Exploring the Benefits of Auslan in Early Intervention Approaches for Deaf Children

A report commissioned by Deaf Australia and Deaf Connect

By Dr. Michael D'Rosario and Emma Dawson

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FIGHTING INEQUALITY IN AUSTRALIA

We acknowledge the traditional owners of country and pay respect to past, present and emerging Elders.

We also acknowledge and respect the members of the Deaf community in Australia, who preserve their rich heritage, culture, and our language; Auslan (Australian Sign Language).
We also acknowledge our custodians of Auslan, promoting awareness, equality, and access through our sign language.
Through Auslan, we inspire future leaders in our Deaf community to continue our legacy and heritage.

View the companion reports and Auslan translations here

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About Deaf Australia

Deaf Australia was founded in 1986 as a peak national advocacy body that represents all Deaf, Deafblind hard of hearing people and others who live in Australia and use Auslan as their language of preference. The focus has and continues to be on developing access to information and accessible communication.

We work with Australian governments and collaborate with key stakeholders to make sure that Australia complies with the United Nations Convention on the Rights of Persons with Disabilities. The CRPD and the Australian Disability Strategy guides our work; we aspire to achieve equity for Deaf people across all areas of life.

About Deaf Connect

Deaf Connect is the largest whole-of-life service provider and social impact organisation for Deaf, Deafblind and hard of hearing Australians. We stand with the Deaf community to build capacity and influence social change while paying respect to history, culture and language.

Our focus is on community and empowerment, supporting Deaf Australians and their families to make choices and actions to thrive in life, while delivering on a national agenda to improve equity for the Deaf community, and to remove systemic cultural and language barriers.

About Per Capita

Per Capita is an independent progressive think tank, dedicated to fighting inequality in Australia. We work to build a new vision for Australia based on fairness, shared prosperity, community and social justice.

Our research is rigorous, evidence-based and long-term in its outlook. We consider the national challenges of the next decade rather than the next election cycle. We ask original questions and offer fresh solutions, drawing on new thinking in social science, economics and public policy.

Our audience is the interested public, not just experts and policy makers. We engage all Australians who want to see rigorous thinking and evidence-based analysis applied to the issues facing our country's future.

About the Authors

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Michael is an experienced economist/econometrician and interdisciplinary research lead with longstanding associations and experience working with the NFP sector, universities and social impact focused organisations. He has worked in community development in both Australia and Asia. Prior to working with PerCapita, Michael served as a chair at Deakin University, the manager of a large research program/organisation affiliated with the University of Melbourne, the ESG & Impact Advisor to CPA Australia, and as Research, Policy and Communications Advisor to the Victorian Aboriginal Legal Service and the National Aboriginal and Torres Strait Islander Legal Service. Michael has published extensively in Economics, Data Science journals and led a number of large economic evaluations.

At PerCapita, Michael serves and Chief Economist and Head of Data Science, focusing largely on leading economic evaluation, economic modelling, ensemble forecasting and interdisciplinary research projects. Michael has served as a health economist and advisor to a number of refugee, youth and health focused charities, including Anchor, YouthConnexions, DCS, Deaf Connect, Deaf Australia, as well as peak hygiene charity Pinchapoo. In addition to working with PerCapita, Michael advises on the design of courses in Research Methods with a leading Australian university.

Prior to working in the NFP sector Michael worked with PwC, KordaMentha, AusAid, Victoria University and the University of Melbourne. Michael has served on a number of university boards as a Non-Executive Director and Deputy Chair. Michael is a recipient of the LexisNexis/Butterworths Prize, an Australia Endeavour Award, and the Alfred Deakin Medal.

Emma Dawson, Executive Director

Emma has worked as a researcher at Monash University and the University of Melbourne; in policy and public affairs for SBS and Telstra; and as a senior policy adviser in the Rudd and Gillard Governments. She has a research background and policy expertise in economic inequality, immigration, gender equality, disability inclusion, retirement incomes and social security.

Emma has published reports and articles on a range of policy issues. She is a regular contributor to Guardian Australia, The Age/SMH and the Australian Financial Review and is a frequent guest on various radio programs nationally. She appears regularly as an expert witness before parliamentary inquiries and often speaks at public events and conferences in Australia and internationally.

Emma is the co-author of Per Capita's landmark report Measure for Measure: Gender Equality in Australia, and co-editor, with Professor Janet McCalman, of the collection of essays What happens next? Reconstructing Australia after COVID-19, published by Melbourne University Press in September 2020.

Overview

While the benefits of sign language are readily apparent, the role of the timing of language intervention, and early intervention are not readily apparent to many who do not possess a thorough understanding of the benefits of such intervention and the process of language acquisition. The decision to support sign language as the first language for a deaf child is a complex one for parents, given that most deaf children are born into hearing families. Nonetheless, the nearly half century's worth of research supports the role of sign language in early intervention.

Auslan is the language of the culturally Deaf and hard of hearing community in Australia. While sign language usage has been shown to benefit cognitive development and support better learning outcomes, it may be argued that Auslan has not received the same level of support at a national level that European and American sign languages have within their respective jurisdictions over the past 50 years, and consequently there is a dearth of research considering the benefits of early language intervention employing Auslan from an economic perspective. There is, however, a well-established qualitative benefits and developmental research evidence base, that evidences the benefits of sign languages including Auslan, and other European sign languages and American Sign Language, that is instructive and rigorous.

This commissioned research report seeks to summarise the benefits of Auslan and early intervention strategies to inform policy and support a deeper understanding of the role of Auslan as a language modality and the benefits of early intervention as a developmental strategy.

Understanding Deafness through a cultural lens

Members of the Deaf community usually see themselves as forming a linguistic-cultural community, although some may also identify with the disability sector to varying degrees.[1] This is frequently not acknowledged or well understood within Australian society.[2] As noted by the WFD (2019) "Deaf people consider themselves as a linguistic and cultural group, with highly complex natural languages but the rights of deaf people are however assured through disability policy, legislation and international instruments. Deaf identity is not a monolithic entity, and a person can also have other identities relating to gender, race, disability, socioeconomic status."

Deaf, Deafblind and hard of hearing people in the Deaf community use Auslan as their preferred language in Australia: it is considered the language of the Deaf community. It is therefore critical to consider the role of Auslan and its benefits to the Deaf community, and the associated economic benefits more broadly. Deafness is too frequently misunderstood by policy makers, because it is frequently viewed employing a medical-disability model exclusively, with limited regard for the cultural-linguistic lens. This is because there is limited consideration given to the evidence base, and many researchers within policy units possess limited knowledge of the Deaf community.

This report is informed by direct engagement with the Deaf community and the evidence base pertaining to early intervention, Auslan usage, bi-modal bilingualism and the impacts of deafness.

Scope of Research

The present report considers the economic benefits of Auslan accounting for the critical benefits to wellbeing, health literacy, services access and the productivity of the economy. The research seeks to account for the benefits associated with Auslan as a community-enabling and culturally supportive language.

Per Capita's economic evaluation framework and modelling has been developed using publicly available information, as well as data supplied by commissioning entities. The assumptions are based on credible research that has been subject to peer review, with the assumption set then applied to the economic and financial datasets to arrive at our impact estimates.

We employ a scenario forecasting approach, deriving from the extant literature that explores the impacts and benefits of Auslan to consider a scenario where Auslan did not exist, and what the costs and impacts of this significant absence would be. The absence of longitudinal data capturing Auslan capability and language exposure/deprivation data involving an adequate sample cohort, over an adequate time interval, makes primary estimation challenging.

Given this dearth, we rely on shorter episodic research and smaller sample sizes, and therefore there is a degree of uncertainty associated with the estimate set. All studies of this nature evidence a degree of uncertainty and we therefore note that the caution afforded this category of studies be afforded the present report.

While all estimates evidence a degree of uncertainty, we assert that the modelling is based on a sound research base and assumption set and offers a conservative evaluation of the benefits of early language intervention.

Key Terminology

The terms deaf and Deaf will be used according to their cultural definitions amongst the Australian Deaf community, consistent with the extant literature and the guidelines provided by Deaf Australia. People who identify as "culturally Deaf" are more likely to have been born deaf or become deaf early in life, are pre-lingually deaf and use sign language as a primary or preferred mode of communication. Deaf people of the western world identify as a culture with distinct languages and customs, in the same way that people of any particular ethnic group may identify as belonging to that culture, with specific practices and approaches to communication.

1 This 'identification' may be due to the process of categorisation in civic systems, rather than identification as a member of the disability community.

2 For an excellent summary article on Deaf Culture see Carty, B., 1994. The development of deaf identity. In The Deaf Way: Perspectives from the International Conference on Deaf Culture, Washington DC (Vol. 40, p. 43). For a note on the experiences of Deaf Individuals In the health care system see Beaver, S. & Carty, B. (2021). Viewing the healthcare system through a deaf lens. Public Health Research and Practice, 31(5):e3152127.

Auslan – Auslan is the name given to Australian Sign Language, which is the natural language signed by members the Australian Deaf, Deafblind and hard of hearing community

Deaf – The use of a capital "D" in "Deaf" is often used to identify a person or a group as sharing the language and culture of the Deaf community. An individual that identifies as Deaf may employ a number of different methods of communication including different modalities, or multiple modalities. However, there is an emerging trend away from this usage of "D" (see, e.g., Kusters et al, 2017), as it can be seen to create unnecessary dichotomies within a community which exhibits considerable diversity. It is most often used when referring to groups or entities such 'the Deaf community', rather than when referring to individuals.

deaf – denotes auditory deafness, clinical deafness rather than referencing Deaf culture and the Deaf community. However, see previous entry for information about changing usage of "d/D".

Bi-modal bilingualism – describes bilingualism which incorporates the use of languages in both oral and signed modalities (herein Auslan and English).

BANZSL – British, Australian and New Zealand Sign Language is a language family, of which British Sign Language, Auslan and New Zealand Sign Language may be considered to be member languages.

HALY – Health Adjusted Life Year: A burden of disability measure based on how many years of life are lost or affected by the condition.

DALY – Disability Adjusted Life Year: A type of HALY method based on accounting for the number of years lost, and number of years impacted by a disability.

