From Surgery to the Classroom: The Path to Literacy

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A challenging path to literacy…

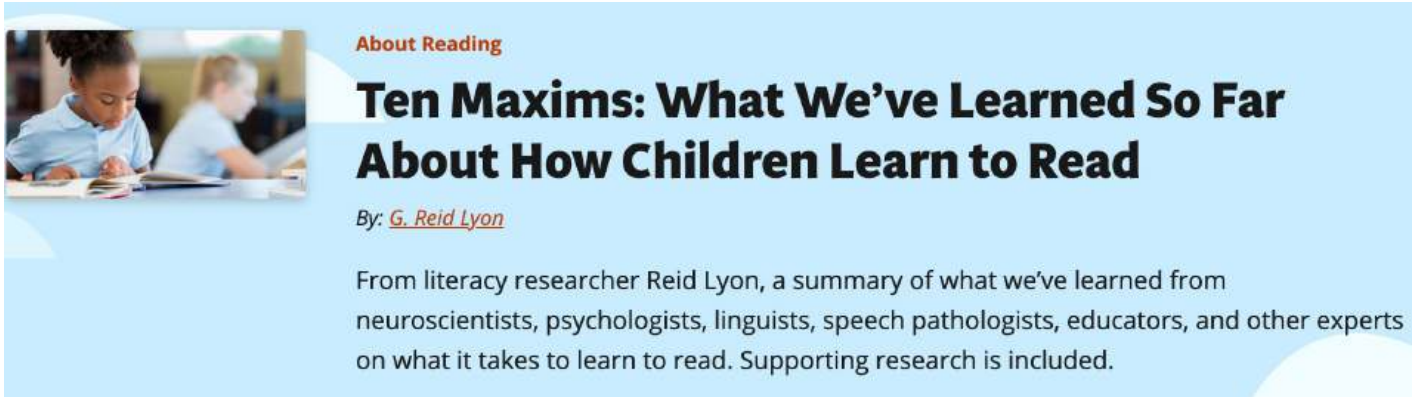
For more than a century deaf children did not achieve age-appropriate literacy outcomes

- Graduating from high school reading and writing at a 4th grade level –> like a typically hearing 8-year-old (Conrad, 1979; Pinter & Patterson, 1916; Qi & Mitchell, 2012)
- Could be described as functionally illiterate
- Impacts education, employment and quality of life

Why such a challenging path?

Language development - beginning with speaking and listening - is the foundation for learning to read and write.

Literacy development is rooted in early social interactions and experiences that include regular exposure to oral language and print. (Lyon, 2026)



For profoundly deaf children…

VERY limited meaningful access to spoken language

via hearing = **POOR literacy outcomes**





The path to literacy now starts here…



Cochlear implants provide meaningful access to spoken language via hearing for children with profound losses …. **for the first time in the history of deaf education.**

Surgeons – you are teachers of literacy!

Everything that parents, teachers and therapists do to develop literacy depends on the access to language that the CI provides.

… and ends here

Research evidence that students with CIs are reading and writing comparable to hearing peers – average to low average range

- Mayer & Trezek (2018) – literature review of 21 studies (N=1000 CI users) over a 20-year period (1997-2016)

- Wang et al. (2021) – meta-analysis of 47articles looked at group differences between CI users (N=900) and hearing peers

Mayer & Trezek (2026)

