

# **THE WRONG WORDS**

**COMPILED AND EDITED BY**

**Aahana Gupta**



## Ingenious Research

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## Preface

In Gurugram, a woman who was found to score impaired on the ADAS-Cog (Alzheimer's Disease Assessment Scale-Cognitive Subscale) came to a Memory Clinic. She spoke fluently for 15 minutes and described her grandchildren, her neighborhood, and the quality of light in the mornings - nearly all indicative of being unimpaired. The 15 minutes of speech indicated impairment; however, the lack of consistently finding a correlation between her performance on the ADAS-Cog and her speech provided evidence to question the construct validity of the instrument in Hindi primary populations. Because all 10 words found on the ADAS-Cog word list have not changed since its first administration in 1984 (the first time it was administered to a population was in 1984 to English-speaking, North American adults), there are now many areas throughout the world (assignments in South Asia, Sub-Saharan Africa, and Latin America) that have administered the same 10 words as a global standard for cognitive assessment and continue to do so.

The Handbook will be a documentation of the effects of diagnostic instruments that have been constructed from a population and applied to a different population and what are the efforts to address the issues when trying to administer an instrument to an individual from a population different than the population that constructed the instrument. The Handbook will address three domains: cognitive assessment in dementia, literacy screening in children, and the neurological basis for reading disabilities. The pattern in each of the three domains is consistent, i.e., a cognitive assessment tool was constructed in one place; the assessed individual is in another place; the difference between the two is a score.

The Chapter structure of the Handbook will be of a Practitioner's record format. Chapter One will describe the ADAS-Cog and the problems of construct validity in Hindi primary populations. Chapter Two will document the Indian Word List and the Smriti Intervention. Chapter Three will document the Sahitya Literacy Programme and the Structured Literacy and Dyslexia Screening Assessment for Devanagari Script. Chapter Four and Chapter Five will address the acoustic neuroscience of dyslexia as it relates to performance on the Hindi Ba-Wa rise time study. Finally, Chapter Six will return to the structural question raised in the first five chapters and address that question.

The information contained in this Handbook is a continuation of several efforts

that are ongoing. Several of the activities described in this Handbook are workarounds, or instruments used when the standard instruments are not construct valid to the assessed individual; they are not replacements for the standard instruments. Workarounds and replacements are fundamentally different; Workarounds identify what was necessary in lieu of a viable standard. The difficulty of creating a viable instrument is much greater than the ease with which one can select an appropriate/useable instrument. This Handbook will describe this difficulty and will detail the clinical and scientific work that supports its validity.

Aahana Gupta  
Cardiff, 2026

## Foreword

Aahana Gupta opens *The Wrong Words* with a scene that strikes a deeply personal chord for anyone who has worked in cross-cultural health. An elderly woman in Gurugram stumbles through the standard ADAS-Cog memory assessment, yet moments later, speaks with warmth, fluency, and sharp recall about her family and daily life. Her mind is clear. What failed wasn't her memory—it was the vocabulary forced upon her. For generations, diagnostic testing outside the Western world has relied heavily on imported instruments standardized decades ago on English-speaking populations. Asking an elderly Hindi or Tamil speaker to recall words like cabin, shore, or engine doesn't just measure cognitive health; it measures cultural distance. This mismatch is not an oversight—it is the direct result of a longstanding dearth of local research and funding dedicated to developing diagnostic tools from the ground up for indigenous populations. For too long, resource constraints and institutional habits have forced clinicians to rely on foreign frameworks, patching gaps with simple translations that fail to capture the nuances of lived experience. What makes this young author's work so vital is that she moves beyond pointing out these systemic gaps to actually bridging them. In developing an Indian Word List, she shows us that true adaptation isn't about literal translation—it's about emotional and cultural resonance. Choosing deeply familiar words like *Tulsi* respects the fundamental truth that memory is rooted in culture, routine, and identity. *The Wrong Words* is both a gentle reality check and an inspiring roadmap. It calls on researchers, practitioners, and institutions to invest in homegrown, evidence-based tools that honor local contexts. To measure a mind accurately, we must first meet people where they truly live.



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# INDEX

| No.                | Chapter / Topic                                                                    | Page No.  |
|--------------------|------------------------------------------------------------------------------------|-----------|
| <b>CHAPTER ONE</b> |                                                                                    |           |
| <b>1</b>           | <b>The Test</b>                                                                    | <b>1</b>  |
| 1.1                | <i>How the ADAS-Cog works: word recall, thirty minutes, global standard</i>        | 1         |
| 1.2                | <i>The Tamil-speaking patient: precision vs validity</i>                           | 3         |
| 1.3                | <i>Construct validity and its absence in Hindi-primary populations</i>             | 5         |
| 1.4                | <i>The scale of the problem across South Asia, Africa, Latin America</i>           | 8         |
| 1.5                | <i>The Indian Word List: criteria, process, and the addition of Tulsi</i>          | 11        |
| 1.6                | <i>What validation requires — and what it cannot do yet</i>                        | 14        |
| <b>CHAPTER TWO</b> |                                                                                    |           |
| <b>2</b>           | <b>The Fix</b>                                                                     | <b>18</b> |
| 2.1                | <i>Twelve patients, twelve weeks: the notes that did not fit the test</i>          | 18        |
| 2.2                | <i>Standardisation vs adaptation: what institutions are built for</i>              | 20        |
| 2.3                | <i>Building the Indian Word List: frequency, concreteness, emotional salience</i>  | 21        |
| 2.4                | <i>The 120-patient study at Marengo Asia Hospital</i>                              | 25        |
| 2.5                | <i>Smriti: WhatsApp-delivered cognitive stimulation in the patient's own voice</i> | 28        |
| 2.6                | <i>What Smriti is and is not — the workaround and what it reveals</i>              | 31        |

| No.                  | Chapter / Topic                                                                                 | Page No.  |
|----------------------|-------------------------------------------------------------------------------------------------|-----------|
| <b>CHAPTER THREE</b> |                                                                                                 |           |
| <b>3</b>             | <b>The Children</b>                                                                             | <b>36</b> |
| 3.1                  | <i>Aastika: zero to fifteen in twelve weeks</i>                                                 | 36        |
| 3.2                  | <i>Why the author went to Sai Public School</i>                                                 | 37        |
| 3.3                  | <i>Music, rhythm, and the neuroscience of reading: what the evidence says</i>                   | 38        |
| 3.4                  | <i>Baseline findings: four in five children carrying neurological vulnerability</i>             | 39        |
| 3.5                  | <i>The music-integrated phonics programme: structure and delivery</i>                           | 40        |
| 3.6                  | <i>Results: Cohen's <math>d = 1.21</math>, Group C's largest gains</i>                          | 42        |
| 3.7                  | <i>Dyslexia in Devanagari: why English tools find nothing</i>                                   | 43        |
| 3.8                  | <i>The SLDSA: five metrics, WhatsApp delivery, no specialist required</i>                       | 44        |
| 3.9                  | <i>Sahitya: the anganwadi network and 3,000 children reached</i>                                | 46        |
| <b>CHAPTER FOUR</b>  |                                                                                                 |           |
| <b>4</b>             | <b>The Sound</b>                                                                                | <b>50</b> |
| 4.1                  | <i>Sound as pressure wave: the amplitude envelope and why it matters</i>                        | 50        |
| 4.2                  | <i>Rise time: the acoustic property underlying reading deficits</i>                             | 51        |
| 4.3                  | <i>Goswami's hypothesis: rise-time processing deficit as the neurological basis of dyslexia</i> | 52        |
| 4.4                  | <i>The Ba-Wa paradigm and its replication across six European languages</i>                     | 54        |

| No.                 | Chapter / Topic                                                                       | Page No.  |
|---------------------|---------------------------------------------------------------------------------------|-----------|
| 4.5                 | <i>What the absence of Hindi rise-time data means</i>                                 | 56        |
| 4.6                 | <i>Email to professor Goswami</i>                                                     | 57        |
| 4.7                 | <i>Her replies: methodology guidance, stimulus files, and field research cautions</i> | 58        |
| 4.8                 | <i>The kindness contamination problem in field studies</i>                            | 59        |
| 4.9                 | <i>The Hindi Ba-Wa app: stimulus design and delivery</i>                              | 60        |
| <b>CHAPTER FIVE</b> |                                                                                       |           |
| <b>5</b>            | <b>The Study</b>                                                                      | <b>65</b> |
| 5.1                 | <i>The school in Sector 4, Gurugram: 200 students, no specialist</i>                  | 65        |
| 5.2                 | <i>The dog on day one: what field research looks like</i>                             | 66        |
| 5.3                 | <i>Participants: 47 children, dyslexia-risk and typically developing</i>              | 67        |
| 5.4                 | <i>The ethics process: why slowness is the point</i>                                  | 68        |
| 5.5                 | <i>The task: 60 trials, 3 conditions, 2 buttons in Hindi</i>                          | 69        |
| 5.6                 | <i>Inside a study before the results are known: uncertainty vs anxiety</i>            | 71        |
| 5.7                 | <i>What the data will show — and what either result means</i>                         | 73        |
| <b>CHAPTER SIX</b>  |                                                                                       |           |
| <b>6</b>            | <b>The Wrong Words</b>                                                                | <b>78</b> |
| 6.1                 | <i>The institution always finds the fault in the person</i>                           | 78        |
| 6.2                 | <i>Precision vs validity: three institutions, three invisible tools</i>               | 79        |
| 6.3                 | <i>The Belmont principle of justice applied to diagnostic construction</i>            | 81        |

| No. | Chapter / Topic                                                                  | Page No. |
|-----|----------------------------------------------------------------------------------|----------|
| 6.4 | <i>Cognitive colonialism: what the phrase means and where it falls short</i>     | 82       |
| 6.5 | <i>What you do: small things and structural change</i>                           | 84       |
| 6.6 | <i>The Indian Word List, Sahitya, Smriti, the Ba-Wa study — and their limits</i> | 86       |
| 6.7 | <i>The woman in the clinic: what we still do not know</i>                        | 88       |
| 6.8 | <i>Finding the right words is difficult</i>                                      | 90       |

## **CHAPTER 1**

### **The Test**

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#### **1.1 How the ADAS-Cog Works: Word Recall, Thirty Minutes, Global Standard**

The Performance of the ADAS-Cog Test: Word Recall, Thirty Minutes Total, Global Standard The ADAS-Cog is a tool used worldwide for assessing cognitive dysfunction in patients with Alzheimer's disease. It was developed in 1984 by three researchers—Sam Mohs, Alan Rosen, and Richard Davis—at the Mount Sinai School of Medicine in New York City. It has been tested on English-speaking subjects throughout the USA and has gained further credibility having been used for this purpose around the world (i.e., Baltimore to Mumbai and Gurugram to Chennai). Originally designed to take approximately thirty minutes, this test measures three basic domains of cognition: memory, language, and reasoning; and includes four specific subtests: naming of frequently used objects, following verbal orders, copying geometric shapes, and, most importantly, word recall. The word recall test provides some of the earliest diagnostic information for Alzheimer's disease based on word recall, and rate of word loss

## THE TEST

over time distinguishes between normal age-related memory changes and dementia from Alzheimer's disease. To assess word recall, the test is administered in a standardized manner. The examiner reads to the patient the same list of ten words aloud and allows two seconds between each word and provides one attempt at word recall after completion of each of three readings of the list. The memory words are read to the subject, and he or she is asked to recall as many of the words as possible after completion of all three readings of the list. The data collected from the recall process is considered one of the most valuable data points to be collected with respect to the accuracy of the total score obtained by the subject. The following section will provide an overview of the methods and outcomes of the ADAS-Cog based on comparisons with the original standardization sample. McRae and Craik (2004) highlighted the need for tests to have adequate normative data, which necessitates a stable word list. As the composition of the ADAS-Cog has remained stable for 22 years, this section will also argue that it is not only the normative data but the test itself that must first be established as stable in order to allow clinicians to use these data to make informed judgements regarding their patient's cognitive abilities.

