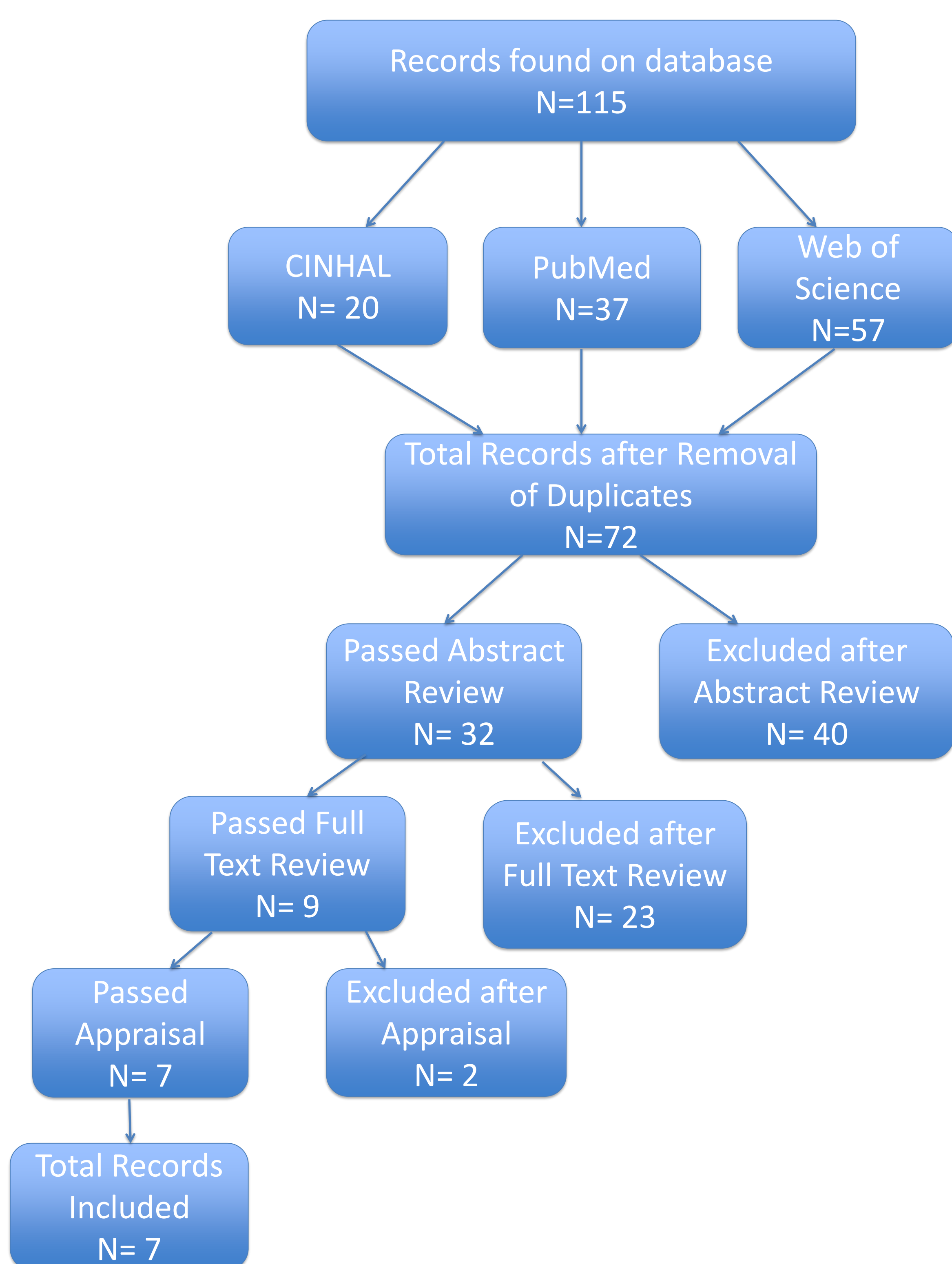


Introduction

Effective communication requires a level of shared understanding. Jones (2015) observes “an essential element to successful communication is the ability to make inferences about the psychological states of others and to predict or explain their behaviour with reference to their mental states, feelings, beliefs and desires”. Theory of Mind (ToM) is the ability to understand that the mental state of others can differ from our own. Many authors attribute the process of ToM to cognitive-conceptual changes tied to language development that occurs during the preschool years (Milligan, Astington, & Dack, 2007). As a whole, studies have found most typically developing children succeed at ToM tasks by 4-5 years of age (Levarez et al., 2012). However, Levarez et al. (2012) reports it is well established that children with severe-profound hearing loss exhibit a delay of 5-7 years in their ability to grasp beliefs of others. Currently there exists a moderate body of research examining ToM development in hard of hearing children. However, studies differ widely in terms of age of intervention, language abilities, lack of sample homogeneity, and quality of materials used.