Systematic review to update the evidence

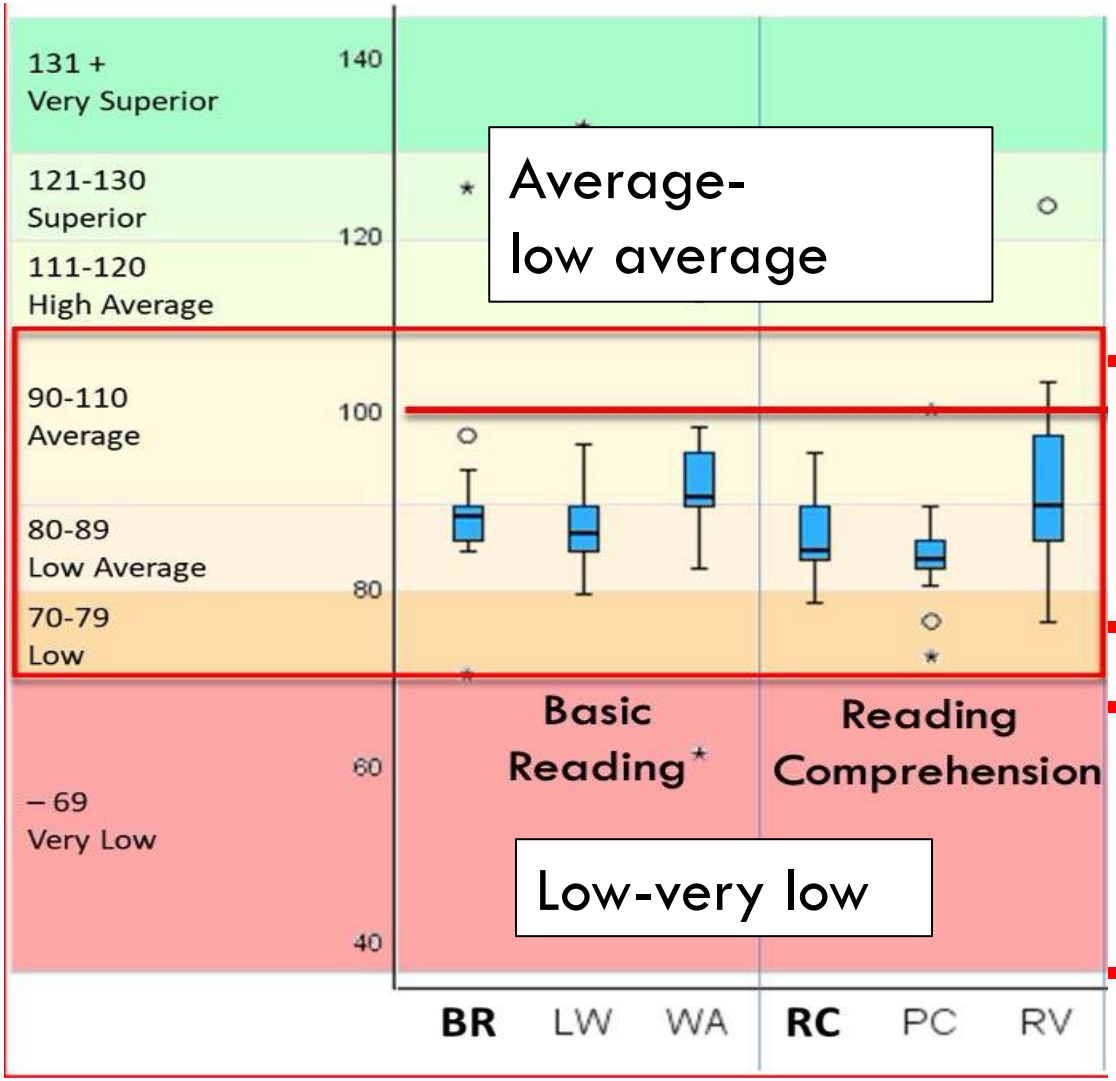
- Only 8 studies identified over a 9-year period from 2017-2025
- 7 studies focused on reading, one on writing
- Total of 189 participants
- Research conducted in five countries (Australia, Canada, Spain, UK, USA)
- Studies reported outcomes in the average range
- Consistent with findings from previous reviews

Mayer & Trezek (2026)

