will be needed for fingerspelling to indicate where it is inappropriate to fingerspell.

Familiarization with Test Content

Having a working familiarity with the test environment and the general content area that will be covered by the assessment,[60] at the student's grade level, helps facilitate the signer's ability to sign the test content accurately during the testing session. Signers also will be able to support students more effectively if they have a working knowledge of all embedded and non-embedded universal tools, designated supports, and accommodations available on the Smarter Balanced assessments. They will also need to know the standard signs for procedural components of the assessment, such as "click and drag" or other computer-based tasks.

Recommendation. **The signer must have thorough knowledge of the Smarter Balanced standards and claims, as well as familiarity with all terminology likely to be used in a grade-level assessment of listening and mathematics.** The Smarter Balanced assessments are adaptive, pulling from hundreds of items. It is not possible to provide items for the signer to review prior to the assessment. Thus, not only must the sign interpreter have thorough knowledge of the Smarter Balanced standards and claims, he or she also must be familiar with all terminology likely to be used in a grade-level assessment of listening and mathematics. Signers should use the guidelines developed for the ASL video signers to help them prepare for the administration of the Smarter Balanced assessment of listening.[61]

Test Security

Test security involves maintaining the confidentiality of test questions and answers, and is critical in ensuring the integrity of a test and validity of test results. To ensure test security and confidentiality, signers need to (a) keep testing materials in a secure place to prevent unauthorized access, (b) keep all test content confidential and refrain from sharing information or revealing test content, and (c) shred, hold, or return all materials as instructed.

Recommendation. **Ensure that all signers sign test security and confidentiality agreements prior to test administration.** Since signers have access to the assessments, they need to affirm that they will not compromise the confidentiality and security of the assessment. Prior to signing the agreement, they should have completed security training that includes information that specifically addresses sign interpretation. The use of signed affidavits for sign interpreters *after* test administration which require them to indicate that they did not violate any procedures can also play a role in improving security practices.

[60] Since the Smarter Balanced Assessment is adaptive rather than a fixed form, any given student may see some of thousands of items—depending on student performance.
[61] At the time that this White Paper was being developed, the set of guidelines for ASL video signers was under development.

ASL Signing Procedures

Signers will not have access to items before the administration of the Smarter Balanced assessment because it is adaptive. Thus, signers will need to be situated so that they can see the screen and so that the student can easily see the screen and the signer. Students who need an ASL accommodation will require a separate test setting to minimize distractions for themselves and their peers, as well as extra time to allow for the items to be signed. In most cases, signers are able to respond to student questions about test procedures such as test directions or how to navigate within the test environment. If the listening and mathematics items have different response formats, signers need to be aware of those.[62]

Recommendation. **Ensure that any and all other needed documented supports and accessibility features are available to the student.** If the individual signing is to provide these other supports, he or she must be qualified to do so. If the signer cannot provide additional documented supports or accommodations, indicate that another person must to be available to provide them to the student.

Scribing for Signing Responses

A student who receives an ASL sign accommodation may also need a scribe for responding to listening assessment items. A determination should be made as to whether students may sign their responses to the person who is presenting the items via ASL. If this is allowed, it will be important to ensure that this person also has met the requirements for scribes. (See Appendix E in the *Usability, Accessibility, and Accommodations Guidelines* for additional information on scribing.)

Recommendation. **Determine whether a signer may also serve as a scribe for the Smarter Balanced assessment of Listening.** Although not considered best practice to have the signer presenting the Listening items also be a scribe, if this is allowed, require that the signer has been trained as a scribe for the Smarter Balanced assessments and understands the Scribing Protocol.[63] According to the Smarter Balanced protocol, when serving as a scribe the signer may ask the student to re-sign words as needed, but such requests must not be communicated in a manner suggesting that the student should make a change or correction. Further, signers, including those who serve as scribes, may not question or correct student choices, alert students to errors or mistakes or influence students in any way that might compromise the integrity of student responses.

Lack of Data and Research

The listening items are at a particular intersection of language and access that do not appear in any other content area. There is a lack of data and research on the provision of an assessment of listening through a human signer. Little is known about the potential changes to constructs, implementation challenges, or appropriate procedures and processes that could help minimize and mitigate those issues. For example, there is a lack of research on barriers to implementation across different sign systems and modalities.

