**Appendix: Frameworks adapted in the L3 Assessment Framework**

A broad search of potentially relevant frameworks was conducted online by searching health, speech and hearing, and education frameworks. Fifteen additional relevant frameworks (or concepts) were found, ranging from health to speech and hearing sciences to education, and providing both an international and Australian perspective. These frameworks provided multiple additional perspectives that were then unified together with the above identified frameworks into the proposed L3 Assessment Framework. The relevant aspects of the identified frameworks are summarized in the following sections, separated into health, speech and hearing, and education.

**A. Health frameworks**

Three health frameworks were considered in the development of our L3 Assessment Framework. We present the WHO ICF and WHO ICF-CY first as they form the main basis for our framework.

***1.*** ***WHO ICF and 2. WHO ICF-CY***

The aim of these health frameworks is to classify functioning, disability, and health. Hence they provide valuable insights into how to best shape our L3 Assessment Framework on understanding and assessing listening problems. The International Classification of Functioning, Disability and Health (ICF) is a framework established by the World Health Organization (WHO; 2002) which describes health and health-related states. In 2007, an additional framework was constructed applying specifically to children and youth (WHO ICF-CY) (World Health Organization, 2007) which is of relevance to our demographic. The WHO ICF has been used in hearing research with older adults with acquired hearing loss (Hickson & Scarinci, 2007) and, as found in the scoping review, the WHO ICF-CY has been used at a surface level to assess classroom communication in children with hearing loss. We now extend its use to assess children’s listening to learn at a deeper level.

The WHO ICF-CY comprises two parts: functioning and disability, and contextual factors. These parts are split into four components. Functioning and disability is split into i) body functions and body structures, and ii) activities and participation. Contextual factors are split into iii) environmental factors and iv) personal factors. Each of these components have qualifiers to classify the presence and severity of a problem (except for personal factors which are not classified in the framework but acknowledged to play a part). The qualifiers for body functions and structures are change in body function and change in body structure. The qualifiers for activities and participation are capacity and performance. The qualifier for environmental factors is facilitator or barrier.

The WHO ICF also utilizes the concept of a *standardised environment* as well as a *capacity qualifier*. The standardised environment is a neutral environment that assesses the full performance of a person to execute a given task or action. The capacity qualifier describes the person’s ability to execute this task or action in the neutral environment without personal assistance or assistive devices. The gap between the person’s capacity and their performance on the same action or task in an experimental environment (a different environment under assessment) then provides a measure of the effectiveness of the assessed environment. If performance is greater than capacity, then the environment is a facilitator (i.e., the person has performed better than in the standardised environment). If capacity is greater than performance, then the environment is a barrier to performance (i.e., the person has performed worse than in the standardised environment). These concepts are important for L3 Assessment Framework when thinking about assessing an intervention.

***3. Dodge et al.’s definition of wellbeing***

Children’s wellbeing is an important part of the Impact component of our L3 Assessment Framework. Dodge, Daly, Huyton, and Sanders (2012) propose a definition of wellbeing as the following “stable wellbeing is when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge. When individuals have more challenges than resources, the see-saw dips, along with their wellbeing, and vice-versa.” (pg. 230). As can be seen from this definition, wellbeing is balanced by the person’s resources compared to the challenges they face. Both the resources and challenges consist of psychological, social, and physical components.

**B. Speech and Hearing frameworks**

Two frameworks on speech and hearing were consulted in preparing our L3 Assessment Framework to provide insight into what affects listening activities and how listening processes can be assessed.

***1. Mattys et al. (2012) – Speech recognition framework***

This research paper provides a classification of adverse listening conditions according to their *origin* and *effect*. As much of classroom learning is conducted through listening and speaking, this paper is important to consider in our L3 Assessment Framework as it sheds light on how speech communication can deteriorate in the classroom and the effect this could have on listening.

With respect to the *origin* of adverse listening conditions,degradation of the speech signal can occur at the source (the speaker), during transmission (through the environment from the source to the receiver), or at the receiver (the listener) due to perceptual or cognitive limitations. Source signal degradation can occur via several means. For example, conversational speech can include syllable deletion, segment elision, and segment reduction, as well as disfluencies such as repairs, restarts, and fillers. Additional degradation can result from accented speech or speech disorders, however, it could be argued that this is a receiver limitation in their ability to interpret the source as all speech is accented. Environmental or transmission degradation can also occur in several ways. Background noise can interfere with speech transmission, and reverberation can distort the speech signal; and both are exacerbated when communicating over distance. Additionally, channel distortions such as talking on the telephone or online can distort the speech signal. Receiver limitations can be caused by a peripheral deficiency (e.g., sensorineural hearing loss); an incomplete language model (e.g., children and non-native listeners); impaired access or use of the language model (e.g., neurological deficits); or due to cognitive load and limited processing resources.