Author(s)/Date/Location	Participants	Measure	Results	Summary
Reading Studies: Standard Scores (n = 5)				
Bell et al. (2019) Australia	CI *n* = 14, *m* = 8;01 yrs. TH *n* = 31, *m* = 7;63 yrs.	YARC	CI *m* = 98.43 (SD = 13.28) TH *m* = 105.32 (SD = 14.08)	Average range
Davidson et al. (2025) U.S.	*N* = 86, longitudinal study, T1 elem., T2 adolescent, T2 *m* = 13;9 yrs.	WRMT, PC subtest	T1 *m* = 101.6 (SD = 15.1) T2 *m* = 101.7 (SD = 16.9) No significant difference between T1 and T2	Average range
Figueroa et al. (2020) Spain	CI *n* = 36, *m* = 14;03 yrs. TH *n* = 54, *m* = 13;5 yrs.	PROLEC-SE-R, expository and narrative comp. subscales	Expository comp. CI *m* = 5.39, TH *m* = 7.06 Narrative comp. CI *m* = 3.83, TH *m* = 5.2	Percentage of CI user able to comprehend texts at TH level expository = 30.55% narrative = 33.33%
Grantham et al. (2022) U.S.	*N* = 104, *m* = 9.0	WRMT, RC cluster (WC + PC subtests)	*M* = 99, 78% of participants scored within 1 SD of normative mean	Average range
Mayer & Trezek (2024) Canada	*N* = 13, *M* = 14;28 yrs.	WJ III-DRB RC cluster (PC subtest + RV subtests)	*M* = 87.00 (SD = 9.46)	Average range
Reading Studies: Age Equivalents (n = 2)				
Harris et al. (2017a) U.K.	*N* = 82, CI *n* = 22, *m* = 79;3 mons. HA *n* = 20, *m* = 78.4 mons. TH *n* = 40, *m* = 70.4 mons.	YARC	CI *m* = 72.7 mons. (SD = 19.4) HA *m* = 71.0 mons. (SD =19.2) TH *m* = 76.3 mons. (SD = 12.5)	No difference in scores based on hearing status
Harris et al. (2017b) U.K.	*N* = 73, CI *n* = 22, *m* = 101.4 mons. HA *n* = 19, *m* = 100.5 mons. TH *n* = 32, CA *m* = 92.8 mons.	YARC	CI *m* = 83.5 mons. (SD = 22.8) HA *m* = 87.8 mons. (SD = 20.5) TH *m* = 100.0 mons. (SD = 12.1)	No difference in scores based on hearing status
Writing Studies: Standard Scores (n = 1)				
Mayer & Trezek (2023) Canada	*N* = 64, grade 4-12, CI *n* = 12, HA *n* = 40, BAHA *n* = 5, No amplification *n* = 7	TOWL-4 SW composite (CC subtest + SC subtests)	CI *m* = 119.00 (SD 24.55), HA *m* = 111.63 (SD = 26.80), BAHA *m* = 122.40 (SD = 17.36), No amplification *m* = 139.86 (SD = 16.88)	Above average range

Note: CI = cochlear implant, TH = typical hearing, YARC = York Assessment of Reading Comprehension, T1 = time 1, T2 = time 2, elem. = elementary, WRMT = Woodcock Reading Mastery Test, PC = passage comprehension, PROLEC-SE-R = Batería para la Evaluación de los Procesos Lectores en Secundaria y Bachillerato-Revisada, comp. = comprehension, RC = reading comprehension, WC = word comprehension, WJ III-DRB = Woodcock-Johnson III Diagnostic Reading Battery, RV = reading vocabulary, mons. = months, TOWL-4 = Test of Written Language-Fourth Edition, SW = spontaneous writing, CC = Contextual Conventions, SC = Story Composition

Findings for CI users (Mayer & Trezek, 2024)



After Cochlear Implantation

Before Cochlear Implantation

Writing samples then and now

Snakes and fishmen are not similar but snake and fishmen are in competation. They tried to catch the fishs. Snake's tongue can drink the blood as smell (deaf college student).

(Mayer, 2009)

Generally speaking most people getting behind the wheel while intoxicated do not even know the effects alcohol has on the human body. Alcohol does and can affect the body in many dangerous ways, long or short term. Although the most overriding one is what this liquid can do to the brian (17-year-old with a CI). (Mayer & Trezek, 2023)