Recommendation. **Gather data and conduct research before addressing other recommendations.** The lack of research and data on many of the critical considerations addressed here indicates that research and data collection should occur **before** any other changes are made to the

[62] When available, the set of guidelines for ASL video signers will include an appendix containing information about the item formats.

[63] Smarter Balanced (2015a).

procedures now in place for Smarter Balanced. Each area under consideration (e.g., identifying students who may benefit; signer qualifications; standardization principles and requirements; familiarization with test content; test security; ASL signing procedures; scribing for signing responses) would benefit from first conducting research and collecting data.

Recommendation. **Collect data on the use and impact of both the ASL non-embedded and embedded accommodations for listening and mathematics items.** In addition to collecting information about the participation and performance of students using this accommodation, also gather feedback from students and signers on the use of this accommodation. These data can serve to evaluate and improve further accommodation use for the student, and also to explore the range of students who would benefit from such an accommodation. If collected by the Smarter Balanced Assessment Consortium, these data can inform the field on the use of ASL embedded and non-embedded accommodations in addition to providing important feedback that may improve the future delivery of the ASL accommodation for listening and mathematics items.

Recommendation. **Conduct needed research on providing supports to students who are deaf or hard of hearing, as well as to other students who use sign language as their primary mode of communication.** Research in the past has been limited, in part, because of the relatively small numbers of students who are deaf or hard of hearing. With the dramatically increased numbers across the Smarter Balanced states, all consortium states would benefit from a research agenda for small incidence populations. Students who are deaf or hard of hearing should be one of these populations.

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Appendix A

Smarter Balanced Listening Assessments Targets for Each Grade

Grade	Assessment Target for Listening
3	Target 4. LISTEN/INTERPRET: Interpret and use information delivered orally. Gr. 3 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. SL-3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.
4	Target 4. LISTEN/INTERPRET: Interpret and use information delivered orally. Gr. 4 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. SL-3 Identify the reasons and evidence a speaker provides to support particular points.
5	Target 4. LISTEN/INTERPRET: Interpret and use information delivered orally. Gr. 5 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. SL-3 Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence
6	Target 4. LISTEN/INTERPRET: Analyze, interpret, and use information delivered orally. Gr. 6 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. SL-3 Delineate a speaker’s argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not.
7	Target 4. LISTEN/INTERPRET: Analyze, interpret, and use information delivered orally. Gr. 7 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. SL-3 Delineate a speaker’s argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.
8	Target 4. LISTEN/INTERPRET: Analyze, interpret, and use information delivered orally. Gr. 8 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation. SL-3 Delineate a speaker’s argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
11	Target 4. LISTEN/INTERPRET: Analyze, interpret, and use information delivered orally. Gr. 11–12 Standards: SL-2, SL-3 (DOK 1, DOK 2, DOK 3) SL-2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SL-3 Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

Source: *Appendix B: Grade Level Tables for All Claims and Assessment Targets and Item Types.* Available at;http://www.smarterbalanced.org/wordpress/wp-content/uploads/2011/12/ELA-Literacy-Content-Specifications.pdf

Appendix B

Smarter Balanced Listening Stimuli Specifications for Computer Adaptive Testing (CAT) Items

Claim 3: Listening Stimuli Specifications for Computer Adaptive Testing (CAT) Items

- Listening (Claim 3) stimuli are ~1minute audio presentations used to measure listening.
- The stimulus should reflect the components noted in the qualitative measures rubric for listening stimuli (purpose or meaning, auditory structure, oral language features, knowledge demands) and meet the appropriate complexity levels by grade.

Audio presentations should also

- be informational and not narrative;
- at grade-level complexity;
- be clear and of fine quality;
- meet the demands of grade-level interest and appropriateness;
- be rich enough to support well-developed questions;
- adhere to descriptions and the level of quality set forth in the Common Core State Standards, the Smarter Balanced Assessment Consortium Content Specifications for ELA, and this document;
- consider accessibility concerns (see the Smarter Balanced Assessment Consortium Accessibility and Accommodations Guidelines);
- adhere to the Smarter Balanced Bias and Sensitivity Guidelines (see the Smarter Balanced Assessment Consortium Bias and Sensitivity Guidelines);
- contain crisp sound with no distracting background noise;
- allow students to pause, rewind, and replay as needed; and
- NOT be overly complex (scattered discourse and/or lack of restatement of key information can make the short-term memory load overly challenging).