QALY – Quality Adjusted Life Year: A type of HALY based on making an estimate of the quality of life, hence the name Quality adjusted life year. The measure includes both a quantity of life and quality of life estimate.

YLL – Years of Lost Life due to disability

YLD – Years of Life impacted by a disability

Cultural dysfluency – People experience cultural disfluency if a culture-based expectation is not met, or where they lack a cogent knowledge of their culture due to separation or a lack of exposure.

Early intervention – the process of identifying risks and engaging in appropriate interventions to minimise the likelihood of adverse consequences for children and young people. Herein unless otherwise stated the use of the expression pertains to Auslan/Sign language based early intervention

Language deprivation – The deprivation of access and exposure to language. May result in cognitive deficits and 'language deprivation syndrome', a form of language and cultural dysfluency.

Language acquisition – the process of acquiring a first language, sometimes also a second language if it is acquired very early. First language acquisition is acquisition of the native language of the individual. Language acquisition should be distinguished from language learning, which is a more structured process for learning a second or subsequent language.

Research approach

In formulating a viable and appropriate research strategy to undertake the research and associated analysis, we engaged in a series of consultations with a number of different research partners and stakeholders from the Deaf community, the research community and with several peak organisations within the sector.

Presentation of research strategy and methodology to stakeholders

Upon establishing a viable research framework we initiated a consultation process with representatives of the Deaf community and services sector. During these consultations we outlined the following;

1. The methodological approaches proposed for the research
2. The availability of different data sources (and those that required specific permissions)
3. The approaches available for the dissemination of research

We obtained feedback from the group and sought to reflect this feedback in the research methods to the extent appropriate.

Research Reference and Advisory Group

While engaging in this research we have sought feedback from and consulted with experts from the Deaf community, academia, and health economics. The reference group informed the following aspects of the research.

- Offering insights into new and compelling research
- Offering comment on the DALY and benefits evaluation methods
- Providing support in securing key third party datasets
- Supporting the communication and dissemination of findings

Members of the Research Reference and Advisory Group

We would like to acknowledge the significant contribution of Prof. Breda Carty in her review of the analysis presented within this report and her support in the presentation and dissemination of the analysis. We would also like to acknowledge the significant efforts of the reference group.

Prof. Breda Carty – Emeritus Professor of Deaf Studies – Macquarie University

Matt Lloyd Cape – Manager – Research and Advocacy – PerCapita

Brent Phillips – Chief Impact Officer – Deaf Connect

Jen Blyth – Chief Executive Officer – Deaf Australia

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Acknowledgements

We would like to acknowledge the following parties that have supplied data or research that was assistive in the analysis conducted within this report.

National Accreditation Authority for Translators and Interpreters

Expression Australia

Introduction

There is a significant evidence base that has been established over many decades, exploring the impact of language on cognitive development, and the role of early intervention. This evidence base serves as the impetus for this research project. The analysis presented seeks to survey the literature, and outline the established literature, serving as a precis to the research on early intervention. The research considers the evidence base pertaining to Auslan (and sign languages more broadly) as an early intervention approach for deaf children while also considering the extant research on bilingual and bicultural approaches to early intervention. Employing estimates deriving from the research exploring the impacts of deafness, the report offers a series of estimates of the costs of delaying intervention.

There is ample evidence supporting the notion that oral-aural and visual-gestural modalities of language and communication 'nourish the brain's language mechanism' (Hall 2017). This assertion is critical to the acknowledged benefits of sign language as an early intervention approach. Each modality of language, oral and signed, is enriching and facilitates language acquisition. It is a common misconception that one or the other is detrimental to cognition, which is not supported by the evidence base. This report does not therefore adopt an 'either-or' view of using signed and oral approaches, given the apparent benefits of each. The report focuses on the benefits of Auslan early intervention for deaf and hard of hearing (DHH) children, even when oral-aural skills are also being developed.

Humphries et al. (2014) assert that it is frequently the case that "language" and "speech" are used interchangeably by policy makers and researchers. This usage reflects a fundamental misunderstanding about the nature of language. Language is rich and diverse, and sign language is a distinct form of language and modality of communication.

The Deaf community is diverse with several communication methods used. Some members of the community are bimodal bilingual, with fluency in both Auslan and spoken and/or written English. Others use primarily Auslan and may have limited fluency in English. Some may continue to use educational communication systems such as Signed English (Ozolins and Bridge 1999). It is important to note that, for Deaf people, fluency in English does not necessarily mean that they can understand spoken English. Nonetheless the community shares a common association with Deaf culture. Auslan is the language of the Deaf community, and a defining aspect of Deaf culture.

The benefits of early intervention are not merely in respect to cognitive development and academic attainment. Many parents are choosing sign language as a modality of language for their deaf children because of the social and cultural benefits associated with Auslan usage. The highly supportive and community-oriented nature of the Auslan community within Australia is a source of immense social capital and engagement for many.

A brief history of Auslan usage

In the 19th century, British, Irish and Scottish people who were deaf migrated to Australia and brought their sign languages with them. Over time, an Australian sign language developed its own unique characteristics. Like any other living language, Auslan continues to evolve over time to meet the communication needs of the Deaf community.

Auslan emerged within dedicated "schools for the deaf" and became the preferred mode of communication for the Australian Deaf community. The term Auslan was coined in the late 20th century by linguist Trevor Johnston (Johnston & Schembri, 2007).

It possesses a grammar and sentence construction approach that is distinct from English, and its sign lexicon is also somewhat differentiated from antecedent sign languages. While Auslan is best understood as a language coming from the BANZSL family of sign languages, it continues to change and draws from other sign language dialects. Its origins lie in 19th century migratory patterns and like any other language it has evolved over time with lexicon expansions adding richness to the language.

Auslan draws from many different lexicons, and many modern expressions used by young people draw from ASL (American Sign Language). As Auslan emerged as the language of the Deaf community, so too did the research program driven by the Deaf community, evidencing the best models of intervention for young deaf learners. The benefits of Auslan are in part linked to the timing of intervention.

The benefits of early intervention

Understanding the benefits of early intervention requires an understanding of the challenges that may arise in the absence of such intervention. The following segment of the report outlines early intervention concepts and practices broadly, and the role of early language intervention, with a specific focus on sign language based early intervention.

What is early intervention?

Early intervention is the process of offering appropriate support to children and young people that are identified as being at high risk of adverse outcomes absent of such intervention. Identification of high-risk children and young people is paramount to effective intervention (Yoshinaga-Itano 1999, Gale, 2019).

The primary purpose of early intervention is to prevent problems from occurring, and not to wait for them to arise. Where problems arise, respond as expediently as possible. In the case of deafness, the absence of early intervention may result in forgone developmental benefits, and result in visual processing of language information rather than language region processing of signed

language[3] (a less efficient means of processing sign language), and in the medium term, give rise to adverse psycho-social impacts. This developmental variation will occur regardless of the language that is being acquired and is therefore not isolated to the signing modality but pertains to all language acquisition.[4] Early intervention also seeks to promote self-efficacy and foster the requisite skills and capabilities for successful and independent lives.

The implementation of early intervention is often varied, and there is no singular approach to any type of intervention. Intervention is often tailored to the needs of the individual and their potential risks. Examples of methods employed in early intervention include school-based program delivery, peer or adult mentoring, engagement sessions, and programs delivered using technology to improve beneficiary skill sets.

Within different risk categories different interventions are necessary. Considering a hypothetical category of risk, entirely separate to our focus, for example involving a hearing individual at risk of criminality, a program of mentoring may be considered an appropriate early intervention. For a child with autism early intervention may involve home visitation to support skill development that includes training for parents to support them in caring for their child. A child that is deaf may benefit from early Auslan exposure and learning in their home and school settings. They will benefit from exposure to deaf peers and Deaf culture. They may also benefit from hearing aids or implantation depending on the nature of their deafness, and associated oral strategies, or some combination of strategies reflecting a bimodal bilingual approach.

The nature of the risks faced by the child will determine the type of intervention and the impact of timing of intervention. There is strong evidence suggesting that early intervention is best within most risk categories however with some categories of risk and vulnerability later interventions may still provide significant and comparable benefits to the child. For example, a child at risk of criminality may benefit from later life mentoring, beyond their early youth. But some risks are time dependent, and necessitate early-stage intervention, particularly those risks that are associated with cognitive, physical, or psycho-social development. This appears to be the case with the risks associated with language acquisition that appear to necessitate early term intervention, potentially within the first five years.

Early language intervention for a deaf child may involve exposure to Auslan education, oral-aural skills, community, and Deaf culture. Early intervention may alleviate and reduce the risk of language deprivation and the associated condition, language deprivation syndrome. Early Auslan exposure ensures first language acquisition and is associated with cognitive and developmental benefits.

While acknowledging that other early intervention strategies exist, our focus herein is specifically on Auslan/sign language based early intervention strategies and their impact on deaf children.

How does early intervention generally work?

There are several different approaches to the administration and delivery of early intervention reflective of different national perspectives and cultural differences. They all seek to identify and reduce the factors that are drivers of risks and maximise the number and extent of protective factors within the life of the child.

The factors that impact a child's life negatively are well understood and well established in research. These factors also interact in complex ways, making no two experiences identical. Failure to identify individuals evidencing high risks increases the likelihood of mental and physical health problems, criminal involvement, substance misuse, or exploitation or abuse in later life.

Factors impacting development, learning, physical and mental health, and engagement with the community differ for each child, and vary at personal, family, community, state and societal levels. There are protective factors that exist and emerge to protect, support, equip and nurture children. But they do not emerge within every child's situation, or they emerge to a differential level. Examples include socio-economic status, parental mental health, quality of schooling, broad familial support, and nurturing social environments proximate to the child, and available to the child. In the context of deafness, the critical moderating factor is access to language, language and developmental progress, and the impact of programs that redress language deprivation.

With many risk categories factors are largely not deterministic at an individual level, however evidence suggests that with deaf children, access to language and first language acquisition are key determinants of future outcomes, both academically and more broadly.