The English language has ten words that have remained exactly the same for all 12 years of the ADAS-Cog and for the last 22 years overall. These words are: butter, arm, shore, letter, queen, cabin, pole, ticket, grass, and engine. These words have also remained unchanged since the development of the original ADAS-Cog in 1984.

This reliability is no fluke; in order for normative data based on word lists to retain validity, there must be uniformity in the

## THE WRONG WORDS

lexicon used to establish them. If words change, then previous comparisons are rendered invalid, and the thousands of hours that have gone into calibration of clinical thresholds over the years will be for naught. This rigidity is a matter of methodological principle but, as this chapter discusses in detail, it is also a structural issue concerning a world-wide clinical population for whom the list was never intended.(1)

### **1.2 The Tamil-Speaking Patient: Precision vs Validity**

Psychometrics provides the basis for the differentiation between precision and validity, which are presented to all students in their introductory statistic courses. The definition of precision asserts that there will be consistency in the measurements that are taken with an instrument regardless of time or situation. Validity asserts that an instrument has measured exactly what it claims to measure. An instrument can be precise yet invalid simultaneously. This appears to be a thinking error that occurs in clinical practice when the clinician using the instrument is not the same individual that validated it.

An example of how this occurs was witnessed in a neurology clinic in Gurugram. This patient is a seventy-two-year-old woman from Tamil Nadu who has been living in Gurugram to be near family members. She speaks Hindi fluently enough for day-to-day conversation, but her first language is Tamil. This woman is a highly fluent speaker of Tamil having spoken it without thought or effort as part of her daily routine throughout her life. She has never thought of or used English as a primary thought language or domestic activity language. She is evaluated using the ADAS-Cog. Her score from recall trial one and recall trial two are recorded; therefore, her total score is

## THE TEST

recorded as: cognitive impairment.(2)

Four minutes after the test ends, she begins to speak to her daughter; she does so without hesitation and with no apparent effort at finding words; she speaks fluently as if she is completely in control of her memory. She names her grandchildren; she knows their ages; she knows which one recently has begun school and is taking it seriously. She continues speaking for fifteen minutes without a pause and never loses the train of her thoughts.

The apparatus was accurate. Ten words, presented in the same order and at the same time intervals, gave exactly the same results as they do in every other clinical situation. However, in this instance, the instrument did not accurately assess this particular individual's ability to perform on episodic memory tasks. Rather, the instrument measured the distance between an elderly Tamil-speaking individual's lexicon and the English-language test developed in New York City in 1984; this distance was found to be great, and therefore was recorded as a pathology.(3)

The clinically relevant distinction I have already made is that the distinction between precision and validity is lost in clinical practice. Although the score reflects the scoring that is obtained, no note would be made in the case file that the instrument used to derive that score was developed for a different population. There would also be no flag that the patient's primary language was Tamil; therefore, the words provided to the patient do not have the same association to her memory as the words did to the memory of the population for which the test was originally developed. As such, the outcome

## THE WRONG WORDS

recorded in the case file simply reflects a finding without qualification. This finding established a basis for authority and validity through a body of evidence spanning over 40 years of clinical use.(4)

The clinician who administers the ADAS-Cog has no requirement to establish the validity of the instrument. Validating a measurement is an institutional function; therefore, the clinician is expected to utilize the tools sanctioned by the institution by following the protocol established by the institution. Moreover, it is inherently outside of the clinician's role to question the validity of the tool, in addition to being a deviation from an established protocol. This has been one of the reasons why tools that should have been questioned have remained unchallenged for over 40 years.

### **1.3 Construct Validity and Its Absence in Hindi-Primary Populations**

The construct validity of a test refers to the generalizing of results from that cognitive test to cognitive abilities in all tested populations. All of the words presented to the individual during the recall task must be able to be accurately represented as being encoded (i.e. encoded in long-term memory by all individuals in the population tested) by the individuals in the population group being tested, such that failure to recall a word from the test does not represent a true memory impairment, but is a result of differing encoding due to language, culture, or individual experience.(5)

The construct validity of ADAS-Cog (Alzheimer's Disease Assessment Scale - Cognitive Subscale) word recall and

## THE TEST

ADAS-Cog has been established in thousands of English-speaking individuals. There is an extensive number of normative data available on this population and the clinical threshold scores for this population have been validated in many larger studies. Therefore, in the English-speaking population, a low score on the word recall subtest can be considered a valid measure of episodic, rule-based, memory ("episodic memory loss").(6)

Thus, there is no construct validity proven for ADAS-Cog word recall as to individuals who primarily speak Hindi. This does not imply that such validity has been presumed to exist, but rather that no formal question of whether construct validity exists for this subtest exists in the literature and thus, there has been no finding as to its existence. The absence of this establishing research is a silence.

### **1.3.1 The Importance of Encoding in Practicing Clinically**

When words are encoded into long-term memory there is not uniformity in the amount of long-term encoding across individuals/population groups. An individual will be able to more greatly recall or demonstrate their ability to recall an individual word that they encountered more frequently, in a variety of contexts, and with more significant emotional or sensory input as compared to a word that they have only encountered in a language acquisition setting or in the written context. The word "butter" is a good example of this type of situation. It is known to be a word that is encoded in the earliest beginnings of learning English as a second language (ESL). It can be found in numerous children's picture books, with children using this word at breakfast tables or using this word

## THE WRONG WORDS

when preparing food. An English-speaking adult with normal cognitive function will have learned Butter through thousands of daily experiences over the course of a lifetime. The encoding of Butter, at this point, is so extensive that it exists in the individual's long-term memory with minimal effort required to access it.(7)

In contrast, a 72-year-old woman who has spent her entire life speaking Tamil and cooking with ghee likely has not learned Butter in the same way. She might know what the word is and be able to produce it in a language exercise, but its place in her long-term memory will be very different from that of the person the test is designed for. Testing her ability to recall Butter does not measure her episodic memory but assesses her lexical history compared to an American English speaker in 1984.

The full word list includes items such as Cabin, Shore, Engine, Pole, Ticket—each is part of the context of the American English speaker for whom the test was developed and is significantly different than the context of an elderly subject living in Gurugram, Patna, or Lucknow.

### **1.3.2 Differential Encoding and Risk of Misdiagnosis**

The negative clinical outcome created by differential encoding is the existence of consistent assessment biases. Patients whose primary language is Hindi, when evaluated with the word list of the English version of the ADAS-Cog (Cognitive Assessment of Alzheimer's Disease) test, are likely to score lower on the word recall than if they did speak fluent English. This occurrence can be attributed to the fact that the words used for the Hindi-primary individual have not existed in that

## THE TEST

individual's long-term memory for as long as they had for the English-speaking individual. The above bias is significant for the diagnosis of Mild Cognitive Impairment (MCI) and normal ageing because MCI is the intervention point where both pharmacological (drugs) and non-pharmacological interventions can be the most effective, monitoring prevents or delays the progression to dementia, and the accurate identification of MCI has the greatest clinical impact. Misclassification of MCI due to differential encoding can lead to a patient moving into a diagnostic and therapeutic pathway that is out of sync with their actual cognitive status. An individual whose actual MCI is masked by a higher-than-typical level of performance on a word list because the words that were administered were culturally salient will not be provided with timely treatment. The source of the bias lies in a similar structural failure in both instances, namely, the use of an instrument that has been validated for one population but has not been validated for other populations to determine MCI.(8)

### **1.4 The Scale of the Problem in South Asia, Africa, and Latin America**

The situation set out here is not confined to a single clinic, city, or country. There are numerous diagnostic and treatment sites throughout South Asia, East Asia, sub-Saharan Africa, and Latin America where the ADAS-Cog is being administered in its original English form or in direct translations that incorporate the same cultural assumptions that were in the original word list. The people using these assessments in each of the above geographic locations are heterogenous linguistically and culturally in ways that were never taken into

## THE WRONG WORDS

account in the original validation study for the ADAS-Cog. The demographics of the elderly who attend neurology clinics in major urban areas in India (e.g., Delhi NCR, Mumbai, Chennai) indicate that many of these patients are not English speakers. Many of the elderly population in those regions are native Hindi speakers, but there are also numerous regional language speakers (e.g., Tamil, Telugu, Bengali, Marathi, Kannada, Gujarati). Yet, in these clinics, the same 10-word English-language videotape will be used to assess all of the patients who visit the clinics regardless of the primary language spoken.(9)

| <b>Region</b>               | <b>Primary Languages Affected</b> | <b>ADAS-Cog Version in Use</b>         | <b>Validation Status for Primary Language</b> |
|-----------------------------|-----------------------------------|----------------------------------------|-----------------------------------------------|
| Northern India (Hindi Belt) | Hindi, Urdu, Bhojpuri, Awadhi     | English original or direct translation | Not validated for Hindi-primary speakers      |
| Southern India              | Tamil, Telugu, Kannada, Malayalam | English original                       | Not validated                                 |
| East Africa                 | Swahili, Amharic, Somali          | English original                       | Not validated                                 |
| West                        | Yoruba, Hausa,                    | English original or                    | Not                                           |

## THE TEST

|                         |                                          |                                        |                                                |
|-------------------------|------------------------------------------|----------------------------------------|------------------------------------------------|
| Africa                  | Igbo                                     | French translation                     | validated                                      |
| Latin America           | Spanish (regional varieties), Portuguese | English original or direct translation | Partial validation in Castilian Spanish only   |
| East and Southeast Asia | Mandarin, Cantonese, Tagalog, Vietnamese | English original or direct translation | Some validation in Mandarin; limited elsewhere |

*Table 1.1 - Regional Deployment of the ADAS-Cog Without Validated Cultural Adaptation*

Approximately 600 million people worldwide speak Hindi. However, there is virtually no research to support or assess cognitive ageing in the Hindi-speaking populations or the best way to assess episodic memory function in Hindi-speaking adults. This is not the case of not having enough researchers interested in this field; rather, it is a systematic and historically repeated pattern of using non-Hindi dominant research samples as the reference group for developing measurement instruments to assess Hindi-speaking adults.