Source: Smarter Balanced Assessment Consortium: English language arts & literacy computer adaptive test (CAT) and performance task (PT) stimulus specifications, January 2014. Available at: http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/05/TaskItemSpecifications/EnglishLanguageArtsLiteracy/ELAStimulusSpecifications.pdf

Appendix C

Sample Score Report for Smarter Balanced ELA/Literacy

Smarter Balanced Assessment Consortium

Sharon D. Hosler Grade 6
State: California District: Ropefish Lynx Public Schools
School: Kangaroo Hippopotamus Community Middle

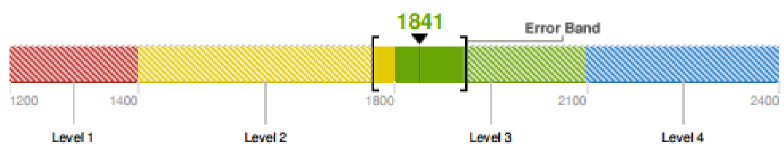
ELA/Literacy

Summative 2014 - 2015 Effective Date: 4/16/2015

Overall Score

1841 Level 3

The student has met the achievement standard and demonstrates progress.



Reading

At/Near Standard

Students can read closely and analytically to comprehend a range of increasingly complex literary and informational texts.

Writing

At/Near Standard

Students can produce effective and well-grounded writing for a range of purposes and audiences.

Listening

At/Near Standard

Students can employ effective speaking and listening skills for a range of purposes and audiences.

Research & Inquiry

At/Near Standard

Students can engage in research and inquiry to investigate topics and to analyze, integrate, and present information.

Accommodations

The following accommodations were made available:

Alternative Response | American Sign Language | Braille | Noise Buffers | Printed items | Printed passages/stimuli | Read aloud | Scribe | Streamline Mode | Text-to-speech

Appendix D

Smarter Balanced Mathematics Assessments Targets for Each Grade

Grade	Claim	Assessment Targets
3	Concepts and Procedures	**Priority Cluster** • Understand properties of multiplication and the relationship between multiplication and division. • Multiply and divide within 100. • Geometric measurement: understand concepts of area and relate area to multiplication and to addition. • Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects. • Solve problems involving the four operations, and identify and explain patterns in arithmetic. • Develop understanding of fractions as numbers • Represent and solve problems involving multiplication and division. **Supporting Cluster** • Use place value understanding and properties of plane figures and distinguish between linear and area measures. • Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures. • Reason with shapes and their attributes. • Represent and interpret data.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategically. • Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose or solve problems
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute

Grade	Claim	Assessment Targets
		propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. • Base arguments on concrete referents such as objects, drawings, diagrams, and actions.
4	Concepts and Procedures	**Priority Cluster** • Use the four operations with whole numbers to solve problems. • Use place value understanding and properties of operations to perform multi-digit arithmetic. • Extend understanding of fraction equivalence and ordering. • Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers. • Generalize place value understanding for multi-digit whole numbers. • Understand decimal notation for fractions, and compare decimal fractions. **Support Cluster** • Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. • Geometric measurement: understand concepts of angle and measure angles. • Gain familiarity with factors and multiples • Generate and analyze patterns. • Represent and interpret data. • Draw and identify lines and angles, and classify shapes by properties of their lines and angles.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategically. • Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose or solve problems.

Grade	Claim	Assessment Targets
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. F. Base arguments on concrete referents such as objects, drawings, diagrams, and actions.
5	Concepts and Procedures	**Priority Cluster** • Use equivalent fractions as a strategy to add and subtract fractions. • Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition. • Apply and extend previous understandings of multiplication and division to multiply and divide fractions. • Perform operations with multi-digit whole numbers and with decimals to hundredths. • Understand the place value system. **Support Cluster** • Graph points on the coordinate plane to solve real-world and mathematical problems. • Classify two-dimensional figures into categories based on their properties. • Write and interpret numerical expressions. • Analyze patterns and relationships. • Convert like measurement units within a given measurement system. • Represent and interpret data.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategies • Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose or solve problems.