Early intervention strategies involving deaf children involve parental decisions pertaining to the use of varied intervention strategies, such as the use of oral strategies, sign language, or bimodal bilingual approaches, or implantation when implantation is plausible. The choices faced by parents are impacted by their own knowledge or lack thereof pertaining to Deaf culture, the extent of the child's deafness, and their community network.[5]

The challenges faced by parents are difficult to navigate, and often a source of immense stress. Options are often presented in a diametrically opposed manner (Humphries et al 2014, Hall, 2017), as a false dichotomy, and this makes the decision faced by parents all the more challenging. Ching et al (2018) explore this decision process conducting a series of interviews with parents identifying a series of key themes "(1) parents draw on a variety

3 There are established patterns for access and processing language. In sign language as with spoken language the Broca's area is activated, while processing sign language as with spoken language employs Wernicke's area, consistent with spoken language.

4 For a general introduction to these issues see Suri, Sana. "What sign language teaches us about the brain". The Conversation.

5 Added complexity arises from the many parties that engage with the decision process that may have divergent views pertaining to appropriate intervention, and the plausibility of multiple concurrent interventions, often described as bi-cultural and bi-modal approaches. There are a number of medical and allied health professionals that are parties to the decision process, including audiologists, hearing health professionals. Our discussion with reference group members indicates that many of these allied professionals may be unaware or not engaged with the Deaf culture. It is imperative that relevant stakeholders possess adequate knowledge of the benefits of Auslan as an intervention, in addition to a viable knowledge of the role of Auslan in bi-cultural, bi-modal interventions.

of experiences and information to make decisions; (2) parents' preferred outcomes for their children drive their choices; (3) child's preference and proficiency drive parental choice; and (4) parents' fears and worries influence decisions. The results reinforced the importance of parents receiving unbiased, descriptive information as well as evaluative information from professionals, so that they could consider all options in making a decision that met their needs."

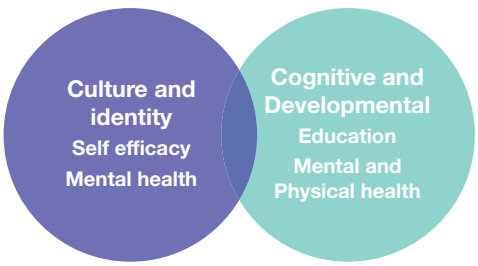
Equally challenging is the process of moderating progress and the decision to change a communication method. Where a decision has been made, parents may be fearful of change. Given the stark presentation of choices, the decision to change or include a new method may be a highly stressful one. Scarini (2018) conducted a thematic analysis of the decision factors influencing changes in communication method identifying five key themes influencing parental/caregiver decisions, "(1) family characteristics; (2) family access to information; (3) family strengths; (4) family beliefs; and (5) family-centered practice. The overall finding that the family unit is at the core of decision-making has important clinical implications regarding early intervention professionals' provision of family-centered services when working with the families of children with hearing loss".

Overall, the decisions pertaining to early language acquisition, modalities of intervention and any potential change in intervention strategy present parents with an incredibly stressful and confusing set of choices. Understanding the implications of these decisions is critical for parents and policy makers alike. The decision to defer potentially viable interventions appears to have consequences well beyond childhood.

Exploring the benefits of early sign language intervention

It is important to acknowledge that language fluency and early exposure to language afford benefits to users of language beyond communication alone. Sign language, like all living languages, provides users with benefits to cognition and development that further enable and support better educational access and learning outcomes. Knowledge of and exposure to Deaf culture are also supported and positively associated with Auslan knowledge and early exposure to Auslan moderates native language capability. The benefits of cultural membership have not been accounted for sufficiently when considering the benefits of early intervention. These two broad benefits categories are the focus of the current report, with consideration given to secondary benefits that derive from these two primary benefits categories, most notably, educational attainment and mental health outcomes.

Figure 1 – The benefits of early intervention



Cognitive and developmental benefits

The benefits of sign language to cognitive development are apparent within the significant body of literature exploring the impact of sign language on early childhood development. As noted in the preliminary discussion, it is important to recognise that sign language as with aural-oral languages is enriching and developmentally valuable. It evidences all the same cognitive benefits as spoken languages. The timing of intervention remains critical given the nature of first language learning and language development. There is a significant evidence base supporting the assertion that language acquisition during the first five years is most critical for native language acquisition.

Concerningly, sign language is often presented as the last choice or as part of a false dichotomy with oral language, whereby parents are often made to feel as though they must choose between one strategy or the other (Humphries et al. 2014). This presentation is contrary to the existing research exploring language and cognition.

Humphries et al. (2014) notes that parents are often told that the best way for their child to acquire spoken language is to raise them without sign language. In many cases, parents are advised by medical professionals with minimal knowledge and understanding of sign language and Deaf culture that sign is to be chosen only as a last resort (Petitto 1998, Johnston 2006), and that great effort should be devoted instead to the acquisition of speech. Given that these parents are hearing and unfamiliar with deaf people's lives and sign languages, many opt for the more typical oral and/or aural choice (speech and audition only).

This false dichotomy presentation of the decision framework faced by parents may result in many young deaf children not being afforded the benefits of sign language or only being given access to sign language when other methods have been unsuccessful (when it is often too late to receive the full benefits). The benefits remain compelling, however with the introduction of Auslan being associated with improved language and communication development across both signed and spoken languages, pointing to potential to support cognition, social and emotional development (Wong et al, 2018).

While cochlear implantation offers immense benefits to many receiving implantation (Blamey and Sarant 2003; Blamey et al., 2001; Preisler et al., 2002, Sharma et al. 2020), recipients of implantation achieve different levels of benefit. Some children are able to pursue oral/aural intervention strategies through implantation. For some children, cochlear implantation does not provide full access to spoken language (Meadow-Orlans et al., 2004). Most deaf children receiving implantation are functionally hard of hearing (Blamey, 2002; Blamey et al., 2001; Schick et al., 2006; Spencer, 2002; Spencer & Marschark, 2003). These children benefit from exposure to and assistance in learning signed language (Hall et al. 2017; Spellun & Kushalnagar, 2018). This is also the case for children with late diagnoses and/or later age of cochlear implantation (Lyness et al. 2013). The present report does not consider the relative merits of different approaches to intervention, acknowledging the well documented benefits of both sign language and implantation, amongst other notable strategies. Rather the report focuses on the benefits of Auslan as an early intervention strategy for profoundly deaf

children, and for those that may benefit from both oral and sign language interventions.

Understanding the benefits of Auslan usage to children that are profoundly deaf and for those children that are not able to access full spoken language is of critical importance. Notably however, all strategies appear to benefit from the earliest intervention. Critical to this discussion is the consideration of the dichotomy presentation of oral and alternative strategies. While it is well established that sign language is cognitively beneficial and not at the expense of oral/aural strategies, the highly pervasive either/or view remains. The following studies explore the cognitive benefits of sign languages in early childhood.

Neuro-plasticity and the window for early intervention

The neural plasticity underlying language learning is a process rather than a single event (Banaszkiewicz, 2021, Richardson, 2020). The language and literacy research strongly supports the notion of a critical window for first language acquisition. Language acquisition may occur at any time, but to receive the benefits associated with 'native' capability or first language capability, and complex grammatical understanding, learners benefit from early exposure to language (Mayberry et al. 2011, Humphries et al. 2014).

Humphries et al. (2011) note that "the language or languages the child acquires during these early years are called first languages. Around five years of age, the plasticity of the brain begins to gradually decrease. A child who has not acquired a language by that time (often called "the critical period") runs the risk of not acquiring native-like fluency in any language". Where a child evidences greater challenges in first language acquisition due to deafness, regardless of the extent of deafness, this interval represents a critical window for intervention (herewith critical intervention window, CIW). This critical period is important for first language acquisition for hearing children but rarely presents challenges; as language deficits generally only arise as a result of intentional neglect, or a lack of exposure to language where a child has not been around people. For deaf children, the critical intervention window represents the interval during which first language acquisition necessitates intervention.

Studies of deaf people employing scanning technology to observe activation in regions, and the plausible impacts of acquiring sign language at different times support this assertion. A study of adults in the U.S. employing ASL (for a term of 30+ years) that were exposed to ASL at different times (birth to three years, four to seven years, and eight to fourteen years), identified an "age of acquisition" effect that impacted their ability to understand grammar (Mayberry et al., 2011).

Notably, the study identified that activation occurs differently depending on the timing of ASL exposure, notwithstanding the significant term of ASL usage. Later exposure to ASL demonstrated greater activation in posterior visual brain regions, and less in anterior language brain regions when exposed to video of ASL sentences. Where individuals were exposed to ASL earlier in life the reverse was observed. This means that the individual processed language differently depending on the initial sign language exposure term. Sign language is processed visually by those who were exposed to ASL later, rather than within the language regions of the brain. This is a less efficient means of processing language. Hall (2017) emphasises that the sign language acquisition window is not longer, citing Mayberry et al. (2011); noting that "Even after decades of language use, later exposure to ASL meant less processing in language brain regions". This is a key finding, as robust neural pathways in the language regions of the brain are essential for developing language fluency and for learning new languages across the lifespan.

The visual attention patterns of children also differ based on exposure to sign language. A longitudinal study of deaf and hearing infants, exploring sign language exposure from parents, identified that a mother's use of signed language and gesture is strongly associated with the attention patterns of the child, as well as their approach to social interaction and language progressing. A mother's use of sign language when a child is 12 months old was associated with the noted developmental progress dimensions observed in the child at 18 months old (Meadow-Orlans, Spencer, Koester, & Steinberg, 2004).[6] These studies offer further evidence of the critical window for language acquisition.

Timing of initial intervention(s)

The identification of hearing loss at the earliest point has been identified as critical to the success of intervention with a number of studies determining that identification during infancy, then supported by a suitable intervention by the age of approximately six months makes normal language development (either spoken or signed language) a possible outcome (see inter alia Anderson, 2006; Arehart & Yoshinaga-Itano, 1999; Schick, 2003; Yoshinaga-Itano et al. 1998). In particular, Yoshinaga-Itano et al. (1998) have identified that where the child's hearing loss is identified by six months of age they have "significantly higher receptive and expressive language skills than children with later-identified hearing loss". Inge (1981) notes that "there is now considerable evidence in support of the Piagetian-Wernerian hypothesis that early language emerges out of a more general symbolic capacity, one that also includes the use of gestural symbolic schemes in play".