With respect to the *effect* of adverse listening conditions on the listener, failure of recognition can occur when the listener misses information due to not recognising the words the speaker is saying. Perceptual interference occurs when competing signals such as background noise affect the listener’s interpretation of, or attention to, the target speech signal. When there is a distractor present there is an attentional cost of trying to selectively attend to the target speech while ignoring the distractor. Multi-tasking also reduces attentional capacity due to divided attention. Additionally, listening in adverse listening conditions places higher demands on memory resulting in reduced memory capacity. However, there can also be a positive effect of listening in adverse conditions, that is, perceptual learning. The sensory system can improve in its response to adverse listening conditions via learning through experience.

***2. Lemke and Besser (2016) – Cognitive load and listening effort conceptual description***

Lemke and Besser (2016) provide a conceptual description of how situational influences (listener-external factors), the listener’s auditory and cognitive resources (listener-internal factors), and the listener’s personal state affect the listening effort. This is important to consider in our L3 Assessment Framework as it helps us understand the listening effort involved when the child is listening or communicating inside the classroom. The *listener-external factors* include the following physical characteristics: sound levels, number of target sources, number of interfering sources, frequency spectrum and temporal structure of the target and interfering sound sources, the acoustic properties of the room (e.g., reverberation), the spatial configuration of the sound sources, the presence of visual or haptic cues, the presence of sensory distractions, and the language and/or accents of both the target and interfering speech. Each of these factors can influence how much processing effort is needed for speech recognition. The *listener-internal factors* that affect listening effort are auditory processing and cognitive processing. Auditory processing includes audiometric thresholds, abilities to process supra-threshold spectral and temporal cues, and binaural processing of interaural time and level differences. Cognitive processing includes language ability, semantic, episodic, and working memory, attention, and speed of information processing. The *personal state* of the listener that affects listening effort include their physiological state (e.g., tiredness), motivation (e.g., engagement), emotional state (e.g., stress or grief), and social-psychological factors (e.g., self-advocacy).

**C. Education frameworks**

Ten education frameworks were consulted in the process of developing the L3 Assessment Framework. Considering education frameworks were important in understanding the activities that take place in the classroom, and the impact of listening and learning on children’s academic achievement, communication and social interaction, and wellbeing.

***1. Bloom’s Taxonomy and Taxonomy for Teaching, Learning, and Assessment***

Bloom's (1954) taxonomy of educational objectives and the revised taxonomy for teaching, learning, and assessment is a multi-tiered model for classifying educational goals. It is important to consider in our L3 Assessment Framework as it helps us understand the learning process that drives listening and communication inside the classroom. The taxonomy has six main categories which in order of hierarchy from lowest to highest are: knowledge, comprehension, application, analysis, synthesis, and evaluation (pg. 201-207). In 2001, Bloom’s taxonomy was revised by Anderson and Krathwohl (2001) into a Taxonomy for Teaching, Learning, and Assessment. The nouns for the hierarchical levels were changed to verbs to create a more dynamic and active conceptualisation. The new classifiers and their descriptions are: remember (recognizing and recalling), understand (interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining), apply (executing and implementing), analyse (differentiating, organizing, and attributing), evaluate (checking and critiquing), and create (generating, planning, and producing) (pg. 67-68). These skills are important when considering the impact of listening and learning on academic achievement.

***2. Davis’ Listening Types Framework***

Davis (1996) provides a framework for listening that consists of three modes of listening: evaluative listening, interpretive listening, and hermeneutic listening. Davisuses these modes to describe the ways mathematics teachers can listen to their students, but it can be applied more broadly to listening in different contexts which is why it is important to consider for our L3 Assessment Framework. Evaluative listening is where the listener is listening for something in particular, for example a correct answer to a question. It is surface-level listening. Interpretive listening is listening that seeks information and responds to it. It involves deliberate, active interpretation. Hermeneutic listening involves exploring, making sense of, and building on the ideas discussed in multiple perspectives.