Grade	Claim	Assessment Targets
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. • Base arguments on concrete referents such as objects, drawings, diagrams, and actions.
6	Concepts and Procedures	**Priority Cluster** • Apply and extend previous understandings of arithmetic to algebraic expressions. • Reason about and solve one-variable equations and inequalities. • Understand ratio concepts and use ratio reasoning to solve problems. • Represent and analyze quantitative relationships between dependent and independent variables. • Apply and extend previous understandings of multiplication and division to divide fractions by fractions. • Apply and extend previous understandings of numbers to the system of rational numbers. **Supporting Cluster** • Compute fluently with multi-digit numbers and find common factors and multiples. • Solve real-world and mathematical problems involving area, surface area, and volume. • Develop understanding of statistical variability. • Summarize and describe distributions.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategically. • Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose

Grade	Claim	Assessment Targets
		or solve problems.
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. • Base arguments on concrete referents such as objects, drawings, diagrams, and actions. • At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.)
7	Concepts and Procedures	**Priority Cluster** • Analyze proportional relationships and use them to solve real-world and mathematical problems. • Solve real-life and mathematical problems using numerical and algebraic expressions and equations. • Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. • Use properties of operations to generate equivalent expressions. **Supporting Cluster** • Draw, construct, and describe geometrical figures and describe the relationship between them. • Solve real-life and mathematical problems involving angle measure, area, surface area, and volume. • Use random sampling to draw inferences about a population. • Draw informal comparative inferences about two populations. • Investigate chance processes and develop, use, and evaluate probability models.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategically. • Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used.

Grade	Claim	Assessment Targets
		• Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose or solve problems.
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. • Base arguments on concrete referents such as objects, drawings, diagrams, and actions. • At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.)
8	Concepts and Procedures	**Priority Cluster** • Understand the connections between proportional relationships, lines, and linear equations. • Analyze and solve linear equations and pairs of simultaneous linear equations. • Work with radicals and integer exponents. • Define, evaluate, and compare functions. • Understand congruence and similarity using physical models, transparencies, or geometry software. • Use functions to model relationships between quantities. • Understand and apply the Pythagorean Theorem. **Supporting Cluster** • Know that there are numbers that are not rational, and approximate them by rational numbers. • Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. • Investigate patterns of association in bivariate data.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategically. • Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical

Grade	Claim	Assessment Targets
		models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose or solve problems.
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. • Base arguments on concrete referents such as objects, drawings, diagrams, and actions. • At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.)
11	Concepts and Procedures	**Priority Cluster** • Interpret the structure of expressions. • Write expressions in equivalent forms to solve problems. • Perform arithmetic operations on polynomials. • Create equations that describe numbers or relationships. • Understand solving equations as a process of reasoning and explain the reasoning. • Solve equations and inequalities in one variable. • Represent and solve equations and inequalities graphically. • Understand the concept of a function and use function notation. • Interpret functions that arise in applications in terms of a context. • Analyze functions using different representations. • Build a function that models a relationship between two quantities. **Supporting Cluster** • Define trigonometric ratios and solve problems involving right triangles. • Summative, represent, and interpret data on a single count or measurement variable. • Extend the properties of exponents to rational exponents. • Use properties of rational and irrational numbers. • Reason quantitatively and use units to solve problems.
	Problem Solving	• Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. • Select and use appropriate tools strategically.

Grade	Claim	Assessment Targets
		• Interpret results in the context of a situation. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).
	Modeling and Data Analysis	• Apply mathematics to solve problems arising in everyday life, society, and the workplace. • Interpret results in the context of a situation. • Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. • Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. • State logical assumptions being used. • Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas). • Identify, analyze, and synthesize relevant external resources to pose or solve problems.
	Communicating Reasoning	• Test propositions or conjectures with specific examples. • Use the technique of breaking an argument into cases. • Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. • Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is. • State logical assumptions being used. • Base arguments on concrete referents such as objects, drawings, diagrams, and actions. • At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.)

Appendix E

Smarter Balanced Accessibility Considerations for Each Claim

Accessibility & Claim #1: This claim clarifies the importance of conceptual understanding and procedural knowledge underlying the important core content in CCSSM. The standards refer to the ability to carry out procedures, describe concepts, communicate results, use appropriate tools strategically, and explain why specific procedures make sense. Neither the claim itself nor the CCSSM explicitly addresses the challenges that some students with disabilities face in the area of mathematical calculations. Because of the importance of building skills in computation in early schooling, the explication of the content may be different in early school grades compared to later school grades. Providing assistive technologies such as an abacus or calculator may not be considered appropriate up through about grade 4. At some point during intermediate grades, however, the use of these tools is considered an appropriate avenue of access to allow students to demonstrate that they are able to "calculate accurately and efficiently."