Yoshinaga-Itano (2006) offers the proposition that age of identification is not a direct determinant of the production of speech in children that are deaf. But it is positively associated with language development. Additionally, Yoshinaga-Itano (2005) offers the instructive conclusion that "when children are able to produce lexical and grammatical units of language, regardless of modality, they have a framework for developing spoken language articulation skills".

Conceptual development and Theory of Mind

While language exposure supports language development it is also critical to other key cognitive functions, such as those associated with Theory of Mind (ToM). Theory of mind is a representation of an individual's capacity to understand others

6 Shum (2020) present findings revealing a distinct network for sign language and detail the temporal propagation supporting sign production.

by being able to presume what their mental state is. For example, one can understand the mental states, beliefs, emotions and preferences of others, understand they can be different from one's own and be able to demonstrate capability in modifying behaviour to accommodate this.

Richardson (2020) notes that "language provides a rich source of information about other people's thoughts and feelings". Consequently, delayed access to language may influence an individual's capacity to understand and consequently engage with others in social interactions, as it impacts cognitive development associated with ToM.

Richardson (2020) has identified that "...neural responses to ToM stories (specifically, selectivity of the right temporo-parietal junction) in these children resembles responses previously observed in young children, who have similar linguistic experience, rather than those in age matched native-signing children, who have similar biological maturation. Early linguistic experience may facilitate ToM development, via the development of a selective brain region for ToM". This discovery is significant and further emphasises the benefits of early intervention and sign language usage to understanding others and in social interaction.

Bi-modal bilingualism, monolingualism and developmental outcomes

Since the establishment of dedicated programs of intervention for D/deaf children and the advancement of sign languages, language philosophies and education of deaf children have been caught within a seemingly intractable debate pertaining to the use of sign language or exclusive spoken language approaches where plausible (Hall 2017), and this 'either/or dilemma' has presented several challenges for parents and policymakers alike.

Research exploring the benefits of sign language within bimodal/bicultural bilingualism, while mixed, on balance supports the assertion that bicultural bilingual approaches are cognitively and developmentally beneficial (Adesopeet al., 2010, Luk et al., 2011). This matter warrants a separate precis to the research. Nonetheless, in Per Capita's evaluation of the literature, two themes emerge, that bi-cultural approaches are developmentally beneficial, or that bicultural bi-modal approaches are developmentally neutral: neither beneficial nor detrimental to oral/aural strategies. There is less evidence of deleterious impacts to cognition and development associated with sign language exposure.[7] Nonetheless, Hall (2017) notes that the belief of "sign language-interference has endured despite a long-standing lack of empirical evidence that spoken language-only approaches are more effective" (see inter alia, Henner, Caldwell-Harris, Novogrodsky, & Hoffmeister, 2016; Humphries et al., 2016).

Indeed, the literature evidences immense diversity of perspectives with most favouring bilingualism. In fact, bilingualism is associated with better cognitive outcomes when compared with monolingualism (Adesope et al. 2010), especially at earlier ages of active bilingualism (Luk et al. 2011).

Recent systematic reviews and research syntheses conducted by Fitzpatrick et al. (2016) and Humphries et al. (2014) represent the dialectic debate and diversity of research perspectives well. In a review of sign language and spoken language interventions or bimodal bilingual interventions in comparison with oral interventions Fitzpatrick et al. (2016) concluded "…very limited, and hence, insufficient evidence exists to determine whether adding sign language to spoken language is more effective than spoken language intervention alone to foster [spoken] language acquisition" (Fitzpatrick et al., 2016, p. 14).

Humphries et al. (2014) in citing much of the extant empirical work offer the counter position that sign language is cognitively beneficial and bilingual learners' evidence better cognitive outcomes than monolinguals. Hall (2020) asserts that the work of Fitzpatrick et al. (2016) is fundamentally flawed noting such reviews fail "to distinguish natural sign languages from artificial communication systems, which would not enable bilingualism or language transfer (e.g., sign-supported speech or signing exact English)" (see also M. L. Hall, Caselli, & Hall, 2017). Hall (2020) also notes that the approach to many evidential reviews is somewhat flawed, essentially that "the authors approach the system review as if the "burden of evidence is in only one direction; however, if the evidence is supposedly insufficient in one direction – ipso facto, it is insufficient in the other direction and there is insufficient evidence of spoken language-only approaches being more effective" (Hall 2020).

The influential study of Geers et al. 2017 is also noteworthy. The study of children receiving implantation and exposure to sign language asserted that the speech of children not exposed to sign language was more intelligible than that of children exposed to sign language. The study claimed more age-appropriate progress in reading and spoken language for non-sign language users. However, the study appeared to lack essential controls and specification challenges. For example, the work of Hall et al. (2017) offers the following important critique of Geers et al. 2017. Hall et al. (2017) assert that "the authors used an unconventional, ambiguous, and arguably misleading definition of 'sign language' that did not differentiate naturally evolved sign languages (in this case, American Sign Language) from other manual communication systems, which are not natural languages but artificially constructed methods of communicating in English (e.g., sign-supported speech, manually coded English). These artificial systems offer limited information in the visual modality and are not intended to promote the acquisition of a signed language. There is no reason to believe that children would learn a sign language through these systems. While this may reflect how families who use 'sign language' actually communicate, calling these systems 'sign language' creates a straw man that naïve readers may assume to refer to natural sign languages. We are not aware of anyone who would argue that such communication systems confer the same benefits of a natural sign language."

The results of Geers et al. 2017, may be consequential to misspecification. Critically, the work of Geers et al. (2017), as noted by Hall et al. (2017) does not control for intervention timing or the 'mastery of sign language'. Therein, learners may not have had access to timely intervention, or quality sign language training. These findings are also contrary to many studies evidencing

7 For the notable critiques see Geers et al (2017) and for a response to Geers et al (2017) see Hall (2017).

stronger academic performance where fluent sign language was a provided intervention (see Humphries et al. (2014) for a precis).

Additionally, research conducted by Dammeyer et al. (2018) evidences the desire of many hard of hearing students and students receiving cochlear implantation to know more sign language (41.5%).

On the weight of presented evidence, we favour the postulate that sign language has either a favourable or neutral impact on bilingual learners, and do not support the 'language interference' contention. We favour the views presented by Hall (2020) and Humphries 2014 that language deprivation, through the exclusion of a fully accessible visual language such as sign language, appears to be a more likely cause of poor language outcomes in Deaf people.

Sign language as a protective factor

Arguably as important as any proposed intervention's plausible benefits is the potential for a given intervention to be unsuccessful, and the role of concurrent interventions where there is uncertainty or unevenness in the results of a given intervention.

This is the most significant benefit of sign language, its role as a core intervention or as part of a suite of interventions, as a protective factor. Where only oral-aural interventions are employed, the child is exposed to significant risk that the strategy may not be successful (see Hall 2017).

Humphries (2012) notes that "If they miss this critical period for exposure to a natural language, their subsequent development of the cognitive activities that rely on a solid first language might be underdeveloped, such as literacy, memory organization, and number manipulation. An alternative to speech-exclusive approaches to language acquisition exists in the use of sign languages such as American Sign Language (ASL), where acquiring a sign language is subject to the same time constraints of spoken language development.

It is plausible that a deaf or hard of hearing child may benefit from a diversity of strategies including aural-oral strategies. However, absent of a sound language foundation, that same child is exposed to the risk of the strategy being ineffective, and is at risk of language deprivation.

The notion of sign language as a protective factor is also supported by studies considering the role of sign language intervention timing and native language acquisition. Thompson et al. (2007), Mayberry et al. (2011), and Levine et al. (2016) consider native language acquisition and identify that sign language exposure prior to the age of five is associated with native language acquisition. The research evidences the role of sign language as a protection against language deprivation.

This notion of protective benefit is also strongly supported by Yoshinaga-Itano (2005 & 2006), as noted earlier in the report, the studies identify that while not directly determined by age of identification language development is strongly and positively correlated to intervention timing. Additionally, regardless of modality, when children are able to produce grammatical and lexical units of language, they possess a framework for the development of language articulation skills (Yoshinaga-Itano,2005). This evidences the strong protective benefits of sign language, whereby sign language provides a foundation for lexical and grammatical understanding and for critical early communication, the early development essential to future learning pertaining to language and beyond.

Auslan, as part of an intervention strategy ensures that deaf children are provided with a viable modality for speech, and the necessary language foundation to progress developmentally. Sign language is therefore intrinsically valuable because of its inherent benefits and its role as a source of protection, against language deprivation and the potential ineffectiveness of other strategies. Where a child benefits from alternative interventions, they are exposed to Auslan daily and have been exposed to native Auslan users, they benefit from bilingualism; where another concurrent strategy has not yielded the benefits that were hoped for in written and spoken English, Auslan has provided the child with a foundation of language without the ensuing benefits of a naturally developing language along expected lines.

As noted within our earlier report "The economic benefits of Auslan", the benefits of Auslan in supporting capability enhancement and as a protective factor in the life of the child are not considered in great detail within the literature, but there remains a significant body of literature advancing this contention in the broader sign language literature. The evidence base pertaining to sign languages more generally, strongly supports the assertion that sign languages are a critical protective factor in the life of a deaf child.

Key finding:

There is a critical window for first language acquisition, during which language acquisition is strongest. Failure to facilitate intervention during this intervention window, appears to be associated with atypical neural language processing, and poorer cognitive and developmental outcomes.

Key finding:

Non-native and first language acquisition may not be achievable where intervention does not occur within the critical intervention window.

Key finding:

The critical period for language acquisition appears to be the same for both modalities of communication, oral and signed.

Key finding:

Sign Language processing capabilities and sign language grammatical understanding procured over long term does not appear to fully overcome differences in initial sign language exposure terms. While many deficiencies may be overcome with time, there remain specific language capability deficiencies that may not be overcome where early exposure has not occurred.

Key finding:

Early sign language usage is associated with better cognitive and developmental outcomes in both deaf children who have received implantation and in those who have not. Bi-modal bilingualism is associated with better developmental outcomes than monolingualism.