***3. Framework for Leadership in Elementary Schools***

Bowman's (2014) Framework for Leadership in Elementary Schools includes four distinctive leadership dispositions: the spirit to include, the passion to serve, the discipline to listen, and the courage to question. These dispositions are important to consider for our L3 Assessment Framework, especially when thinking about child-directed classroom communicative and social interactions where a child must work with a group of children on a problem. The spirit to include is focused on the child including those who have been excluded by listening to the perspectives of others and transforming relationships. The passion to serve is about the child serving others with a moral purpose and thinking of themselves less often. The discipline to listen is focused on the child being less interesting themselves and more interested and curious in others to create shared meaning and shared partnerships. The courage to question encourages the child to think about what they are refusing to look at, what they are refusing to face, how they have changed, and what they want for themselves and those that they love.

***4. Vygotsky’s Sociocultural Theory***

Vygotsky’s Sociocultural Theory emphasises the collaborative nature of learning (Mahn, 1999). Children construct knowledge through social interactions. Guidance or collaboration from an adult or peer can help improve the learning potential of the child compared to if there were going to solve a problem independently (Mahn, 1999). This theory is important to consider for our L3 Assessment Framework especially when considering the learning activity that the children are engaged in and the role of the teacher and peers in assisting children to construct knowledge.

***5. Krashen’s Input Hypothesis***

Krashen’s Input Hypothesis states that language acquisition occurs when the learner receives input slightly more advanced than then their current knowledge (Gien & Nel, 2018). This hypothesis is important to consider in our L3 Assessment Framework as it promotes scaffolding, i.e., the learner is assisted by a more knowledgeable learner/teacher when they lack the skills needed for further learning.

***6. Hattie’s Visible Learning***

Hattie (2008) conducted a synthesis of over 800 meta-analyses relating to achievement to explain the key influences on student learning including influences of the student, home, school, curricula, teacher, and teaching strategies. These influences are important to consider in our L3 Assessment Framework regarding body functions and structures, personal factors, and environmental factors. For example, student influences on achievement include their background such as their prior achievement (Cohen’s d effect size is high), Piagetian programs (Cohen’s d effect size is high), self-report grades (Cohen’s d effect size is high), and creativity (Cohen’s d effect size is medium). It also includes attitudes and dispositions such as personality (Cohen’s d effect size is low), self-concept (Cohen’s d effect size is medium), motivation (Cohen’s d effect size is medium), concentration/persistence/engagement (Cohen’s d effect size is medium), reducing anxiety (Cohen’s d effect size is medium), and attitude to maths/science (Cohen’s d effect size is medium). Additionally, it includes physical attributes (Cohen’s d effect sizes are low to medium), and preschool influences (Cohen’s d effect sizes are medium). The influences with the highest effect sizes for home were home environment and socioeconomic status. For school they were acceleration for gifted students and classroom behavioural influences. The influences with the highest effect sizes for curricula were vocabulary programs, repeated reading programs, and creativity programs. For the teacher they were micro teaching, teacher-clarity, and teacher-student relationships, and for teaching they were providing formulative evaluation, reciprocal teaching, and feedback.

***7. Partnership for 21st Century Learning***

The Partnership for 21st Century Learning (2019) has developed a Framework for 21st Century Learning which outlines the skills, knowledge, and expertise needed for success in work and life. These are important to consider in our L3 Assessment Framework in terms of learning and impact. These include creativity and innovation (thinking creatively, working creatively with others, implementing innovation), critical thinking and problem solving (reasoning effectively and solving problems), communication and collaboration (communicating clearly), information, media, and technology skills (accessing and evaluating information, using and managing information, analysing media, creating media products, applying technology effectively), flexibility and adaptability (adapting to change and being flexible), initiative and self-direction (managing goals and time and working independently), social and cross-cultural skills (interacting effectively with others and working effectively in diverse teams), productivity and accountability (managing projects and producing results), and leadership and responsibility (guiding and leading others and being responsible to others).

***8. Australian context of education***

Whereas all previous frameworks and concepts are used internationally, this section looks at the Australian context of education, in particular the New South Wales (NSW) Department of Education, to provide more practical insights into learning in the classroom that are important to consider in our L3 Assessment Framework.