As the scope of the problem is currently not fully known because it is not considered a problem, being able to accurately quantify the extent of this issue is very difficult. There are no national registries in most of the regions that contain a large number of non-English speaking patients which would allow

## THE WRONG WORDS

the tracking of the number of non-English-dominant patients who are assessed using English-language instruments. Also, there are generally no clinical guidelines in most of the affected areas indicating the limitations of the assessment tool. The Gurugram patient is not an outlier; rather, she is part of a much larger cohort of similar patients.

### **1.4.1 How Translation Does Not Resolve the Problem**

One could assume that translating the ADAS-Cog word list into Hindi, in and of itself, addresses the cultural bias in the instrument. Directly Restating the Above Passage Includes the Following: Makhan for butter, Kebin for cabin, Kinara for shore, and Injin for engine are all valid terms of different definitions under each of the respective encodings found in Makhan, Kebin, Kinara, and Injin based off of both differing lexical familiarity of each translation within Hindi language speakers versus the English language original words. The same principle applies in translation providing only the formal structure of the instrument whilst the psychometric basis will not transfer from ADAS-Cog original to the ADAS-Cog (translated) since there has been no psychometric validation performed on any versions of the ADAS-Cog for Hindi speaking individuals.

Word lists that are translated into Hindi from another language are labelled new and would do not possess the same psychometric validity as a new word list does as the two word lists would have undergone separate validation processes, which include frequency/topic analysis, depth of encoding studies, assessment against emotional importance, subject matter/specified by the normative sample used to create, and

## THE TEST

subject matter would require calibrating for clinical thresholds; the aforementioned steps have not been appropriately conducted on Hindi-translated versions of the ADAS-Cog.

Psychometric adaptation - or creating a culturally and linguistically appropriate version of a psychological instrument for a particular culture - is distinct from creating a fungible (usable in all other cultures) word list by its definitional characteristics, being time consuming and costly and it has not been documented by peer-reviewed articles in any way to date outside of the English-speaking world for the ADAS-Cog and if there are any published materials, they are not sufficient to develop a clinically valid psychometrically adapted version of the ADAS-Cog for primary populations; as a result of these limitations, the need for an Indian word list (a culturally adapted version of the Hindi-translated ADAS-Cog) has emerged and serves as a initial foundation for further research to improve the quality and develop culturally adapted word lists for use with Hindi speaking populations.

### **1.5 The Indian Word List: Why and How The Word List Was Developed and Addition of Tulsi**

The Indian Word List (a proposed culturally adapted Asian word list) is an instrument used to provide an instrument that is culturally and linguistically appropriate to aid in assessing the memory of Hindi-speaking elderly population that is based upon the previously discussed and documented methodological limitations and disadvantages of existing, validated instruments. The Indian Word List currently does not have any clinical validity, but has been proposed for clinical validation. The word list was created using the same psychometric criteria

## THE WRONG WORDS

for selecting words for the original ADAS-Cog; however, they were applied to the Hindi language and the life experience of elderly, Hindi-speaking patients in North India. The three criteria are:

**High Frequency Across Hindi Dialects:** There is vocabulary, accent, and register variability between the Hindi that is spoken in Uttar Pradesh, Haryana, Rajasthan, Bihar and Delhi NCR. Therefore, in order to be reliably familiar to the elderly speaker, the word that is selected for the Hindi ADAS-Cog must be one that all elderly speakers would recognize as a term that is common throughout this region, rather than only one that is common to one dialect or urban register.

**Concrete and Imageable:** Abstract words make poor candidates for recall because the way they are encoded by individuals differs. Concrete objects and substances represent items that can be seen, touched, held, eaten and used, therefore they will be encoded more reliably and retrieved more consistently.

**Emotionally Significant in the Daily Lives of Elderly Hindi-Speaking Adults in North India:** This third criterion was not explicitly mentioned in the original ADAS-Cog literature, and therefore represents the principal conceptual contribution to the development process of the Indian Word List. Words related to daily activities, household routines, and events that have both emotional and ritual significance for elderly Hindi-speaking adults, will be more deeply encoded than words that are only encountered in a spoken or written form.

A fourth criterion for phonological distinctiveness was retained from the original ADAS-Cog design requirements. Auditory confusion occurs when there are words that sound similar to

## THE TEST

each other, and this results in false negatives that are not independent of memory functioning. The Hindi phonological inventory has phonological distinctiveness within the boundaries of phonological parameters for all words in the proposed word list.

| No. | Word (Hindi)   | English Gloss |
|-----|----------------|---------------|
| 1   | Roti / रोटी    | Flatbread     |
| 2   | Haath / हाथ    | Hand          |
| 3   | Ghar / घर      | Home / House  |
| 4   | Paani / पानी   | Water         |
| 5   | Ped / पेड़     | Tree          |
| 6   | Kursi / कुर्सी | Chair         |
| 7   | Kitaab / ककताब | Book          |
| 8   | Gaadi / गाड़ी  | Vehicle / Car |
| 9   | Phool / फूल    | Flower        |

## THE WRONG WORDS

|    |               |              |
|----|---------------|--------------|
| 10 | Doodh / दूध   | Milk         |
| 11 | Tulsi / तुलसी | Sacred Basil |

*Table 1.2 - Proposed Indian Word List with Hindi Script and Transliteration.*

### **1.5.1 The Tulsi Concept**

Tulsi or "sacred basil" is a plant that is found in almost every courtyard of all Hindu households in Northern India and is tended to daily. Tulsi has significance as an item in prayers, traditional medicine, and food preparation, and it has ritualistic significance over the lifetime of older women in India. There is no English equivalent to the word Tulsi, nor is there a neutral translation of the word. The addition of Tulsi to the standard word list, changing the list from ten items to eleven items, identified the true nature of the problem of the word list was not just the question of concreteness and frequency but whether or not the object experiences of daily life are the same across cultures. The assumption of the ADAS-Cog is that a patient's ability to recall an item is based on the common experience of an English-speaking, American population in 1984. The word Tulsi would not have been a word available to anyone in the world that existed in 1984 but would continue to exist in the current Indian culture. The inclusion of the word Tulsi indicates that the construction and development of a culturally appropriate word equipment that can be recalled would still require substitution within the same context of meaning but require an expansion of the meaning context to that of the

## THE TEST

actual experience of those being tested.

For a patient who lights incense at the Tulsi plant each and every morning for 60 years would have a different memory of this word than would the memory of any of the other words in the original ADAS-Cog word list. The memory of this word would be extensive, involve many sensory modalities and be reinforced by ritualistic activity. The emotionally charged significance of the word Butter or Cabin cannot be compared to the significance of these words for a Tamil-speaking woman in their own lexical and domestic culture.

### **1.6 What validation requires — and what it cannot do yet**

As stated previously, the Indian Word List presented herein is only proposed. It is important to stress this multiple times, as the difference between a proposed measurement instrument and an established instrument for clinical practice is the difference between a question and an answer. In order for a word recall measurement tool to be utilized within clinical practice, there are multiple validation phases that must be completed; yet, for the Indian Word List, some validation phases have not been successfully completed, namely:

Normative Data Research - To provide benchmark data for clinical purposes, a normative sample must be obtained from a large, representative group of cognitively healthy elderly persons who speak Hindi as their primary language. These data points will allow clinicians to understand what constitutes "normal" performance on the measurement tool. Without normative reference points, it is impossible for clinicians to interpret patient scores.(10)

## THE WRONG WORDS

**Reliability Testing** - The measurement tool must produce consistent scores from one patient to another across time (test-retest reliability) and across different examiners giving the exact same test to the same patient (inter-rater reliability). Inconsistency will inflate false positives as well as the likelihood that a patient is incorrectly diagnosed as having a condition.(11)

**Criterion Validity Testing** - The measurement scores must be compared to an established clinical reference standard via a comprehensive neuropsychological testing protocol to ascertain that the measurement identifies the same impaired patients as the clinical reference standard will identify during the testing process.

**Sensitivity and Specificity Calibration** - The clinical thresholds at which the measurement identifies a patient as having symptoms of impaired functioning need to be reliably determined in order to achieve maximum sensitivity (true positives) and minimum specificity (1 - false positives). These clinical thresholds will differ from those provided by the ADAS-Cog due to differing populations.

**Peer Review and Publication** - The validation data must undergo independent scientific examination and published in a peer-reviewed format prior to being considered validated for clinical use.

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## CHAPTER 2

### The Fix

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#### **2.1 Twelve Patients, Twelve Weeks: The Notes That Did Not Fit the Test**

One problem with noticing an observable phenomenon is that it is impossible to ignore it after it has been discovered. The observations detailed below were collected over a 2-month period at a Neurology Clinic in Gurugram, IN on twelve patients before any formal study design existed for this group of patients. Thus, these observations are not scientific data; rather they represent a systematic pattern of clinical observations - gradually increasing in their unity with one another - indicating that they all point in a similar direction.

The twelve patients noted above are all elderly adults living in the Delhi-NCR region: Delhi, Haryana, and UP and most of them were much more comfortable communicating in Hindi rather than English. All twelve patients participated in a standard ADAS-Cog assessment and were also asked to remember ten English words.

Patient No. 4 is Hindi Dominant; He failed the word recall subtest of all three attempts. However, after the neurologist

## THE FIX

finished the official evaluation, he spoke to the patient in Hindi about his daily walking route, what medications he took and the route he takes to the market. The patient did this without having to pause for words, etc.; he was easily communicating as if he remembered everything that he was talking about.