Key finding:

The evidence base supports the conclusion that sign language provides benefits to cognitive development and learning processes that are broadly consistent with the benefits of oral modalities of communication.

Key finding:

There is no evidence that sign language has any deleterious impacts on the cognitive development of learners employing a bi-cultural bi-modal approach to their learning. Sign language may result in better educational outcomes for bi-cultural, bi-modal learners than deaf children employing oral strategies in isolation.

Key finding:

Sign language is a harm minimisation mechanism ensuring that, alternative interventions notwithstanding, users are able to establish a viable language foundation, that protects the user from potential dysfluency, and the potential that alternative interventions may be ineffective. Bi-modal bilingualism and sign language access must therefore be considered as appropriate.

Educational benefits

Sign language research evidences a strong association between sign language intervention timing and educational outcomes and attainment. This association may be persistent in later years with several recent studies presenting evidence of the impact of sign language capability on vocational outcomes in later life (Dammeyer et al. 2018). Many of the benefits to education derive specifically from the cognitive development benefits of Auslan in early education. Among the sign language users who were identified with deafness at a very early age (that is, those who develop natural language skills in sign language) demonstrate a higher level of educational attainment. (Dammeyer et al. 2018). In the US sample, male gender and better sign language skills were associated with having a job (Ibid, 2018).

A study of sign language users and vocational outcomes conducted in the US determined that sign language capability was the strongest determinant of vocational success and employment status (Dammeyer et al 2018). Early language intervention and exposure to sign language is a strong determinant of language capability, and native or first language capability. The study findings supported the assertion that early intervention supports better vocational outcomes and employment as a consequence of improved language capability

Social and Communal benefits

Among parents of children who are deaf or hard of hearing, there remains a significant level of interest in sign language learning (Kecman, 2019; Ching et al., 2018). For some children, cochlear implantation does not provide full access to spoken language and these children benefit from exposure to and assistance in learning a signed language (Hall et al. 2017; Spellun & Kushalnagar, 2018); this is also the case for children with late diagnoses and/or later age of cochlear implantation (Lyness et al. 2013).

However, some parents have chosen bilingualism to support not only language development and learning, but also social identity and inclusion (Kecman, 2019). This choice aligns with the view of Deafness as a cultural and linguistic identity (Chijioke, 2008; McIlroy & Storbeck, 2011; Young, 1999; Riddell & Watson, 2003).

The introduction of Auslan is associated with improved language and communication development across both signed and spoken languages, pointing to potential to support cognition, social and emotional development (Wong et al., 2018). Positive parental reports further supported this notion. These findings suggest that a bi-modal bi-lingual approach in early intervention may alleviate the risk of language deprivation and associated adverse impacts on cognition and psychosocial wellbeing. Research regarding the psychosocial benefits of bimodal bilingualism in early intervention programs is evident within Deaf Studies literature.

Preisler (1997) identified that hard of hearing children possessed less knowledge of the social rules of communication, such as taking turns when communicating and making eye contact. Engagement with the Deaf community may alleviate some of these challenges and address these knowledge gaps by facilitating communication between Deaf peers.

Research conducted by Antia & Kreimeyer (2010) observed that deaf and hard of hearing students interacted less with their hearing peers, and their time in each interaction was also shorter than their hearing peers. They also spent less time in interaction overall. It is therefore predictable that access and engagement with the Deaf community provides deaf children with significant socialisation benefits and encourages greater and more frequent peer to peer interaction. These interactions may alleviate the impact of some of the interaction deficits that occur with their hearing peers and provide benefits to confidence and self-efficacy.

Recalling the earlier evidence of the role of sign language in a child's Theory of Mind it is instructive to note that this aspect of sign language acquisition is critical to the child's engagement with their peers (Lecce et al, 2014, Ronchi et al, 2020) from both the Deaf and hearing communities. Beyond enabling communication, the ability for Auslan to support cognitive development as it pertains to a child's Theory of Mind enhances the child's ability to surmise and formulate views pertaining to others.

Key finding:

Auslan early intervention aligns with the desire to provide children with a strong sense of identity and self-efficacy and perceives intervention as capability enhancing rather than pure response to disability.

Key finding:

Key finding: Sign language usage appears to be positively associated with children's emotional development, and their capacity to engage and relate to others, specifically the child's Theory of Mind

Mental and Physical Health

The benefits associated with early language intervention and Auslan usage are diverse and there is a plausible multiplicative effect associated with each category of intervention benefit (social engagement, education and community participation) that is greater than each in isolation. These benefits are significant and are also associated with broader benefits to physical and mental wellbeing. Membership to a community is a source of personal utility and also provides wellbeing benefits. A sign language user is able to engage with the cultural aspects of sign language usage, a shared sense of identity and a common association.

It is important to acknowledge that there remains a dearth of research exploring adolescent and youth mental health within the D/deaf community. While research has identified that deaf adolescents typically have more mental health challenges than their hearing peers, recent research indicates this may be due to familial communication mismatches in part. Similarly, there is mixed evidence pertaining to the deaf youth cohorts, and the benefits of sign language versus spoken language within deaf youth cohorts. Some research supports the assertion that deaf spoken language adolescents experience better mental health than sign language users. However, there is a significant evidence base supporting the benefits of sign language for identity, cultural association and community engagement, it is notable that all these factors are correlates of better mental health (for a worthwhile precis on culture and mental health generally see Fernando, 2010).

Similarly, the cultural aspect of sign language usage is often not considered sufficiently within the existing research. Understanding these aspects is critical to offering an accurate account of differential mental health experiences of deaf youth. Similarly, the moderating role of peer matched communication and familial matched communication, essentially access to signing peers and family members remains underexplored. Recent research evidences the potential impact of familial communication matching on youth mental health.

The most notable challenge within the literature is the absence of exploration of the role of early intervention in mental health outcomes. It is perhaps self-evident that first language acquisition and signing capability may play a critical role in mental health, however most studies explore cohort differences without accounting for the timing of sign language intervention, and peer/educator/familial communication matching. What is apparent in engagement with representatives of the signing community is the significant benefit that they assert derives from Deaf culture, with Auslan critical to the existence and establishment of the culture. Critically, Per Capita's appraisal of the literature indicates that longitudinal analysis of the experiences of individuals choosing early intervention, versus those delaying intervention, is essential to formulating a more definitive position pertaining to the role of not just sign language, but early intervention on the mental health of D/deaf children at different life stages. Presently the limited research exploring youth mental health and the role of early versus later intervention makes drawing definitive conclusions challenging.

Early intervention is strongly associated with better learning outcomes, greater self-efficacy, and better first language acquisition: all strong correlates of wellbeing and better mental health (Glickman et al. 2020, Hall, 2017).

What is also evident is the potential impact of language deprivation (and the potential emergence of language deprivation syndrome) on mental health, self-efficacy and self-determination of members of the Deaf community. Later language intervention is logically associated with language deprivation, and results in individuals not accessing sign language 'natively' if intervention occurs after an individual is approximately five years old. Later intervention, coupled with limited opportunities for engagement, will result in more culturally marginal and language dysfluent people, who are more likely to evidence poorer mental health outcomes.

People who have experienced severe language deprivation comprise a minority of people seen in Deaf mental health programs, though they may require a grossly disproportionate allocation of resources to serve (Glickman et al. 2020). Deaf people that evidence language deprivation may also face severe health service access challenges. As noted by Glickman et al. (2020) "...what makes language deprivation a game-changer for the Deaf mental health field, however, is that providers will increasingly work with such culturally marginal, language-dysfluent people. This calls for a greatly expanded toolbox drawing upon both cultural and disability frameworks, including research into all the implications of late and inadequate language exposure"

Access challenges may be consequential to the combination of co-morbidities presented by deaf children and adults. Older Deaf or hard of hearing adults frequently present with other comorbidities making collaborative care and accessing appropriately tailored care challenging. In Dupis (2019), the frequency of identification of co-morbidities with audiological disability was 68% for visual, 50% for cognitive, and 42% for manual dexterity issues; 84% had more than one comorbidity. The frequency of co-morbidities may make it more challenging for older adults to identify a single source of care, with this deemed highly beneficial to achieving better health and care access outcomes. Earlier intervention and the sign language capability of individuals promote better health access outcomes by reducing the likelihood of language deprivation and promoting self-efficacy. Early intervention involving Auslan exposure may also assist deaf children who evidence co-morbidities, and deaf adults who benefit from early intervention if multiple morbidities are present as they age.

Self-expression is increasingly challenging for deaf children and adults with comorbidities that may impact their capacity to communicate needs, and express concerns to providers of health services. The emergence of co-morbidities or existing co-morbidities may result in a decline in self-efficacy. This declining self-efficacy causes older deaf adults to be at a disadvantage when accessing services. Challenges associated with self-

expression may result in self-exclusion, whereby older deaf adults choose to forgo care services because of the stress they feel in accessing services. Self-exclusion is however not a unique challenge impacting only elderly members of the Deaf community, with young people plausibly impacted by lower self-efficacy and a desire to self-exclude.

Consequently, there remains a dearth of life course studies exploring cohort specific challenges and mental health divergences within the Deaf community, that specifically account for communication matching, the timing of intervention and familial environment. However, the language deprivation research is highly instructive.

Where early intervention is seen as a moderating factor of language deprivation, early intervention is likely to promote cultural identity and association (reduce cultural marginalisation) and improve language capability, improving mental health outcomes and self-efficacy.

Early intervention aligns to a more modern and culturally safe mental health paradigm, yet supporting strong self-advocacy, efficacy and representation at the earliest stages of a child's engagement with services and civic systems. This approach is aligned with what Glickman et al. (2021) assert is the third paradigm of deaf mental health service.[8]

This mental health paradigm shift has been acknowledged as the culturally affirming model of care (Glickman et al. 2020, Glickman & Gulati, 2003; Glickman & Harvey, 1996; Leigh, 2010). Early intervention is culturally affirming, and is associated with lower potential language dysfluency, reducing the likelihood that the deaf person will necessitate elevated levels of care and increasing the likelihood that they will be able to advocate for their own needs.

Key finding:

Language deprivation is associated with poorer mental health outcomes. Early intervention and the earliest timing of intervention impact language deprivation.