Table 1: Search Strategy Flow Chart



Methods

A review of the literature was conducted in three different databases (PubMed, CINAHL, and Web of Science) using the following search strategy: (("theory of mind" OR "theory-of-mind") AND (child*) AND (develop* OR delay*) AND ("hard of hearing" OR hear* impair* OR deaf*)). This search yielded 72 results after duplicates were removed. Articles published in the last ten years that compared deaf and hard of hearing children to normal hearing peers under the age of 18 were considered for review. The researchers achieved 97% inter-rater reliability in abstract review tasks. Only 9 articles met full inclusion criteria and were appraised by three researchers and given a rating of good quality or lesser quality. After appraisal, 7 articles were further reviewed for the purpose of the research question. Due to the limited number of studies that assess ToM in deaf and hard of hearing children, low quality studies were included for review.

Table 2: Study Summaries

Study	Aim	Participant	TOM Task	Quality	Results
de Villiers et al. 2012	Asks whether children with delayed language and delayed explicit false belief reasoning can succeed on explicit deception tasks.	HI (n = 45) NH (n = 45)	1.Verbal False Belief reasoning Tasks 2.Low Verbal False Belief reasoning tasks 3.Deception Tasks	4b	HI children were significantly delayed compared to NH children in both verbal and low verbal explicit false belief tasks.
Jones et al. 2015	Designed to measure hearing impaired children's ToM development and to investigate the relationship between language ability and false belief task performance.	HI (n=27) Age Matched NH (n = 23) Younger NH (n=23)	1.First-order false belief: unexpected location tasks 2.First-order false belief: unexpected contents tasks 3.Second-order false belief task: ice-cream story	4b	HI children performed more similarly to the younger controls on second-order false belief tasks. Indicating a delay in ToM skills.
Ketelaar 2012	Compare ToM abilities of children with CIs to NH & consider relation of chronological age, age of implant, language comprehension	CI (n=72) NH (n=69)	1.Common, uncommon desire 2.Intention-Understanding 3.False belief 4.Language comprehension	4a	False belief & uncommon desire tasks yielded the lowest scores for CI group, even when controlled for language comprehension.
Levarez 2012	Determine if ability to grasp beliefs of others stems from ability with verbal demand or conceptual delays.	HI (n=12) NH (n=12)	1.Non-verbal false belief (cartoon scenarios) 1.Mentalistic- change seen/ unseen 2.Mechanistic	4a	No significant differences found between group's performance of any task.
Peterson et al. 2009	Progression of steps in ToM between HI and NH children	HI (n=33) NH (n=60)	1.Diverse desires 2.Diverse beliefs 3.Knowledge access 4.False belief 5.Social pretense 6.Hidden Emotion	4a	HI children and NH have consistent sequence of ToM. HI has slower rate of acquisition of sequence.
Rommel et. al	Compare ToM and language development between children with CI and NH children	CI (n=30) NH (n=30)	1.Theory of Mind Scale 2.Hiding and Finding game 3.False Photograph Task 4.Memory for Complements	4b	ToM development in CI children was not very delayed, if at all, relative to the children with NH
Sundqvist et al. 2013	Age of first CI association with development of ToM	CI (n=16) NH (n=18)	1.Cognition Task (Unexpected location) 2.Emotional Task	4a	CI group performed worse on both tasks compared to NH group.

Results

Table 2 shows the results of the seven articles that were analyzed for the current systematic review. Three of the studies were given a low quality rating and four of the studies received a high quality rating. All seven studies varied in tasks that were given to the participants to assess ToM. It should be noted that all studies included children with a hearing impairment. However, in three of the studies the HI participants had cochlear implants. Two of the articles found that the HI group did not differ significantly from the control group of normal hearing participants. Peterson et. al (2009) concluded that while the HI group was delayed in all ToM task compared to the control group, the HI group developed ToM in a sequence consistent to the control group. The other four studies also concluded a delay in ToM tasks when compared to normal hearing peers. Jones et. al (2015) compared the HI group to an age matched control and a younger age control group. They found that the HI group performed similarly to the younger group and therefore were delayed in ToM compared to age matched peers. de Villiers et al. (2012), Ketelaar (2012), and Sundqvist et al. (2013) all concluded that the HI participants performed significantly worse than the NH control group in all ToM tasks tested. Differences found between studies are detailed in the discussion.

Discussion

Although no direct conclusions could be drawn, the variability in the findings of this review adds to the growing evidence that supports the complex relationship of ToM development and language skills. Hearing impaired children “are a unique population with atypical language experience and thus provide an opportunity to illuminate the relationship between language ability and theory of mind performance” (Rommel, 2008). However, there are still many factors that need to be controlled upon studying this population such as intervention (cochlear implants vs. traditional amplification) Regardless of mode of amplification, it is important clinicians and teachers be aware of possible implications for ToM development and language skills and make appropriate referrals for intervention. Future study aims should include intervention approaches to ameliorate delays and support normal ToM and social-cognitive development trajectories in children with hearing loss. The authors of the current study have no conflict of interests.

Acknowledgements

This systematic review was completed as a project for SPHS 701 – Research Methods under Dr. Linda Watson and Dr. Mallory Baker.

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