Patient No. 7 could not recall either Cabin or Shore, as they are both words that would not have been familiar to someone who has lived their entire life in Gurugram. At the conclusion of the session, participant #11 was able to name fourteen items in the kitchen, in Hindi, without hesitation after being informally asked. The participant tested in the severely-impaired range on the ADAS-Cog (Alzheimer's Disease Assessment Scale-Cognitive Scale) at that time; however, when her daughter arrived to pick her up, she recited, spontaneously and with great emotion, a four-stanza poem in Urdu from memory.

All of the written notes are continually pointing in one direction: the ADAS-Cog test was measuring something, but it was not always measuring what it claims to be measuring. More specifically, the test is not consistently measuring episodic memory function in patients for whom the words on the word list of the test do not match their past or current lexicon. In many of the cases, the test was measuring the differential encoding of the patient's vocabulary, which is a mismatch between the words that the patient has assumed are known and the words that they actually know.<sup>(1)</sup>

This should not be interpreted to mean that the ADAS-Cog test is not a useful tool; it is still a well-validated test for use by patients who speak English and have over 40 years of clinical data; the issue is not that the test is not useful when used

## THE WRONG WORDS

appropriately, but rather that the test is being used inappropriately and no method exists to identify and/or remedy this misuse of the test.(2)

### **2.2 Standardization vs Adaptation: What Institutions Are Built For**

Institutions are built to achieve standardization; Institutions are created to assure consistent outcomes and production of the same output under identical conditions from a large number of practitioners/clinical sites and/or a large number of patients/clients. This is not a failure. Clinical care can be reproducible and auditable through the properties of Institutions, but without these properties the ability to be able to perform comparative clinical outcome analysis, quality measurement, or utilize evidence-based medicine cannot occur.(3)

Institutions are not designed to recognise that a condition has changed and that the 'Standard' can no longer be used. The ADAS-Cog is an example of a standard. In the clinics of India where it is used, the ADAS-Cog continues to serve as a standard, although it will not be noted anywhere within the standard clinical file, that it was validated in a completely different population.

The Authority for use of the ADAS-Cog is derived primarily from the institution that validated the ADAS-Cog and the years of normative data which was created from utilizing the ADAS-Cog and has provided the scores from using the ADAS-Cog with clinical meaning. Therefore, the population (i.e. Patients) that the ADAS-Cog is being administered to will not have been

## THE FIX

part of the process to validate the ADAS-Cog.(4)

The structural tendencies for institutions to locate error at the person vs. tool level is not based on bad faith. Rather, it is the result of how institutions process information. The ADAS-Cog has been validated; the protocol has been established; the clinician adheres to the protocol; therefore, when the output is unexpected, the clinician will conclude that the source of the problem is the patient without having to make any change to the institutional structure. Whereas explaining the need to change the institutional structure because the unexpected output is due to limitations of the tool which were not disclosed to the clinician or the patient is structurally invisible.(5)

This is why things that should have been called into question for 40 years continue to be uncalled into question. Understanding this pattern has great clinical significance in that the correction is unlikely to be made from within the system under normal practice circumstances. A neurologist may recognise that a patient has scored impaired on one assessment but has then spoken fluently but as defined by the institution the neurologist has no authority within their clinical scope to make a change to the assessment tool. An instrument requires an individual to step outside their clinical role and create a study, collect data and develop a rationale in a manner recognised by the institution (by means of peer-reviewed documentation). The aforementioned will be the lengthy journey that therefore provides patients with the assessment of being incorrectly assessed in the interim.

### **2.3 Building the Indian Word List: Frequency, Concreteness, and Emotional Salience**

## THE WRONG WORDS

The first obstacle in the construction of the Indian Word List was obtaining data on words in Hindi based on their frequency of occurrence. There exists an extensive amount of variation amongst the Hindi language; therefore, a frequency of language needs to be ascertained based on a large enough sample to find out which words in Hindi are truly common. In order to ascertain the frequency with which words in Hindi occur, the sample needs to be representative of all dialects, all registers, and all of the significant internal variation in Northern India.

Hindi is not one language. Hindi in U.P. is different from Hindi in Haryana, which is also different from Hindi in Rajasthan. Differences exist in all areas of language, including, but not limited to, vocabulary and also in the register. For example, the most basic and the most frequently used words used to express ideas in domestic life differ from region to region. A word can be commonplace in one area and not in another. Any list of words that will be employed all over the Hindi speaking areas of India should be founded not on regional familiarity, but have validity for the entire population being tested.

### **2.3.1 Frequency of Use**

The principal data source for the analysis of how frequently words are used in Hindi was the existing corpus of data that is available for Hindi, which was analysed and correlated with research that identified names for nouns in South Asian languages. The goal here was not to determine the most frequently used Hindi words in general use, but rather the most frequently used words in the domestic, oral, and everyday by the elderly, Hindi-speaking adults in India. This is not the same as determining the most frequent words used in the journalistic

or literary forms of Hindi.

The frequency criterion is used as a filter when determining which words to include. Any candidate word that had regional variations; was used more frequently in writing than having been used in speaking; was used in situations that an elderly adult living in rural or semi-urban areas of India would almost certainly never encounter, was excluded from the list of possible candidate words for the final word list.

### **2.3.2 Concreteness and Imageability**

The source for the concreteness criteria is empirical research (psychometric) on how people encode and recall words. Individuals rarely consistently encode abstract words (i.e. words referring to concepts, emotions, and relationships) and those that do not consistently encode abstract words do so more based on their levels of education, cognitive styles, and types of language. Concrete words that refer to the physical objects or substances that can be seen, touched, held, cooked, and used, are consistently and deeply encoded and easily retrieved.(6)

The imageability criteria is similar but distinct to the concrete criteria. An imageable word refers to any type of word that evokes an image that is both clear and constant in the majority of people's minds. Imageability is a good predictor of recall success with regard to memory but does not have any connection to how often a word is used. Pictures or images taken out of context and into the realm of everyday use exist at the same time and therefore have created a preferential area in long-term memory for those words that will do so. Therefore, it can be said that these two types of words (i.e., frequent and

imageable words) are suitable candidates for use in a word recall instrument to measure an individual's memory as opposed to his or her ability to access lexical information.(7)

### **2.3.3 Emotional Salience: A Missing Criterion from the Original ADAS-Cog Word Selection Literature**

Emotional salience was not included as a criterion for word selection in the original ADAS-Cog literature; however, it became apparent as a result of some careful consideration regarding the reasons different words are easier to recall compared to others, especially in the context of differentiating those words by the frequency in which they are used as opposed to the degree to which they have become an integral part of an individual's lived experience.

Words that become tied to someone's experiences (e.g. used on a daily basis or has significance from an emotional or practical standpoint) have much deeper encoding than words that have been used only in a verbal or written context. For example, if a patient lights a diya each evening for the last few years, they have created a different form of encoding through their lived experience with the diya compared to someone who has only come into contact with the word diya through either written or spoken forms. The encoding of the word is influenced by the various senses, reinforced emotionally, and takes place under repetitive conditions for years which results in the word almost becoming automatic for that individual.(8,9)

In order for a word recall device to differentiate between those who have memory impairment from those who have different types of encoding, the instrument needs to use only words that

all individuals who are part of the population will have encoded through their lived experience and therefore, not through just linguistic exposure. Therefore, emotional salience is not an additional criterion but is a necessary element contributing to the validation of an instrument for the target population.

The chosen words for the proposed Indian Word List will contain only culturally relevant items to represent similar concepts as those listed in the English version of the ADAS-Cog with similar characteristics that validate the instrument use for English-speaking populations.

### **2.4 The Study of 120 Patients at Marengo Asia Hospital**

The first formal empirical comparison of the proposed Indian Word List was conducted with the ADAS-Cog standard test for cognitive assessment in a population of Hindi speaking patients. The following study contains ethical approval from the hospital institutional review board and was under the clinical supervision of the Head of Neurology.

#### **2.4.1 Study Design**

The study enrolled a total of 120 patients that had been referred for cognitive assessment to the neurologist at the Marengo Asia Hospital. The sample of 120 was chosen to provide adequate statistical power for planned comparisons and to provide sufficient power (40 patients minimum) to permit subgroup analysis for drop-out rates.

Each patient received both the ADAS-Cog Word Recall Test (standardized in English), as well as the Indian Word List, administered in the same session with a small break in between

## THE WRONG WORDS

tests. The order of administration was randomized for each participant so that any fatigue or practice effects would be evenly distributed to each instrument. All patients consented to participate in this study prior to their enrollment using informed consent forms in Hindi.

### **2.4.2 Data Collection Procedures**

Structured qualitative observations were made for each patient, in addition to numeric recall scores for both instruments, including: the patient's apparent degree of engagement with each word list; whether or not there was evidence of recognition (recognition being an emotional/physical response resulting from encountering a word that was a part of the patient's experience) with any items from the Indian Word List that were not present when the English list was administered; and the level of correlation between the discrepancy between the two scores in regard to the administering clinician's independent clinical assessment of the patient's cognitive state. The qualitative data could not be used primarily as outcome data. However, these qualitative data were captured to assist in placing the numerical data within context and to provide relevant data for improving the design of future studies. The main outcome variable was the difference in recall score (between the Indian Word List and ADAS-Cog) for each patient.<sup>(10)</sup>

### **2.4.3 Preliminary Results**

Of the sixty individuals, there were 38 who had no discernible difference in their scores (recall) based on which instrument

## THE FIX

they were using (Indian Word List vs ADAS-Cog). In thirty-eight of the sixty patients who performed better using the Indian Word List, Independent evaluation of these 38 patients by the clinician indicated that most of them were classified as having mild cognitive impairment rather than moderate or severe cognitive impairment based on his/her classification system. This finding could have clinical significance.

The point at which people have mild cognitive impairment is the point at which non-medication-based interventions have the strongest supportive evidence to demonstrate benefit from said interventions, amount of difference between treatment and not treatment have the greatest quantity there, and the most benefit from those individuals' correct classification will occur over their life (the trajectory of their disease). If patients where Hindi is their primary language are being systematically scored as more impaired than they actually are at the point where they have mild cognitive impairment (i.e., due to the Indian Word List not matching their lexicon history) it is conceivable that there will be long-term clinical ramifications for this population due to their incorrect classification over the course of treatment. Preparation for submission to Journal of Alzheimer's Disease of the manuscript detailing these findings is currently underway. No claims presented exceed the level of support provided by preliminary data. Presenting these findings provides evidence of the empirical basis for the question of construct validity in this population, and the predicted direction of any systematic bias is consistent with theoretical prediction.