Take-away Question

Given the importance of literacy in the lives of deaf individuals …

And the unprecedented positive shifts achieved by cochlear implantation…

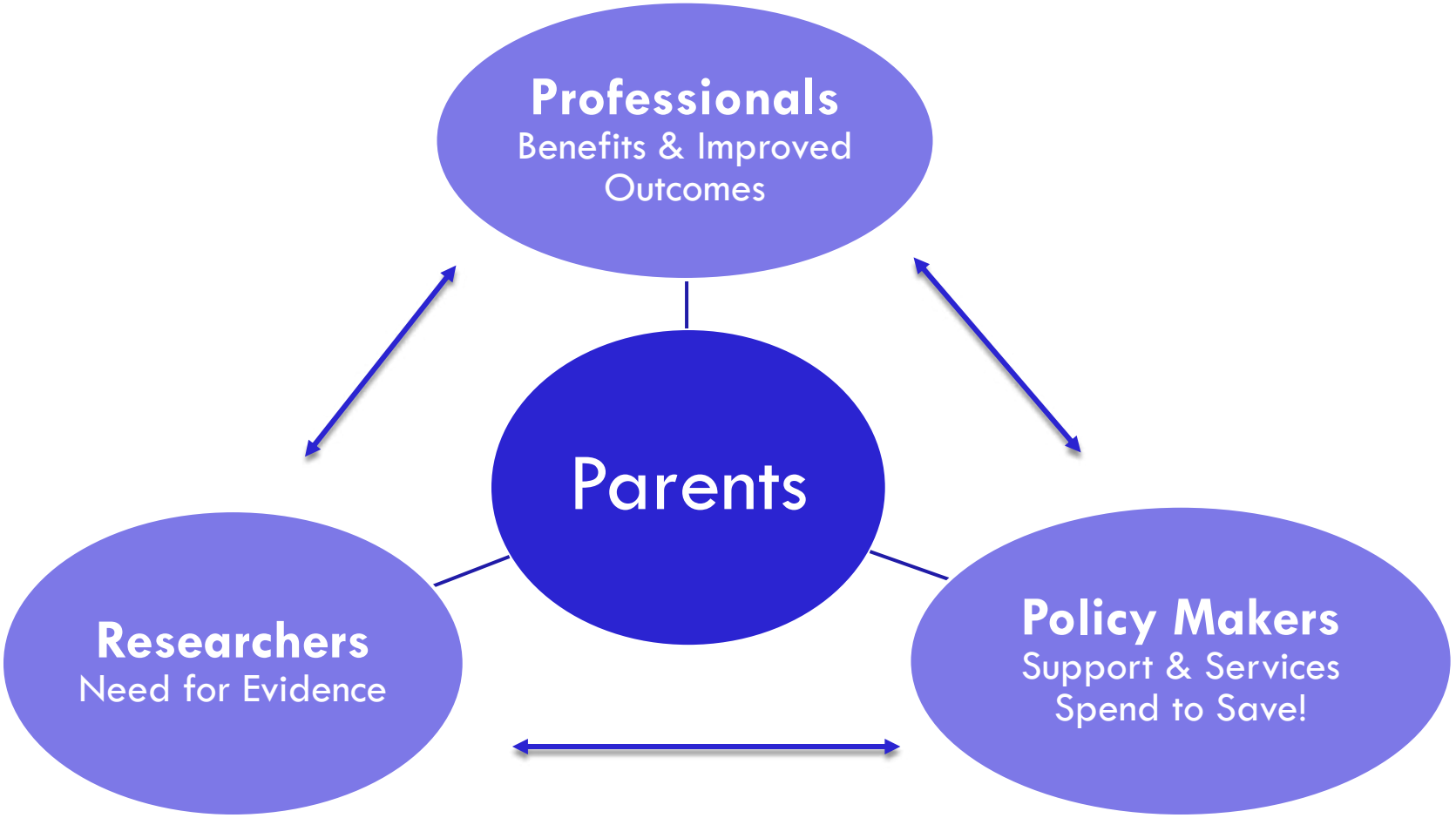
Why is this outcome of CI getting so little attention?



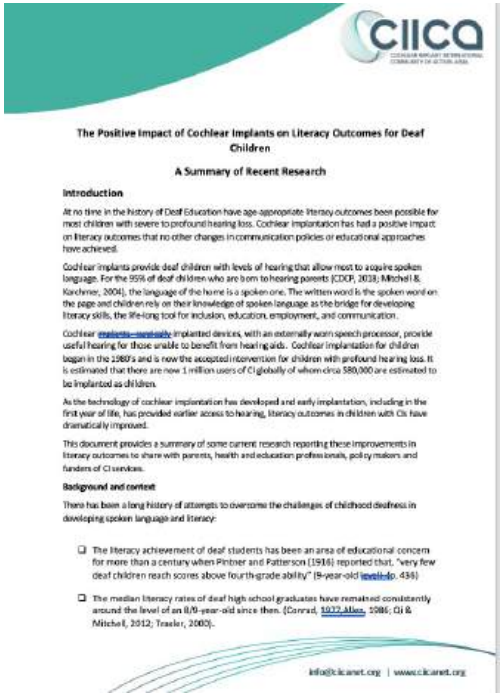


Who needs to know?