It is also important to address access to mathematics via decoding text and written expression. The uses of alternative means of access and expression are ones used by successful individuals (Reitz, 2011) to demonstrate high levels of success, and thus are an appropriate avenue of access to the content for students with disabilities in the areas of reading decoding and fluency as well as for those with blindness or visual impairments. Likewise, allowing students alternative ways to express their understanding of mathematics content is important. Students who are unable to explain mathematical processes via writing or computer entry might instead provide their explanation via speech to text technology (or a scribe) or via manipulation of physical objects.

A major aspect of all the claims, including Claim #1, is communication, especially students' ability to explain why or how given procedures or approaches work. To maximize access to English learners who are at a lower proficiency in writing and speaking, it is important for Smarter Balanced to explore allowing ELL students to use diagrams, drawings, equations, and mathematical models, as well as words. It will also be useful to provide opportunities for ELL students to communicate their understanding through performance tasks or other approaches where multiple domain input can be provided. Furthermore, when a major performance difference exists between tasks such as expanding and explaining, it will be important to allow students to express their views through the use of native language, where that is appropriate.

Accessibility and Claim #2: This claim about mathematical problem solving focuses on the student's ability to make sense of problems, construct pathways to solving them, persevering in solving them, and the selection and use of appropriate tools. This claim includes student use of appropriate tools for solving mathematical problems, which for some students may extend to tools that provide full access to the item or task and to the development of reasonable solutions. For example, students who are blind and use Braille or assistive technology such as text readers to access written materials, may demonstrate their modeling of physical objects with geometric shapes using alternate formats. Students who have physical disabilities that preclude movement of arms and hands should not be precluded from demonstrating with assistive technology their use of tools for constructing shapes. As with Claim #1, access via text to speech and expression via scribe, computer, or speech to text technology will be important avenues for enabling many students with disabilities to show what they know and can do in relation to framing and solving complex mathematical problems.

With respect to English learners, the expectation for verbal explanations of problems will be more achievable if formative materials and interim assessments provide illustrative examples of the communication required for this claim, so that ELL students have a better understanding of what they are required to do. In addition, formative tools can help teachers teach ELL students ways to communicate their ideas through simple language structures in different language modalities such as speaking and writing. Finally, attention to English proficiency in shaping the delivery of items (e.g. native language or linguistically modified, where appropriate) and the expectations for scoring will be important.

Accessibility and Claim #3: Successful performance under Claim #3 requires a high level of linguistic proficiency. Many students with disabilities have difficulty with written expression, whether via putting pencil to paper or fingers to computer. The claim does not suggest that correct spelling or punctuation is a critical part of the construction of a viable argument, nor does it suggest that the argument has to be in words. Thus, for those students whose disabilities create barriers to development of text for demonstrating reasoning and formation of an argument, it is appropriate to model an argument via symbols, geometric shapes, or calculator or computer graphic programs. As for Claims #1 and #2, access via text to speech and expression via scribe, computer, or speech to text technology will be important avenues for enabling many students with disabilities to construct viable arguments.

The extensive communication skills anticipated by this claim may also be challenging for many ELL students who nonetheless have mastered the content. Thus it will be important to provide multiple opportunities to ELL students for explaining their ideas through different methods and at different levels of linguistic complexity. Based on the data on ELL students' level of proficiency in L1 and L2, it will be useful to provide opportunities as appropriate for bilingual explanations of the outcomes. Furthermore, students' engagement in critique and debate should not be limited to oral or written words, but can be demonstrated through diagrams, tables, and structured mathematical responses where students provide examples or counter-examples of additional problems.

Accessibility and Claim #4: Many students with disabilities can analyze and create increasingly complex models of real world phenomena but have difficulty communicating their knowledge and skills in these areas. Successful adults with disabilities rely on alternative ways to express their knowledge and skills, including the use of assistive technology to construct shapes or develop explanations via speech to text. Others rely on calculators, physical objects, or tools for constructing shapes to work through their analysis and reasoning process.

For English learners, it will be important to recognize ELL students' linguistic background and level of proficiency in English in assigning tasks and to allow explanations that include diagrams, tables, graphic representations, and other mathematical representations in addition to text. It will also be important to include in the scoring process a discussion of ways to resolve issues concerning linguistic and cultural factors when interpreting responses.

Appendix F

Sample Score Report for Smarter Balanced Mathematics