Key finding:

Early intervention aligns with a culturally affirmative model of mental health care that acknowledges the Deaf culture.

8 Glickman et al 2020 describe paradigm three as Deaf Mental Health service with the Integration of Culture and Disability Considerations.

Overview of the key benefits of early intervention

The following table summarises the key findings of the report and the associated literature, noting supporting research as well as any neutral and refuting findings of note. The summary is non-exhaustive and intends to outline the studies maintaining each position regarding the noted benefit, in each instance.

Benefit	Supporting	Neutral	Refuting
Sign language supports cognitive development	Hall (2017) Humphries et al. (2014) Spellun & Kushalnagar (2018) Adesope et al. (2010) Luk et al. (2011)		
Infants (<6 months) are able to learn sign language	Thompson et al. (2007) Mayberry et al. (2011)		
Sign language usage during infancy (<12 months) yields significant language acquisition benefits	Thompson et al (2007) Mayberry et al. (2011) Levine et al., (2016)		
Consistent language usage and exposure is required prior to five years of age to support native proficiency	(5) Thompson et al. (2007) (5) Mayberry et al. (2011) (5) Levine et al. (2016)		
Sign language capability is associated with better vocational outcomes amongst deaf persons	(6) Dammeyer et al. (2018)		
Sign language usage is not a source of language deficiency in second language acquisition in children	Hall (2017) Humphries et al. (2014) Spellun & Kushalnagar (2018) Adesope et al. (2010) Luk et al. (2011) L. Hall et al. (2017) (3) Padden & Ramsey (2000) (3) Strong & Prinz (2000) (3) Mayer & Akamatsu (2003) (3) Paul (2003) (3) Schick (2003) (3) Allen et al. (2007) (3) Wilbur (2008)	Fitzpatrick et al. (2016)	Geers et al. (2017)
Sign language usage is associated with better learning outcomes in bi-modal bi-lingual learners	(2) Bunta et al. (2016) (2) Guiberson, (2014) Hall (2017) Desselle (1994) (4) Klatter-Folmer et al. (2006) (7) Cummins & Gulustan (1974) (7) Prinz & Strong (1998) (7) Bialystok et al. (2004) (7) Baker (2006) (7) Lightbown & Spada (2006) (7) Bialystok et al. (2007) (7) Kushalnagar et al. (2010)	(2) Bunta & Douglas, (2013) (2) Francis & Ho, (2003) (2) McConkey Robbins et al. (2004) (2) Green, & Waltzman, (2004) (2) Sininger et al., (2010) (2) Thomas et al., (2008) (2) Waltzman et al., (2005) Kampfe & Turecheck, (1987) Mapp and Hudson (1997)	(1) Deriaz et al., (2014) (1) Kiese-Himmel, (2008) (2) Boons et al., (2012) (2) Forli et al., (2018) (2) Teschendorf et al., (2011)

Benefit	Supporting	Neutral	Refuting
Native language acquisition is associated with earlier language exposure/ intervention	Doidge 2007 Cam & Newport 2007 Woods & Carey 1979 Martins 2004 Mayberry 1994, 1998, Hall & Johnston 2009, Hudson & Newport 2009		
Better language and developmental outcomes are associated with early intervention/exposure	Mayberry & Fischer 1989, Emmorey & Corina 1990, Newport 1990, Emmorey 1991, Mayberry & Eichen 1991, Wood 2007, 2011 Johnson & Newport, 1989; Baker et al. 2006; Palmer et al. 2012		

Source: PerCapita 2022. (1) Vocabulary only studies. (2) Language acquisition outcomes only. (3) Studies of Sign language user school performance controlling for confounding factors. (4) Syntax complexity studies. (5) Early intervention studies. (6) Limited number of studies/estimates. (7) Studies exploring creative, problem solving, flexibility with persistence into childhood.

There remains significant evidence of the benefits of early intervention, and the role that sign language plays in early intervention strategies. The evidence base largely supports the assertion that sign language is cognitively beneficial, with only modest evidence supporting the counter position. Similarly, early intervention is asserted to be associated with better sign language outcomes, and better academic outcomes within the extant body of research. There is little evidence of sign language having any detrimental effects on oral language acquisition, with the evidence base supporting bicultural bimodal interventions where plausible. Regarding mental health, the research remains somewhat inconclusive with evidence that cultural identity within the Deaf community is valued and may be associated with positive health indicators, but also evidence of significantly poorer mental health outcomes within the D/deaf community.

There is growing concern among researchers that current early-intervention programs do not provide a well-informed or adequate range of options for parents and deaf children (Anderson, 2006; Arehart & Yoshinaga-Itano, 1999; Sass-Lehrer & Bodner-Johnson, 2003).

The lifelong consequences of language deprivation are too far-reaching, from early childhood to adulthood, to limit a deaf child's time-sensitive language acquisition opportunities. Rather than focusing on auditory deprivation and speech skills, developmental approaches for deaf children should prioritise healthy, expected development of all developmental domains (e.g., cognitive, academic, socioemotional) that comes with the guaranteed full acquisition of a fully accessible first-language language foundation such as sign language.

Quantifying the benefits of early intervention

Establishing the economic benefits of early intervention is challenging given the dearth of studies exploring the impact of early intervention in the long term. Studies establish that language deficits may not be redressed fully even after significant terms of sign language usage, and language deficits arising early in life with subsequent language exposure impact how language is processed by the brain.

Establishing the benefits of early intervention necessitates determining the impact of deafness absent of early intervention. Viewing deafness through a disability lens may be somewhat unhelpful given the existence of Deaf culture, and the utility and amenity provided by sign language. However, Health Adjusted Life Year (HALY) methodologies provide a mechanism for the determination of early intervention benefits estimation.

Employing disability weights deriving from the Global Burden of Disease study (2019) and Value of Statistical Life (VASL) estimates, we are able to establish an estimated cost of deafness. These cost estimates may then be adjusted to account for the capability enabling and cognitive benefits of early intervention that are counter to the disability impacts. Critical to the estimates is the impact of Auslan on capabilities, the research assumes that Auslan is capability enabling, supporting self-efficacy and social, economic and cultural engagement, attenuating the impact of disability.

Absent of access to an accessible language (with sign language being the most accessible), deaf persons face significant and deleterious language deprivation, that is associated with poorer health and wellbeing outcomes. Language deprivation is significant because individuals evidencing deprivation require more significant social and economic supports (Hall, 2017).

Language deprivation is also associated with higher rates of depression and anxiety and is likely to exacerbate the impact of disability (Evidence of this is presented in Glickman et al. 2021, Glickman and Pollard Jr 2012). In Glickman et al. the authors note the emergence of deaf mental health patients that are increasingly culturally dysfluent and language deprived, facing greater difficulty in accessing and benefiting from mental health care. Additionally, the frequency of co-morbid conditions and the impact of culturally unsuitable services for deaf persons makes it highly predictable that the dearth of culturally viable services would exacerbate co-morbid conditions, as deaf persons find it harder to access suitable services). While sign language may be learnt after the critical period, where intervention does not occur during the critical intervention window, there may be enduring language deficits.

For conservatism we employ a constant level of diminished benefit approach, noting that deleterious cognitive impacts may arise far more rapidly, meaning that shorter differences in intervention terms are likely to have a greater impact than suggested by the modelling, particularly earlier. This approach however was critical for conservatism in the absence of life course data. A complete methodological note is included in the appendices. For clarity the estimates presented are opportunity costs, the opportunity cost of delaying intervention for a defined term.

The lifetime opportunity cost of delaying early Auslan intervention by two years from age five to age seven is $128,245, employing a DALY approach, and assuming a fractional reduction[9] in Auslan benefits. This estimate account for a diminution in wellbeing, employment outcomes benefits, educational attainment or health literacy.[10] This estimate is based on an 18-year model, where the decline in intervention timing is assumed to be at a constant level annually over this term. To analyse the estimate sensitivity, we apply a less conservative assumption, a 13-year decline model. This approach assumes that the level decline in economic benefit is more rapid, aligned to the concept that the impact of language deprivation is more rapid and occurs earlier.

Under this assumption the opportunity cost of delayed intervention from age five to 7 is $171,474,[11] though again deficits may occur more rapidly.

Considering now the earliest intervention timing versus intervention in year five, essentially within the first year of life rather than at the time of school commencement; the total economic benefit is between $273,782 (18-year model) and $367,445 (13-year model).

In addition to exploring the costs of delayed intervention we also explore the extent of learning deficits caused by delayed intervention for a child aged 10 where intervention is delayed by two years from five to seven.

The average learning deficit of a child aged 10, having their intervention delayed for a term of two years is approximately 20%. Therein, a child with a delayed intervention term (two years delayed) evidences a knowledge deficit of approximately 20% by age 10 in comparison to peers absent of early intervention. This learning deficit is a significant opportunity cost.

The need for a longitudinal exploration of lifetime benefits of Auslan

While the research surveyed strongly supports the assertion that early intervention is welfare enhancing, through its benefits to education, social engagement and general wellbeing, there remains a dearth of Australian research exploring these benefits longitudinally. There is immense benefit in exploring learner experiences through time. There is an absence of Australian life course studies involving members of the D/deaf community. Exploring the implications of oral/aural interventions as well as interventions involving early exposure and engagement with Auslan would be instructive to policy formulation.

As noted by Glickman et al. (2020) the emergence of language deprivation and increasingly culturally disconnected and language dysfluent[12] people, necessitates greater research focus. Glickman et al. 2020 calls for “a greatly expanded toolbox drawing upon both cultural and disability frameworks, including research into all the implications of late and inadequate language exposure”. The work of Glickman et al. (2020) and Gulati (2019) has provided a sound evidence base and launching point to “acquire a science-informed consensus as to an operational definition and diagnostic criteria for Language Deprivation” (Glickman et al. 2020).

Initiating a research program involving cohorts of individuals that have engaged in different early-stage decisions pertaining to sign language exposure and capturing data pertaining to their experiences at different critical junctures shall inform decision processes and policy formation. This would support better learning and developmental outcomes for deaf children and support the Deaf community more broadly, while supporting more effective social investment.