### **2.4.4 Limitations of the Current Study**

Several limitations must be clearly stated regarding the present

## THE WRONG WORDS

study's findings. Patient sample size. Although 120 patients provide adequate statistical power to detect moderate effects with the planned comparisons, this sample size is inadequate to provide normative data for the Hindi primary sample required for clinical instrument validation. In order to establish normative data, the sample should be larger and more geographically diverse.

Single-site design. Study participants were only obtained from one site, a tertiary care neurology clinic in Gurugram. Therefore, participants from a tertiary care neurology clinic are probably not representative of the larger population of Hindi-speaking elderly adults who will potentially have access to clinical instruments for primary or secondary care in the United States. Lack of independent/criterion standard. This study attempted to compare the two-word recall measures against each other and against clinician opinion. There was no independent neuropsychological test battery administered in the patients' dominant language, which would serve as a “purer” comparison between the two measures than the clinicians' opinions alone.

The study focuses only on the word recall subtest of the ADAS-Cog. The overall ADAS-Cog includes additional subtests other than the word recall subtest, and some of those subtests may require cultural adaptation in addition to the word recall test. The study fails to address some of the subtests in detail.(11)

### **2.5 Cognitive Stimulation from WhatsApp in the Voice of the Patient**

There are two deficits in the clinical care of Alzheimer's

## THE FIX

disease; the first is the clinical assessment and the second is the subsequent interventions. In many developing countries, such as India, there is unclear continuity of care from diagnosis of Alzheimer's disease to referral for non-pharmacological treatment through a pathway. For the majority of patients, no structured form exists.

The benefits of non-pharmacological care are well documented in the literature and have been recommended by the World Health Organization (WHO) for the treatment of Alzheimer's disease. In high resource countries these types of treatments are provided in memory clinics and day programs by trained professionals; however, this infrastructure is absent in India for the majority of patients.(12)

When families receive an Alzheimer's diagnosis for a family member, they typically return home and do what they know to provide support, yet the patient frequently continues to decline. In India, there is a culturally ingrained structure of family caregivers, which has proven to provide an enormous amount of informal support to patients suffering from Alzheimer's disease; however, because of the lack of structured clinical care, the overall effect of the informal support given by families to these patients can be significantly reduced. The absence of this support network is not due to attitudinal factors but rather to the structure of the healthcare system.

### **2.5.1 WhatsApp as an Opportunity**

With approximately 500 million WhatsApp users in India, the app has penetrated deeply into the older population in India, largely due to the app's very simple interface, particularly the

## THE WRONG WORDS

use of the voice-messaging feature, which is very easy for older users with limited technological skills to navigate. By pressing a button to start the recording, then using that same button to send the message, and a different button to listen back to the message, a person can learn how to use WhatsApp without much effort if they are already part of a family network using this application. So, many elderly patients who may have been intimidated to use smartphones have used WhatsApp for years so they can stay connected with their kids and grandkids.

The logical clinical framework for Smriti stems from this observation - there is a gap in cognitive stimulation after an initial diagnosis, partly because most patients have little access to structured clinical programming; therefore, since WhatsApp is already part of the patient's daily life, a structured program delivery using WhatsApp will provide a distribution advantage over all new platforms/apps available.

### **2.5.2 How Smriti Works**

The name Smriti means memory, in Sanskrit, and is the mechanism by which Adel has been developed to deliver structured, non-pharmacologic cognitive stimulation to individuals with Alzheimer's disease using WhatsApp to deliver the information in the patient's own native language(s) and in a voice-personally familiar to the individual.

The Smriti methodology has three stages of operation: using the patient's ADASCog score, along with the clinical judgement of the neurologist performing the evaluation, the appropriate level of intervention is determined. The Smriti group mapped cognitive stimulation therapy (CST) scores to a

## THE FIX

predetermined level of CDT based on CST's established evidence base. Selecting a non-pharmacologic protocol applicable to that patient's severity rating by using CST-based activities and adapting for delivery through a text messaging interface. For example, to send a message through WhatsApp to stimulate the cognitive functioning of a patient, you would provide prompts for structured reminiscence, object naming, biographical recall, and orientation activities embedded within a conversation. The final stage of the Smriti methodology involves sending the selected protocol to the patient through WhatsApp using the patient's preferred language. Language is determined as part of the clinical record established during the initial evaluation; thus, the same process that tagged the patient in the first place for requiring a language appropriate evaluation guides the language using for the intervention delivery.

### **2.6 What Smriti Is and Is Not: The Workaround and What It Reveals**

Smriti has been piloted under clinical supervision at Marengo Asia Hospital as of 26 April 2026, and a provisional patent was filed in March 2026. The pilot is not intended to be a controlled trial but rather proof-of-concept; demonstrating that the system is technically functional, that patients will engage with it, and that caregivers find it useful in practice.

#### **2.6.1 Pilot Findings**

The pilot has demonstrated three key findings: The System Works - The technical infrastructure necessary for delivering structured cognitive stimulation via WhatsApp, including voice

## THE WRONG WORDS

cloning, protocol selection logic, and scheduling/delivery mechanisms, work as intended and without incident in real-world settings.

Smriti addresses a need that is not being fulfilled by our healthcare system; there were to be memory clinics with staff, structured days, and those who are trained in cognitive stimulation therapy but many patients don't get this type of treatment. Therefore, Smriti allows us to act around a system that has a structural void. That the creation of Smriti was completed without the support of any type of an institution is further evidence of how the institution does not value the group of people it serves. This comment is intended as a structural comment and not as a way to feel good about ourselves. The institution did nothing to create it, and the matter went unresolved until someone outside the institution determined it to be a problem worth fixing. This pattern of having a structural void, needing to develop a workaround and then using that workaround, either within the institution or replacing it, is a well-known occurrence in the history of innovation in healthcare. This pattern, again, should give clinicians pause to consider problems currently being inadequately handled by the institution and why. The Smriti tool was created in direct response to the development of the Indian Word List tool, which means that these instruments have an inherent relationship: they are both designed for use within the same under-resourced and mismatched healthcare system. When using the two tools together, it is possible to accurately assess a patient who is culturally competent; thus, once diagnosed, that patient can be referred to the most beneficial and appropriately targeted intervention. Therefore, the two

## THE FIX

assessment and intervention tools are complementary and form part of a coherent care pathway rather than being separate "solutions" for two different clients.

The current state of care; patients with mild impairment are not given an accurate ADAS-Cog assessment using a culturally appropriate tool; subsequently, these patients are not able to access the post-diagnosis supports available to them; therefore, a patient uses interaction with the healthcare provider separately, rather than through a coordinated care pathway.

| <b>Intervention Type</b>            | <b>Evidence Summary</b>                                                                                                                     | <b>WHO / NICE Recommendation</b>    | <b>Relevance to Smriti</b>                                                                                                             |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Cognitive Stimulation Therapy (CST) | Multiple RCTs demonstrate improvements in cognition and quality of life in mild–moderate Alzheimer's. Cochrane review positive.             | WHO Guidelines 2019: Recommended    | Smriti protocol is adapted from validated CST frameworks. Session structure and activity types are derived from published CST manuals. |
| Reminiscence Therapy                | Evidence supports benefit for mood and quality of life; mixed evidence for direct cognitive outcomes. Meta-analyses positive for wellbeing. | NICE Guidelines: Offer if preferred | Autobiographical recall components of Smriti incorporate reminiscence principles. Familiar voice delivery enhances engagement.         |

## THE WRONG WORDS

|                                            |                                                                                                                                                              |                                                                              |                                                                                                                                                                               |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Music Therapy                              | Evidence for mood regulation, reduced agitation, and in some studies improved recall of personal autobiographical material.                                  | NICE Guidelines: Offer if preferred                                          | Music-based prompts are a secondary component of Smriti delivery; primary focus is CST and reminiscence.                                                                      |
| Family Caregiver-Led Structured Engagement | Limited RCT evidence but substantial observational evidence for benefit when structured and consistent. Reduces caregiver burden when programme is provided. | WHO Guidelines 2019: Supported                                               | Smriti's voice cloning approach operationalises caregiver-led delivery without requiring real-time caregiver presence. Reduces burden while preserving relational quality.    |
| Remote / Technology-Assisted Delivery      | Emerging evidence base; systematic reviews support feasibility and acceptable engagement rates comparable to in-person delivery.                             | No current specific recommendation; consistent with access equity principles | Smriti's WhatsApp delivery model is the core innovation. Pilot findings (engagement rates, technical reliability) are consistent with the broader remote delivery literature. |

*Table 2.1- Evidence Base for Non-Pharmacological Cognitive Stimulation in Alzheimer's Disease.*

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## CHAPTER 3

# The Children

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### 3.1 Aastika: Zero To Fifteen In Twelve Weeks

Aastika was unable to do any blending at all when she first came into the study; she registered a zero out of twenty on the phonological awareness score with no ability to perform either task of getting the sounds to blend or getting the sounds to segment. When asked to start the blending task by the assessor, she nodded her head once, but never produced any sound for the assessor to record. However, twelve weeks later she registered 15 out of 20; she had not become a new child; she was still the same Aastika, with the same brain, the same nervous system, and the same Aastika who had been sitting in a classroom for over 2 years learning from the silence caused by her inability to complete classroom tasks that she was the cause of her failing in these tasks. What changed was the method of instruction that was provided to her; and the only reason that the method of instruction changed was because someone asked why the standard method of instruction was not effective for Aastika. Aastika's journey is not an isolated case; it is the key factual argument of this chapter: Many children who demonstrate failure are in many cases failing as a

consequence of an assessment and instructional architecture that have not been designed to support the diverse needs of all learners.

### **3.2 Why The Author Went To Sai Public School**

This decision did not arise out of a research design; it emerged based on my personal history related to differences in the manner that I learn. What I saw to be missing in the classrooms of Sai Public Schools were instructional methods that I experienced as a learner — structured, multisensory, rhythmic and highly repetitive. The author was diagnosed with Late ADHD (Attention Deficit Hyperactivity Disorder), and before they were diagnosed, they had used many different techniques to manage their ADHD for many years without knowing what to call it. The author's earliest experiences involved using a collection of strategies that were not taken from any clinical handbook, but were developed through an informal observational process by a parent watching which strategies worked best for their child. These strategies happened to line up perfectly with what is found in the evidence-based literature for early teaching of reading.(1)

There was nothing coincidental about the author's personal experience lining up with the evidence of neuroscience that is found in the scientific literature; it was quite the opposite, it was telling. If the author's experience using particular techniques had been founded on the same brain processes that are outlined in the scientific literature for early reading instruction, and if those same techniques were not being used in schools that served the poorest children in Gurugram, then the gap in the experiences of the author and the experiences of

## THE WRONG WORDS

the poorest children in Gurugram was not just a gap in theory. This gap was seen to exist in the real world and there was an opportunity to address that gap. Sai Public School was the location where those opportunities were addressed.