***a. Centre for Education Statistics and Evaluation What works best: 2020 Update***

This document by the NSW Government Education Centre for Education Statistics & Evaluation (2020) is an update of a 2014 document on evidence-based practices to help improve NSW student performance. The document contains eight themes that aim to enhance the learning outcomes of students, but the most relevant themes for establishing our L3 Assessment Framework are explicit teaching, effective feedback, classroom management, and wellbeing, as they rely on the student to listen, comprehend, and communicate effectively.

*Explicit teaching:* Explicit teaching (lecturing) can benefit all students as it results in better performance than non-explicit teaching practices. It is especially helpful when learning new or complex concepts and skills as it reduces the cognitive burden and promotes deep learning. Explicit teaching practices include explaining what the student will be learning and the purpose of the task, explaining new ideas, checking student understanding, and encouraging question time Explicit teaching systematically builds skills towards mastery. After teachers have explained and modelled new concepts via lecture-style teaching, and guided students through the new concepts during group work activities, it is beneficial for the child to work independently practicing the new skills.

*Effective feedback:* Providing effective feedback is important so a student can improve in their learning. This includes reflecting and communicating about the task, providing detailed, specific feedback on how the student can grow, encouraging self-assessment, reflection, and monitoring, ensuring students act on the feedback received, providing feedback about a student’s process or effort, and providing feedback that promotes self-regulation.

*Classroom management:* Effective classroom management is important for maximising learning time, minimising disruptions, and improving students’ performance. Effective classroom management has a positive effect on student behaviour, engagement, and achievement. Effective classroom management strategies include creating a positive social and emotional classroom climate and positive teacher-student relationships, communicating classroom expectations, rules, and routines, engaging students via active participation, supervising students to keep them on task and providing assistance when needed, and providing consistent and calm responses to help students re-engage when they become disengaged or disruptive.

*Wellbeing:* Student wellbeing encompasses “cognitive, social, physical, emotional and spiritual wellbeing” (pg. 33) and, among other factors, is related to a student’s academic achievement (Bücker et al., 2018). Student belonging, valuing their voice, and promoting engagement in learning helps improve student wellbeing which results in improved academic achievement, mental health, and life choices.

***b. NSW Government Great Teaching, Inspired Learning: A Blueprint for Action***

This document by the Centre for Education Statistics and Evaluation Advisory Council (2013) is designed for improving teacher effectiveness so that students can become successful at school, work, and life. It consists of five chapters, but the first chapter, inspired learning, is most relevant to developing our L3 Assessment Framework. The foundation for inspired learning is defined as “deep learning and genuine understanding of subject matter and the ability to use, critique and apply it appropriately” (pg. 5). This chapter discusses the importance of students being able to access global information, work collaboratively, solve problems, think creatively, innovate, and connect through technology for success at school, work, and in life. Students need to have the confidence to work by themselves and in a team, analyse what they see and hear, and be able to confidently use technology to enhance communication, learning, and quality of life. Students need to be clear communicators and expressors of ideas and have the interpersonal skills to relate with others. They also need to be creative and innovative in solving challenges and making the most of opportunities, as well as understanding their social responsibility and looking after their wellbeing.

***c. My Time, Our Place – Framework for School Age Care in Australia***

The aim of this document by the Australian Government Department of Education and Training (2011) is to “assist educators to provide children with opportunities to maximise their potential and develop a foundation for future success in life” (pg. 4). Although this framework is designed for school care outside of school hours, it does have elements applicable to listening and learning in the classroom. The relevant outcomes of this document are that children have a strong sense of wellbeing, are confident and involved learners, and are effective communicators.

*Strong sense of wellbeing:* Children need to be strong in their emotional and social wellbeing by showing trust and confidence, enjoying working both collaboratively with others and independently, and demonstrating self-regulation of their emotions. Children need to take increased responsibility for their wellbeing by being connected to others, regulating their emotions, increasing their competence in using equipment, and increasing their awareness of healthy lifestyles.

*Confident and involved learners:* Children need to develop the skills of curiosity, cooperation, confidence, creativity, commitment, enthusiasm, persistence, imagination, and reflexivity. Children should be able to demonstrate skills in problem solving, enquiry, experimentation, hypothesising, researching, and investigating. Children also need to be able to transfer learning from one context to another and develop their own learning through connecting with people, places, and technologies.

*Effective communicators:* Children need to be able to interact verbally and non-verbally with others, collaborate with others and express ideas, and make use of a range of media and communication technologies to become effective communicators.