Conclusions

The implications of language deprivation extend well beyond the critical period for language acquisition. The role of Auslan in responding to language deprivation is self-evident and understanding the role of the timing of intervention is equally pertinent. The impacts of a childhood decision extend well into adulthood, and impact individuals as they age. The implications of

9 Auslan intervention benefits are assumed to decline at a fixed level over an 18 year term, assuming no alternative intervention.

10 These estimates do not account for the efficacy or viability of alternative interventions, there the estimate assumes either the application of Auslan intervention or the absence of early intervention.

11 This estimate is in nominal aggregate terms, the estimate assumes a constant level of decline in benefits over a 13 year term. The estimate only accounts for Auslan intervention and does not consider the impact of alternative intervention types.

12 The notion of language dysfluent refers to low language ability, specifically poor sign language capability.

delay are too consequential to “limit a deaf child’s time-sensitive language acquisition opportunities” (Hall 2017). Employing an auditory lens in evaluating a child’s capabilities may be a hindrance, and while auditory capabilities and speech capabilities are not to be discounted, focusing on core developmental domains during the earliest vestiges is the most pertinent concern. Supporting the child in achieving developmental progress should not be discounted, and these benefits come with the full acquisition of a fully accessible first-language language foundation (necessary for future domain specific and general success) such as Auslan.

This does not preclude bicultural bilingual approaches to intervention, but rather acknowledges that early intervention involving sign language should not be seen as a ‘last resort’ measure. Cochlear implantation is an incredibly beneficial procedure for many. While cochlear implantation was and remains a life altering procedure for those able to benefit from the procedure, it does not guarantee language acquisition. Most recipients remain functionally hard of hearing. Yet many parents are presented with choices pertaining to implantation and sign language as though they are adversaries, somehow diametrically opposed. Such a presentation is unhelpful for both parent and child.

It is critical that the benefits of Auslan as an early intervention strategy are acknowledged given the benefits associated with its usage. Auslan usage does not preclude the use of additional interventions, nor does it appear based on the extant research to cause any deleterious impacts to other strategies. It is critical that the role of Auslan as an early intervention strategy given its benefits to education, self-efficacy, and cognitive development are acknowledged widely. Its capacity to connect individuals to a broader cultural identity and to access services and engage with society in a culturally affirming way represent its greatest benefits to members of the Auslan user community. While this benefit set is difficult to quantify, it is inarguably valuable to deaf people.

Language deprivation can cause cognitive delays and mental health difficulties across the lifespan. Mental health clinicians often see language deprivation and language dysfluency being a common “symptom” in deaf individuals who seek treatment and are subsequently admitted to inpatient hospitals (Black & Glickman, 2006).

The benefits of early intervention appear to be readily apparent where a child is profoundly deaf, and potentially beneficial to hard of hearing children who possess insufficient hearing capability to benefit from an exclusively oral modal of education. Bimodal bilingualism is a highly beneficial intervention for many children, and Auslan should not be presented as a last resort option given the compelling evidence supporting its role as an early intervention strategy in support of first language acquisition and cognitive development.

The critical period for language acquisition is a critical intervention window for deaf children and acknowledging the importance of the earliest plausible intervention and its lifetime benefits to the recipient is critical to developing a credible evidence-based26 approach to this issue set at a national level.

Appendix 1 – The economic benefits of Auslan early intervention, a DALY approach

Consistent with the earlier Per Capita report titled "The economics benefits of Auslan" we employ a DALY approach to benefits estimation. Quantifying the economic benefit of a language is complex, and the literature on the economics of language emphasises this. Challenges associated with assigning value to language capital as a form of human capital are unique, as language is unlike other imbued capitals, it is something that enables all other aspects of social and economic engagement.

Auslan is the language of the Deaf community of Australia, and central to Deaf culture. However, it is a language that is distinct from English and other sign languages, notwithstanding some shared origins, as detailed within the report. Auslan users see themselves as part of a distinct cultural community, akin to other minority communities and benefit from a sense of shared belonging to this community. This shared association makes assessing the benefit of the Auslan language similar, but not the same as the valuation of minority languages, of which there is an established literature.

Critical to determining the economic benefits of Auslan is the acknowledgement that Auslan is arguably more capability enabling than other languages. The importance of capabilities is discussed broadly in literature (see inter alia Naussanbaum & Sen 1993). While the use of the word disability is unhelpful in discussions of the Deaf community, employing a disability lens to evaluate the impact of Auslan on capabilities provides a mechanism to determine the capability benefits afforded through Auslan usage.

The impact of disability on life quality has been examined within several disciplines. Examining the economic benefit of any intervention on an ability set requires the use of a quality-of-life measure. Herein we employ the methodology established by Murray (1990) and WorldBank (1993); to determine the economic benefit of Auslan, specifically a measure of lost health and wellbeing, and the associated gains from Auslan usage.

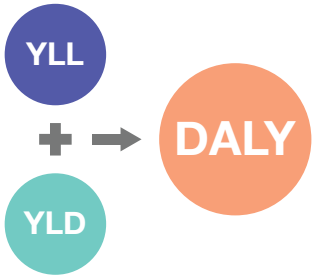
DALY impact of Auslan language usage

The use of loss of wellbeing methodology is consistent with the broader disability impact evaluation literature and has been used in studies (Li 2018, Gao 2015). The DALY methodology focuses on the non-financial costs associated with a specific category of disability. Specifically, the DALY method estimates the costs associated with premature mortality and reduced health, by adjusting total life years to account for disability, resulting in the disability adjusted life years measure. The DALYs as with the QALYs approach are both examples of methods of adjusting life years based on health, so called Health Adjusted Life Years methods (HALYs).

The use of the DALY method within evaluations of the costs of disability are replete within evaluation research, and specifically as it pertains to deafness. Emmett et al. (2016) employs the DALY method to evaluate the benefits of deaf education, with Emmett et al. (2019) employ the approach in the evaluation of deaf education within Asia. Within Australia, the methods have been employed by AIHW (see inter alia Mathers et al. 1999), Begg (2003) and Deloitte Access (2017) amongst others. A systematic review of the use of DALY methods in the evaluation of the burdens of different categories of disability is provided by Polinder et al. (2012).

The DALY estimate comprises two components, firstly an estimate of premature mortality measured in years of life lost due to premature death (YLL) and morbidity determined by the number of years of health life lost as a consequence of disability.

Figure A1 – Disability Adjusted Life Years calculation



Estimates of YLD are determined employing disability weights, these weights derive from estimates of the impact of disability of the health of an individual. The weight is proportional to the health impact of the disability and relative to other disabilities. For the purposes of this research, we exclude the impact of comorbidities, noting that Auslan would likely be beneficial to any comorbid illness, and consequently the estimate may be seen as conservative. A disability weight of zero denotes perfect health (it is important to acknowledge that while this condition is implausible all states are relative), while a weight of 1 corresponds to the loss of life, the definition of imperfect health in the extreme.

Table A1 – Example Disability weights

Disability classifications	Disability weights
Schizophrenia	0.576
Amputation of finger	0.03
Lower back pain	0.0374

Consider the noted example weights, representing some of the variation in DW associated with various states and conditions, lower back pain carries a disability weight of 0.0374, therein, an individual with lower back pain loses 3.74% of a year of 'healthy life' due to the incidence of lower back pain. An individual with Schizophrenia loses 57.6% of a year of healthy life due to their condition. The estimates allow for the determination of the number of years of healthy life lost within specific cohorts. This is particularly instructive in policy analysis. A further benefit is the ability to translate the estimated DALY to a dollar value estimate of the cost of lost health to society. This is accomplished by employing the DALY value and the Value of statistical life. While it must be acknowledged that ascribing value to life in statistical terms is imperfect this method is frequently employed in evaluation studies. Estimate of the value of statistical life frequently employed in health and policy research; the estimate as supplied

by the Department of Prime Minister and Cabinet (2021) is $5.1 million in total and $222,000 per year, in 2021-dollar terms.

Estimates of DALY values and the benefits of Auslan

The initial estimates of DALY values are based on disability weights supplied by the Global Disease Burden of Disability Study (GBD 2019). To determine the benefit of Auslan, the disability weights are applied to cohort specific data to determine the extent of the disability in DALY terms. The relevant weights for consideration are noted in Table A1. Larger weights are attributable to greater levels of hearing loss.

Table A2 – Selected disability weights – GBD Study 2019

	Disability weight
Moderate	0.027
Severe	0.158
Profound	0.204

To estimate the benefit of early intervention involving Auslan to members of the Deaf community with regard to improved wellbeing, it is assumed that Auslan in its capability enhancing capacity, therein, its ability to facilitate communication, community cohesion and inclusion, would reduce the extent of the evidenced disability.

The usage of Auslan is assumed to diminish disability severity by 1 level, from profound to severe. It is assumed that the extent of diminution may be greater or smaller depending on the timing of the intervention. Absent of Auslan many Deaf people would be reliant on non-native languages such as English and transcription, tools and technologies, rather than the community's language of choice.

It is assumed that where intervention is delayed for too long significant cognitive defects may arise, in the processing of language, noting the critical period, or what we have described for deaf persons as the critical intervention window.

While there is a significant body of literature emphasising the cognitive deficiency that arises after this interval for conservatism, we assume that the level of diminution in the benefits of intervention is constant, rather than assuming an exponential rate of decline or constant rate of decline, as are perhaps better supported by the literature.

The difference in the counterfactual or presumed initial level of disability and the new level of disability was determined. This difference is then applied to the SVL, to determine the average annual benefit of Auslan intervention. This intervention is deemed to occur at the age of five on average. Where intervention occurs earlier or later the benefit of Auslan differs. We acknowledge that there is a dearth of research establishing the decline in first language learning rate, so for conservatism we employ a model that assumes a stepped level decline over an 18-year interval, noting that the impact of intervention differentials is likely to be greater in the early years and disfluency and language deprivation result later in life as a result of inadequate exposure during adolescence.