### **3.3 Music, Rhythm, And The Neuroscience Of Reading: What The Evidence Says**

The scientific evidence for integrating music in literacy instruction is very strong based on many different studies that show how the brain processes language through an underlying similarity in how the brain processes music rhythm. The brain uses the same neural pathways for both language processing and music rhythm processing when the brain is processing the time composition that exists in each. Therefore, if a child has the knowledge of how to process rhythm through music, they will better be able to process time when they are learning phonological coding (recognizing letters and sounds) because those two processes share the same neurological pathways for processing information.(2)

In the Hungarian primary school curriculum, music is an integral component of the curriculum for preschool age children because both music and reading work together to improve reading ability. Speech has an amplitude envelope that indicates how the sound of our voice varies in volume over time and contains the rhythmic pattern of the syllables spoken by humans, which has a frequency of about 2 cycles/second. As a result, when children are learning to speak, their developing brain can interpret the amplitude envelope of speech to break continuous speech into smaller pieces that their brains can process. Therefore, if a child has a temporal processing issue

## THE CHILDREN

(e.g., many children with dyslexia or ADHD), the child may have difficulty using the frequency as a regulating mechanism. Music serves to make tangible what exists internally for speech. For instance, when a child claps the rhythm of a word, taps the number of syllables in a phrase, or sings a melody to learn a letter, the child will physically feel the rhythm of the language instead of having only an abstract understanding of the rhythm.

### **3.4 Baseline Findings: Four In Five Children Carrying Neurological Vulnerability**

Results from a study conducted at Sai Public School in Gurugram with children between the ages of 5-7 showed that many had neurological risk factors that could make learning challenging. Of the 55 children that were tested, only 11 were considered to have low neurodevelopmental or typical functioning. Overall, 80% of the children had indicators that would have warranted further evaluation and specialized support if they had been in a school system with appropriate resources and support for children with disabilities. The lack of systems in place to appropriately assess children with early indicators of a learning disability who had been in a classroom for one to two years, being compared to the same outcomes as children who did not have previous markers is very concerning. The average score for the entire group for phonemic awareness skill "blending" was 5.27/10. The average score for phonemic segmenting was 1.1/10. With a score of 1.1 out of 10 for phonemic segmenting is alarming, as it indicates that these children do not have the ability to break spoken words into individual sounds, even with effort, since no one has taught them to learn the way their brains are able to process

## THE WRONG WORDS

information.

| <b>Risk Profile Category</b>                     | <b>n</b> | <b>% of Cohort<br/>(n=55)</b> | <b>Notes</b>                |
|--------------------------------------------------|----------|-------------------------------|-----------------------------|
| No elevated risk indicators (neurotypical range) | 11       | 20%                           |                             |
| Dyslexia-risk indicators only                    | 23       | 42%                           | No elevated ADHD indicators |
| ADHD-like characteristics only                   | 3        | 5%                            | No dyslexia-risk indicators |
| Both dyslexia-risk and ADHD-like indicators      | 18       | 33%                           |                             |
| TOTAL carrying at least one risk indicator       | 44       | 80%                           | Four in five children       |

*Table 3.1 - Baseline neurological vulnerability profile across 55 children with complete data.*

### **3.5 Music Integrated Phonics Program: Structure and Delivery**

#### **3.5.1 Program Design Principles**

The Program was based on three key principles of design, which were derived through both research and experience by

## THE CHILDREN

watching children in the environment of schools: Predictability instead of novelty: Children have problems paying attention and often have difficulty processing sounds. Therefore, they will be better learners with a familiar lesson plan. For this reason, all the sessions provided the same plan throughout the twelve-week program. Rhythm as Scaffolding rather than warm up: Rhythm did not mean that students simply participated in a warm-up activity at the beginning of class; rhythm was used to establish a structural base for children to learn letter-sound connections. A child had to establish the pattern of rhythm in his/her body before being able to read it on paper. Multisensory Encoding: Each target letter-sound type was represented using a movement, a visual representation of that sound, and a melody. The three areas supported each other for a child who either could not picture the letter "k" could find it through the song or find the song through the physical movement.(3)

### **3.5.2 Session Structure**

Each session was approximately 30 minutes, five days per week, for a total of twelve weeks (thus total time of 30 hours of instruction). The structure of the sessions did not differ: 4. Opening: (5 minutes); all of the children will clapped the syllables of numerous familiar words- Tapping on desks to keep track of how many beats long a phrase is. Doing 'call-and-response' chants and rhythms, using target sounds from the week's lessons. Rhythmic sounds were not decorative (like drums). They were also used to express the shape of time in language, before any letters had been invented. Singing a song for each of the target letters and assigning a specific movement

## THE WRONG WORDS

to each song. The children use the song to find the specific letter the same way people use the first few notes of a song to remember the name of a word that was on the tip of their tongue. Writing a narrative song that we would perform with the children's new vocabulary and in the same rhythm that the children already knew from the previous 12 weeks of teaching. After 12 weeks, children who could not read (at all) when they started in the music- and language-integration programme were able to follow the story and sing along while pointing to the words on the page.(4)

### **3.5.3 Participants**

60 children were placed into three groups of 20:

Group A received traditional phonics instruction: Direct letter-sound teaching, practice through repetition and worksheets; this is the control group with traditional methods of teaching literacy.

Group B received the music integration literacy programme; music and language were integrated at every stage of the literacy instruction.

Group C received the music integration literacy programme; children with characteristics similar to ADHD, risk of dyslexia, or both were specifically placed in this group and were identified prior to baseline assessment.

### **3.5.4 Monitoring Program Implementation**

The programme was designed by the author and delivered by trained teachers and volunteers using standardised lesson plans. The author monitored the programme remotely, through

## THE CHILDREN

weekly check-ins and session logs from classroom teachers while they were out of school. Every week, teachers were initially asked specific observational questions so that they would provide an evenly comparable qualitative record of the cohort's performances during the twelve weeks.

### **3.6 Results: Cohen's $d = 1.21$ and Group C show largest gains**

#### **3.6.1 Phonemic Segmenting**

The mean score for phonemic segmenting increased from the beginning to the end of the programme from 1.1 to 3.75 points with a mean increase of 2.64 points. The t-statistic results were 9.36 and  $p < 0.001$ . Cohen's  $d$  was calculated at 1.21 indicating a substantial effect size according to conventional standards.(5)

#### **3.6.2 Total Phonemic Awareness**

The mean score for total phonemic awareness increased from a mean score of 6.37 at the beginning to a mean score of 9.87 at the end of the twelve-week programme, with a mean increase of 3.49 points. Cohen's  $d$  for total phonemic awareness was found to be 0.96. 93% of students in the total cohort achieved improvement on the overall phonemic awareness measure.

#### **3.6.3 Group-level comparisons**

One of the most clinically significant findings from this research study was the differential gain pattern as it existed within each of the Group populations. Specifically, Group C, identified as having a significant amount of neurological

## THE WRONG WORDS

vulnerability markers, achieved the largest reported gains out of the four Groups:

Group C - mean total delta = 3.88

Group B - mean total delta = 2.44

These findings support the neuroscientific prediction that where phonological awareness is interrupted through a partial blockage to the traditional pathway as happens with the dyslexic-risk profile that rhythm-based instruction provides another neural pathway for children developing phonological processing. Thus, for these children, music cannot simply supplement literacy instruction. There have been too many points gained by children whose progress is measured on some form of continuous scale.(6)

### **3.7 Dyslexia In Devanagari: Why English Tools Find Nothing**

In India, Dyslexia affects about 10% of the population, and that figure is stable across languages and cultures. Neurologically Dyslexia is similar across people, not geographically, by script or by socioeconomic status. What is different is the rate of identification of Dyslexia. In India the identification rate is almost non-existent. This is not because Indian children have lower prevalence rates of Dyslexia, rather it is due to the tools used for school assessment being developed for the Roman alphabet and English phonology, and therefore they do not work correctly for the Devanagari script. The Devanagari script functions as an abugida, meaning, each character represents a unit of a consonant and vowel, rather than one phoneme. Hence, the reading difficulties associated with identifying

## THE CHILDREN

Dyslexia in an English classroom (i.e. typical letter reversals, b-d and p-q confusion) appear different in a Hindi classroom. The conjunct consonants, the uses of matras and other vowel diacriticals, and the manner that consonants combine together visually to form letters create difficulties which have no exact equivalent to the English language assessment tools.(7)

The extent of the problem is very large. In India, 76% of Class Three students are unable to read at grade level; 30% of students drop out of school prior to Class Ten. The transition from reading difficulties to dropping out of school is not a totally predictable continuum; early identification of reading difficulties followed by timely instructional intervention can interrupt this. An identification tool was not available for the Hindi classroom, until now - this chapter describes the identification tool that has now been created.

### **3.8. The SLDSA: Five Metrics, WhatsApp Delivery, No Specialist Required**

The Structured Literacy and Dyslexia Screening Assessment (SLDSA) has been specifically developed for use with Hindi-speaking students attending government-run schools. The development of this assessment is subject to two non-negotiable criteria - it requires no expertise to administer and can be administered by non-experts after 1 hour of training. It can be delivered via WhatsApp with no requirement to download an app to a phone, register, pay a fee, or subscribe to anything. These two features are not limitations as a result of available resources; they are requirements that are a result of the target group. If the assessment requires an expert to administer or can only be accessed if downloaded to a phone

## THE WRONG WORDS

then it can not be used to assess the very students that need this assessment the most. The SLDSA assessment will reach the intended audience because this is the medium in which these students already exist.(8)

### **3.8.1 The Five Metrics**

The SLDSA consists of five constructs. Each of these constructs was chosen because they each measure a type of reading difficulty that is different for Devanagari script as compared with the English alphabet and do not show up on English Language assessment tools. Recognition of Letters in Devanagari (including conjunct consonants and matras). One of the earliest signs that children are struggling with reading in Hindi is that they have difficulty identifying matras or conjunct consonants. There is no equivalent in any alphabetic system to the difficulties children in Hindi experience with matras or conjunct consonants. Reversal Patterns for Characters Unique to Devanagari. Similar to English language examples of dyslexia, children who experience dyslexia when reading in Devanagari will exhibit reversals and mirror images of certain characters; however, the characters that are reversed/mirrored are different from the characters that are involved in English language examples. The SLDSA assists in identifying Devanagari-specific patterns of character reversals. Phonemic awareness of Hindi (including moras). Hindi is a mora-timed language and there are different demands placed on children who learn to read in Hindi with respect to their ability to identify sounds at the phoneme level compared with the demands placed on children who learn to read in a stress-timed language like English. The SLDSA has been developed to

## THE CHILDREN

include items that are similar to the prosodic demands of Hindi.