Every parent wants their child to learn to read and write.



CIICA gets the word out!



The Positive Impact of Cochlear Implants on Literacy Outcomes for Deaf Children

A Summary of Recent Research

Introduction

At no time in the history of Deaf Education have age-appropriate literacy outcomes been possible for most children with severe to profound hearing loss. Cochlear implantation has had a positive impact on literacy outcomes that no other changes in communication policies or educational approaches have achieved.

Cochlear implants provide deaf children with levels of hearing that allow most to acquire spoken language. For the 95% of deaf children who are born to hearing parents (CDCP, 2018; Mitchell & Karchmer, 2004), the language of the home is a spoken one. The written word is the spoken word on the page and children rely on their knowledge of spoken language as the bridge for developing literacy skills, the life-long tool for inclusion, education, employment, and communication.

Cochlear implants—surgically implanted devices, with an externally worn speech processor, provide useful hearing for those unable to benefit from hearing aids. Cochlear implantation for children began in the 1980's and is now the accepted intervention for children with profound hearing loss. It is estimated that there are now 1 million users of CI globally of whom circa 580,000 are estimated to be implanted as children.

As the technology of cochlear implantation has developed and early implantation, including in the first year of life, has provided earlier access to hearing, literacy outcomes in children with CIs have dramatically improved.

This document provides a summary of some current research reporting these improvements in literacy outcomes to share with parents, health and education professionals, policy makers and funders of CI services.

Background and context

There has been a long history of attempts to overcome the challenges of childhood deafness in developing spoken language and literacy:

- The literacy achievement of deaf students has been an area of educational concern for more than a century when Pintner and Patterson (1916) reported that, "very few deaf children reach scores above fourth-grade ability" (9-year-old level-dp, 436)
- The median literacy rates of deaf high school graduates have remained consistently around the level of an 8/9-year-old since then. (Conrad, 1977; Allen, 1986; Qi & Mitchell, 2012; Traxler, 2000).

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The Positive Impact of Cochlear Implants on Literacy Outcomes for Deaf Children: A Summary of Recent Research



INVESTING IN CHILDREN'S HEARING:

Deaf Children and the Impact of Cochlear Implantation

Hearing is fundamental for children to acquire the spoken language of their home. Spoken language enables children to communicate, interact with their families and carers, acquire literacy skills and achieve their educational potential. As the World Health Organisation (WHO) noted in their World Report on Hearing (WRH 2021).

"*Unless addressed in a timely manner, those with hearing loss have reduced school performance, slower progression through the academic system, a greater risk of dropping out of school, and lower likelihood of applying for higher education, compared with their hearing peers.*

(WHO, WRH, pages 45-46)

WE KNOW THAT:

- For children with greater degree of hearing loss, cochlear implants (CI) provide hearing not possible with hearing aids.
- Cochlear implantation in children has been shown to be safe, effective and cost-effective.
- Over 300,000 children globally have received cochlear implants (industry estimate).

"*Cochlear implant is one of the most successful of all neural prostheses developed to date.*

(WHO, page 103)

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RECOMMENDATIONS:

- Newborn hearing screening should be in place to allow early fitting of hearing aids and cochlear implants, together with early intervention.
- Cochlear implantation should be considered for all those children with greater levels of hearing loss.
- Children's implantation requires access to multi-professional skills including ear surgeons, audiologists, speech and language therapists, teachers of the deaf, psychologists.
- Children with CI require follow-up services, including regular programming of the system and regular habilitation, including communication and spoken language skills.
- Families and local professionals, including teachers and therapists should be involved in the ongoing care of children with CI.
- Following cochlear implantation, children need the opportunity to hear rich spoken language.
- Lifelong services are required, including managing the technology and the transitions to school, higher education and the world of work.
- Access to accessories to support the use of the CI system in education, work and home should be given.
- Family services, including peer to peer support and groups, facilitate the effective use of the CI system in communication.

Deaf Children and the Impact of Cochlear Implantation

Resources available on the CIICA website