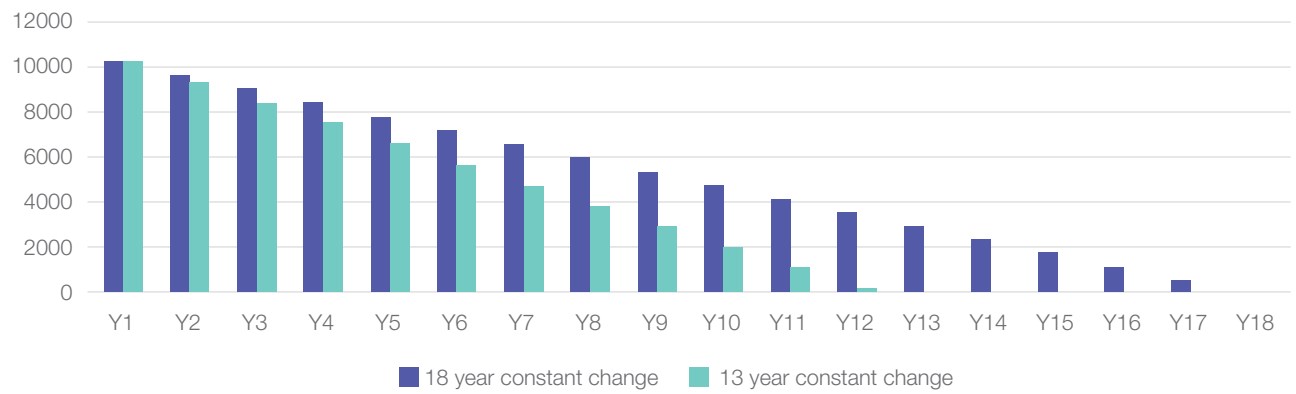
The average annual benefit of Auslan intervention is $12,248 ($10,212 for capability specific benefits) dollars per year.[13] The modelling assumes that the benefit of Auslan has a differential capability enhancing effect due to the timing of intervention. The greatest benefit is procured where intervention occurs in year 1, while the benefit to an individual receiving a language intervention at age 18 while material does not result in a diminution of the impact of deafness from the profound level.

The life expectancy of Australians is 82.2 years of age, and this serves as the basis for the determination of lifetime benefits differentials associated with early and later intervention.

The lifetime benefit of early versus the later term Auslan intervention (from Y1 versus Y5) (18yr constant level decline) in the model is $273,782

The lifetime benefit of a 2-year delay in intervention between five and seven years is $128,245

Change in annual economic benefit associated with intervention timing (DALY method)



13 Please note that this estimate is the average annual benefit level, and aligns to the nominal aggregate benefit level, noting that the benefits accrue in different years. For clarity we present the average rather than the differential value for each year.

Where we employ a constant level of change model assume that there is no diminution in the impact of disability beyond the 13th year, rather than the 18th year. Assuming that the benefits align to pre-adolescent intervention rather than pre-adulthood intervention; a highly plausible assumption given the research, the cost of intervention differs. The chart evidences the variation between the two estimation approaches. The cost of delayed intervention (Y5 rather than Y1) is greater at $374,824.

Appendix 2 – Approximation of learning deficits

To estimate learning deficits caused by the absence of intervention we are able to compare the rate of learning with intervention, with the rate of learning absent of intervention to consider the extent of the learning deficit.

Estimates are based on Humphries et al. (2014) and Blamey (2003). Blamey (2003) states that 'a hard-of-hearing child (within a traditional 'hearing' based learning environment) has about 40–60% of the learning opportunities of a hearing child' because of limited auditory experiences, and, consequently, his or her 'learning rate is about 40–60% of normal' (p. 241). Humphries et al. (2014) note that children that benefit from sign language evidence similar learning outcomes to their hearing peers.

Learning deficits estimation

Intervention learning rate = r1 = 100%

learning rate, no intervention = r2 = 60%

Timing of intervention assumed end y1…end y18

n denotes the years of learning deficit

Age – n = years of normal learning = m

(m X r1) + (n X r2) / Age = Average annual learning deficit

Where a child has intervention delayed from Y1 to Y5, their learning deficit in year 10, assuming no elevated learning rate to counter the deficit; equates to approximately 20%.

Therein, a child not benefitting from a Year 1 intervention, receiving a Year 5 intervention has accrued 20% less knowledge given the differential rates of learning.

Appendix 3 – Exploring pre-lingual deafness and early childhood hearing loss within First Nations communities

There are a number of factors that determine the frequencies of pre-lingual deafness and hearing loss within different cohorts. Hearing loss may result from several different factors, including genetic causes, complications at birth, infectious diseases, chronic ear infections, use of certain medicines, injuries and accidents, exposure to loud noise and ageing (AIHW, 2022). The Word Health Organisation has indicated that 60% of childhood hearing loss is due to preventable causes. Australia's First Nations evidence rates of deafness and hearing loss at disproportionate rates when compared with the broader community, with hearing loss widespread within both pre-lingual and post-lingual Aboriginal and Torres Strait Islander populations and much more common than with non-Indigenous Australians (see Burns & Thomson 2013).

The higher rates of hearing loss are ascribed to higher rates of infection. Otitis media (inflammation and infection of the middle ear) is a significant cause of hearing loss in First Nations Australian children. First Nations Australians suffer the highest rate of otitis media in the developed world (Cornish, 2011). Similarly higher rates of bacterial meningitis also result in higher rates of pre-lingual and post-lingual hearing loss.

The research of Hanna & Wild (1991) illustrates the significantly elevated rates of meningitis within First Nations communities. The researchers identified the annual incidence rate of H. influenzae meningitis was significantly greater in Aboriginal children (150 episodes per 100 000 children under five years of age per year) than in non-Aboriginal children (27 episodes per 100 000), and the mean age of onset of H. influenzae meningitis was significantly lower in Aboriginal children (6.8 months) than in non-Aboriginal children (19.8 months).

Nonetheless otitis media is claimed to be the principal driver of the high rate of hearing loss. AIHW (2022) published frequency data identifies that total or partial deafness was reported for 3.8% of First Nations children, otitis media (middle ear infection) for 2.6%, and other diseases of the ear for 0.5%. Rates of hearing problems among Indigenous children were higher in Remote areas (9.7%) than non-remote areas (6.4%).

These high rates are not consequential to delinquency, or a lack of familial concern, but rather historical disadvantage, limited access to culturally suitable care, and remoteness. These challenges are further exacerbated by socioeconomic divergences. The impact of these disadvantage levels endures into adolescence.

Intra-community disadvantage also influences the frequency of hearing problems, with greater disadvantage being associated with greater hearing loss frequency rates. First Nations Australians aged 15 and over who lived in the most disadvantaged socioeconomic areas (lowest socio-economic level quintile) were 1.4 times as likely to report hearing (or ear) problems than those living in the most advantaged areas (highest socio-economic quintile) at 18% compared with 13% (AIHW, 2022).

Some progress has been achieved in reducing the rate of chronic suppurative otitis media in remote Northern Territory with rates declining from 24% in 2001 to around 13% in 2013, due to the successful use of pneumococcal conjugate vaccines (Leach & Morris 2017; Leach et al. 2016; Morris et al. 2005), the rates remain vastly higher than those in non-indigenous communities (AIHW, 2022). The rates of otitis media are still the highest amongst all developed nations. Otitis media remains a major health problem in Australia, with an unacceptably great dichotomy

of incidence and severity of otitis media and its complications between First Nations and non-Indigenous Australians (Kong & Coates, 2009).

Given the evaluated rates of pre- and post-lingual hearing loss and higher rates of profound deafness, the role of sign languages within First Nations communities is critical. Power (2013) notes that many Australian Aboriginal and Torres Strait Islander peoples use a sign language ("hand talk"). There are over 300 sign languages (ABC, 2021) and the languages mirror the local spoken language and are used both in culturally appropriate settings when speech is taboo and for community communication (Power, 2013).

There remains a genuine dearth of research exploring the prospective benefits of sign language with First Nations communities. Deaf Aboriginal and Torres Strait Islander children should be provided with the opportunity to learn a sign language (be it a First Peoples sign language or Auslan), given the protective and cultural benefits associated with language acquisition.

Deaf Aboriginal and Torres Strait Islander children are exposed to the same risks as Deaf non-Aboriginal and Torres Strait Islander children. Indeed, given the challenges that many face in terms of accessing viable intervention services, social inequality and in some instances remoteness, the challenges they face may be far greater. Humphries (2016) notes that "Deaf children who are not provided with a sign language early in their development are at risk of linguistic deprivation; they may never be fluent in any language, and they may have deficits in cognitive activities that rely on a firm foundation in a first language". Sign language provides some security and protection against the uncertainty of alternative interventions. While there is a dearth of intervention specific research, the benefits of sign language for deaf Aboriginal and Torres Strait Islander children are plausibly the same as those evidenced in the Deaf studies literature, when exploring sign language benefits generally. Deaf Aboriginal and Torres Strait islander children would be protected against the unevenness of other potential interventions and provided with a sound language foundation that is inherently beneficial in learning, and beneficial in second language acquisition.

The rates of hearing loss within First Nations communities, and in particular otitis media are higher than all other developed nations, and consequently should chronic otitis media be better managed through better medical service access, and culturally safe support, the frequency of hearing loss will likely diminish markedly. Nonetheless, for the many that would benefit sign language, sign language-based interventions should be considered, and greater investment is needed to facilitate better access and increased exposure. Sign language should also be considered even when existing interventions are in place, such as oral/aural approaches, as a source of protection, as part of a bicultural, bimodal strategy.

A wholistic approach is needed that acknowledges the complex generational challenges, medical and biological considerations and ensures cultural appropriateness and safety. The dearth of research remains a challenge, Kasper and Leech (2020) were not able to identify a single study that explored the viability of ear health interventions within First Nations communities, in response to otitis media, that met basic robustness criteria. Beswick (2013) asserts that further research with large cohorts of children with and without risk factors needs to be completed to further understand the relationship between risk factors and postnatal hearing loss. There is a similar dearth of research with regard to the viability of differential language-based interventions employing longitudinal data. It is apparent that viable policy requires such research. Similarly, beyond research solutions necessitate greater culturally informed, community led engagement between stakeholders, as noted by Leech (1999) solutions will arise from a greater understanding among Aboriginal and non-Aboriginal Australians of the historical, social and biological determinants of health.

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