**Sight Word Reading in Hindi.** The high frequency sight words that comprise this metric are those words that every child is likely to experience in the first 3 years of learning to read Hindi.

**Drop-off in Engagement During Assessment.** Children who have attention issues will show a characteristic pattern of declining accuracy on a long assessment. In general, children will perform well at the start of the assessment, have a decline in accuracy during the midpoint of the assessment and exhibit highly variable performance during the final third of the assessment. The pattern that results from these three segments provides diagnostic information and will be included as a metric rather than dismissed as being noise.

### **3.9 Sahitya: The Anganwadi Network and 3,000 Children Reached**

#### **3.9.1 Programme Design and Name**

The name of the Sahitya programme comes from the Sanskrit word for "literature" and describes the relationship between a text and its reader in regards to the dialogue that is created when reading. The goal of the Sahitya programme is to create "readers" (i.e., children for whom the written word offers meaning) rather than simply training children to be "decoders" of written texts. The Sahitya programme is a direct extension of the SLDSA programme. The first step in creating the Sahitya programme involved the creation of a screening tool (used to identify children with reading difficulties in Hindi), and the second step in the process involved the need for a process for providing a large number of children with literacy instruction

## THE WRONG WORDS

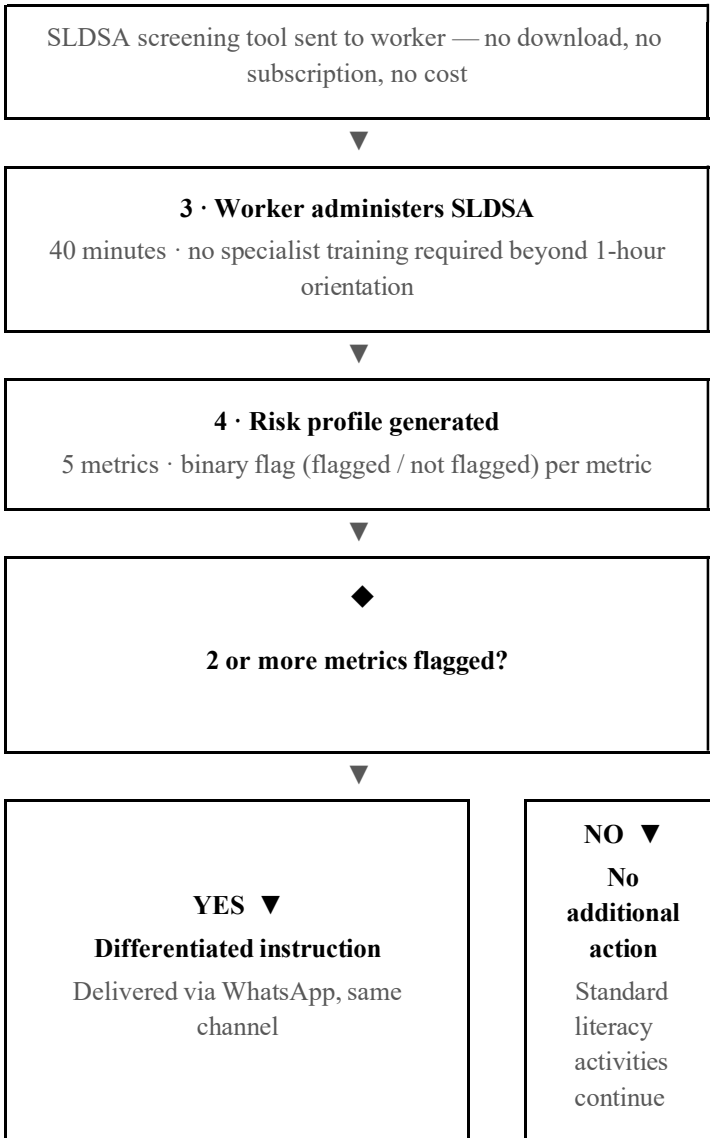
once the tool was in place. The Sahitya programme is the answer/question in this regard.

### 3.9.2 The Anganwadi Delivery Model

Sahitya's delivery model, which is based upon the national network of Anganwadi workers (workers who operate child development centres at the community level) operating in the Gurugram and Delhi NCR areas of India, is designed to service children without creating new resources to service them. The existing Anganwadi System in India provides access to nearly 100 million children through home visits and community sessions conducted by Anganwadi workers. As such, Sahitya's use of a WhatsApp delivery system is designed to work within the existing infrastructure. Delivery will take place through the use of the same existing home visit by Anganwadi workers who are visiting children in their homes to provide them with literacy instruction. WhatsApp will allow for the administration of the SLDSA and provide students with differentiated literacy instruction (based upon the SLDSA results) via the same delivery mechanism. Thus, Sahitya will enhance the existing services provided to children during the Anganwadi Home Visits, rather than create a new service.



## THE CHILDREN



## THE WRONG WORDS



### 7 · Outcomes tracked

Literacy improvement data fed back to programme —  
informs ongoing delivery

*Figure 3.1 - Sahitya Delivery Pathway — From Anganwadi Worker to Differentiated Instruction*

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## CHAPTER 4

# The Sound

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### **4.1 Sound as Pressure Waves: The Amplitude Envelope And Why It Matters**

Sound consists of a pressure wave. This statement is not metaphoric or approximated but is an actual physical phenomenon of how sound works in the real world. When a human talks, the vocal cords vibrate, causing air around them to compress and then rhythmically expand outwards until it reaches a human eardrum. The eardrum moves, transmitting motion through the middle ear's three tiny bones — malleus, incus, and stapes — which help amplify the sound. Next, as sound pressure enters the cochlea and is transmitted via the auditory nerve to the auditory cortex, tiny bundles of hair cells in the cochlea bend with respect to sound pressure.<sup>(1)</sup>

The previous description takes place in milliseconds. Therefore, by the time a listener registers someone has spoken their name, their auditory cortex has already performed quite an amount of signal processing something many people do not notice until such processing starts to fail. Every spoken sound has an acoustic shape, or profile, that indicates how its energy

## THE SOUND

will change over time. For example, when a person begins to talk, the profile reflects how loudly they started their speech, how quickly they reached peak loudness (peak amplitude), how long they've sustained peak amplitude, and how they will drop from peak amplitude back to a resting state. This profile of changing acoustic energy over time is referred to as the amplitude envelope, and the amplitude envelope is one of the most important types of acoustic information regarding speech intelligibility. The primary characteristic of the amplitude envelope, rather than other characteristics, is the rhythm of an incoming sound. The tempo of spoken language (the rise and fall in stressed and unstressed syllables, the relative emphasis throughout an utterance) is represented by a cyclical pattern in amplitude envelopes roughly every two seconds. This cyclical pattern (two syllables per second) represents the fundamental temporal structure of spoken language for all human languages studied. The human auditory system is, therefore, designed to automatically process this rhythmic structure prior to engaging voluntary attention.(2)

### **4.2 Rise Time: The Acoustic Property Underlying Reading Deficits**

Within the components of the amplitude envelope, rise time is of significant clinical importance. Rise time is the time interval between when a sound starts and when it reaches maximum amplitude (energy). This interval is consistent between speech sounds and is one of the primary acoustic cues used by the auditory system to distinguish among different consonants.(3) For a sharp plosive consonant such as /b/, rise time is very short—approximately 30 ms. The production of the sound

## THE WRONG WORDS

begins at the same time it reaches its peak energy, resulting in an immediate onset that the auditory cortex recognizes as a separate acoustic event. For a glide consonant such as /w/, the rise time is much longer—approximately 125 ms. The sound develops towards its maximum energy level over longer than 30 milliseconds, resulting in relatively smooth onset and very different acoustic signature. /b/ versus /w/ has no significant difference in the frequency or the shape of the sound wave that follows them. The biggest difference between the two is the amount of time it takes for that sound to generate from a zero amplitude (silence) to full amplitude (the complete sound). This difference in time is called rise time. Understanding the nature of rise time is fundamental in understanding the neurological basis of reading difficulties — the apparent difficulties in reading letters and words show evidence of difficulties with processing rapid, or "onset," intervals of sound. Rise time is processed pre-attentively (automatically by the brain). Listeners have little if any consciousness regarding their calculations of rise time, just as they do not consciously analyze the frequency (characteristics) of a sound. The auditory cortex processes information about rise time and uses it to group words into categories. When there is a breakdown in rise time processing, there is a blurring of the perceptual boundary between acoustically similar sounds (e.g., the words "bat" and "vat") and that breakdown has a cascading effect through the entire reading process.(4,5)

| Consonant Type | IPA Symbol | Hindi Example | Rise Time (ms) | Classification |
|----------------|------------|---------------|----------------|----------------|
|----------------|------------|---------------|----------------|----------------|

## THE SOUND

|                       |     |          |          |                    |
|-----------------------|-----|----------|----------|--------------------|
| Bilabial plosive      | /b/ | Ba (baa) | ~30      | Short / Plosive    |
| Dental plosive        | /d/ | Daal     | ~25–35   | Short / Plosive    |
| Velar plosive         | /g/ | Ghar     | ~25–35   | Short / Plosive    |
| Bilabial glide        | /w/ | Wa       | ~120–130 | Long / Glide       |
| Palatal approximant   | /j/ | Yahi     | ~90–110  | Long / Approximant |
| Retroflex approximant | /r/ | Roti     | ~80–100  | Intermediate       |

*Table 4.1. Approximate rise time values for plosive and glide/approximant consonants relevant to the Hindi Ba-Wa paradigm. Values based on published acoustic analyses and the stimulus parameters used in the current study. Retroflex approximant included for reference given its frequency in Hindi phonology.*

### **4.3 Goswami's Hypothesis: Rise-Time Processing Deficit as the Neurological Basis of Dyslexia**

In 2002, Usha Goswami and others at the Centre for Neuroscience in Education at the University of Cambridge proposed a new hypothesis that changed the way that scientists understood dyslexia. Earlier theories have focused on phonological awareness (the ability to hear and manipulate the individual sounds of words) as the primary cognitive deficit

## THE WRONG WORDS

that caused people to have reading problems. Goswami (2004) proposed more specific and fundamental conclusions about dyslexia. Accordingly, dyslexia does not stem from phonological awareness; it results from a deficit in how the auditory system processes the rise time of the amplitude envelope. This distinction has significant theoretical implications. Phonological awareness is a good predictor of future reading performance, but not necessarily a prerequisite for learning to read; it arises from the experience of learning to read. Conversely, the auditory processing of amplitude envelope structure begins in utero. For example, children recognize their mother's voice and the rhythmic patterns of her speech before they are born. Immediately after birth, infants process the amplitude envelope of their mother's speech and use the rhythm of the amplitude envelope to segment the continuous speech stream into units over the course of the next several months. Accordingly, the deficit in rise time processing represents a fundamental impairment in auditory development, which has not been previously considered. The hypotheses developed from this principle dictate that children with dyslexia will exhibit poor sound discrimination for sounds differing mainly in rise time and will display normal sound discrimination for sounds differing only by other acoustic characteristics. This hypothesis is a unique prediction that has been supported by numerous independent research studies.(6)

### **4.3.1 Developmental Trajectory for Auditory Temporal Processing**

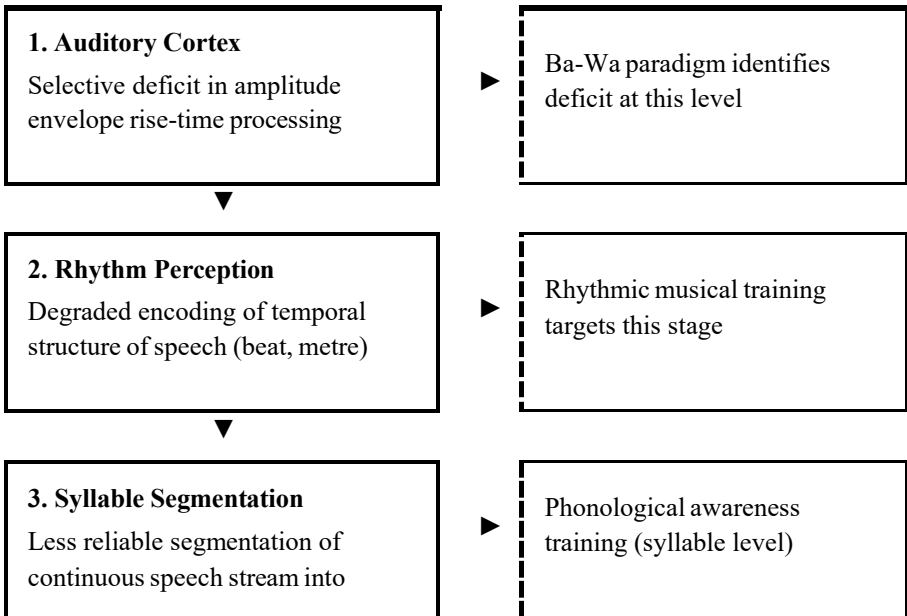
Infants process the amplitude envelope of the speech they hear while still in the womb. By six months of age, typically

## THE SOUND

developing infants use rhythm — and particularly the rise-and-fall pattern of the amplitude envelope — to segment the flowing speech stream into distinct and separate units — not phonemes, not words, but units defined by the specific shape of the auditory signal. These developmental trajectories are clinically important. A child needs to have the ability to segment their speech in rhythm to build up the foundation of phonological representation, which serves as the basis for how proficiently a child can read. If the auditory cortex doesn't process rise-time accurately for sound, there will be difficulty building the phonological representations needed for reading well before the child ever enters a classroom and sees their first letter or word.(7)

### CAUSAL PATHWAY

### INTERVENTION



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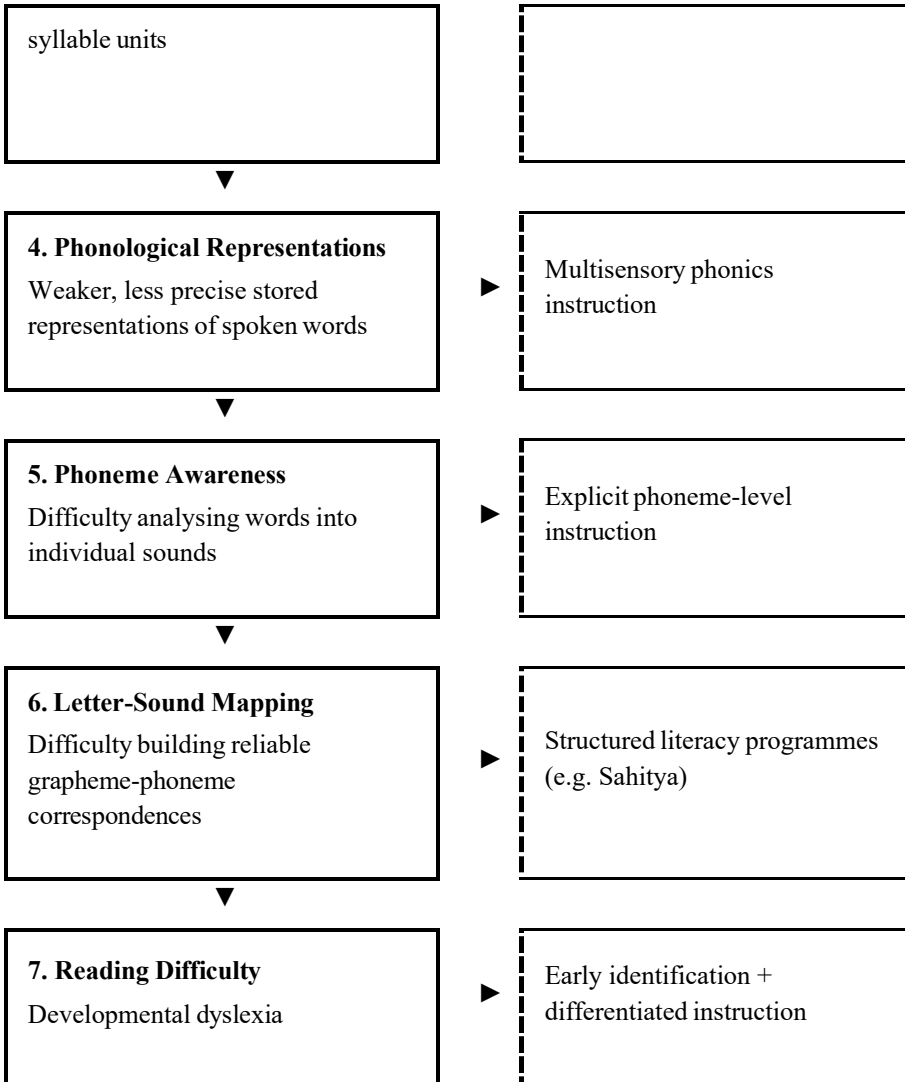


*Figure 4.1- Goswami's Rise-Time Deficit Model (Causal Pathway Flowchart)*

### **4.4 The Ba-Wa Paradigm And Its Replication Across Six European Languages**

One of the best research methods available for determining if the child can process rise-time information in the context of reading is the Ba-Wa paradigm, which was developed by Goswami and has been replicated numerous times with similar results. To use this paradigm, two syntactically synthesized speech stimuli are presented — a variation of /ba/ and /wa/ from Hindi, or their corresponding consonants in any of the six European languages — with a critical difference between the two sounds being rise-time. The primary difference between the two sounds chosen from the amplitude envelope creates the only difference between the two sounds. One sound is a short rise-time representing a plosive, while the other sound is a long rise-time representing a glide; thus, the two sounds only differ by rise-time. If the participant can detect the difference between the sounds, the participant is successfully using rise-time information; if the participant cannot detect the difference, this indicates a rise-time processing deficit for that participant, which would be consistent with Goswami's hypothesis. In a study conducted in 2011 by Goswami and others, Ba-Wa contrast was chosen as the only valid way to separate dyslexic readers (children with developmental dyslexia) from normal developing readers based on the rise-time tasks. Evidence of significant differences in Ba versus Wa discrimination between the two groups (i.e., decreases in ba - wa discrimination when carrying the rise-time contrast) was seen for children with developmental dyslexia. When comparisons were made using the formant transition duration to carry the acoustic contrast, the children with developmental dyslexia performed similarly

## THE WRONG WORDS

to controls. This difference was a specific deficit.(8)

### **4.4.1 Cross-Language Replication**

When assessing the rise-time discrimination for dyslexic readers compared to age-matched typically developing controls, there was significantly less discriminative ability for the dyslexic children in each of the six language studies. Additionally, these results are consistent regardless of script systems (e.g. Latin, Cyrillic), phonological inventories (e.g. English /b/, /d/, and /g/; and Spanish /b/, /d/, and /g/), and orthographic depths (e.g., shallow orthography in Spanish and deep orthography in English). This universality of the rise-time signature of dyslexia through differences in typologically distinct languages is one of the strongest pieces of evidence of a neurodevelopmental foundation of dyslexia independent of the environment and/or linguistic context.(9)

### **4.5 What The Absence Of Hindi Rise-Time Data Means**

Hindi is not one of the six languages in which rise-time processing has been assessed. This absence has implications for interpreting what is known. This does not at all imply Hindi-speaking children with dyslexia do not have deficits with rise-time processing; there is no neurological basis to conclude Hindi-speaking child's auditory cortex is wired differently than that of a child who was raised in an English- or Finnish-speaking exposure when one looks at fundamental aspects of auditory processing (i.e., cochlea and auditory cortex are neither language specific). The implication of the absence of evidence is no one has done the studies. There are no normative

## THE SOUND

datasets for rise-time discrimination in Hindi-speaking children. There are no clinically usable thresholds for how to separate typical from atypical rise-time processing in Hindi-speaking children. There has been no formal inquiry as to whether the neurological signature of dyslexia in European languages will be expressed uniformly or with culture-specific criteria, in Hindi. Hindi is a distinct acoustic language from the languages in which this work has been done. Hindi is a mora-timed language as opposed to a stress-timed language; therefore, the basic rhythmic unit of the language is the mora rather than the stressed syllable. Sound produced in a way that the tongue is curled back towards the roof of the mouth produces Retroflex Consonants which create unique acoustic profiles that do not exist within English or other studied European Languages. It also includes stops that have a contrast between stops created with air (Aspirated Stopped) and without air (Unaspirated Stopped) and therefore will require additional cognitive processes compared to systems that only produce Unaspirated Stops.(10,11)

### **4.6 Email To Professor Goswami**

On 24 March 2026 following the initial Sahitya Programme findings from Sai Public School in Gurugram, an email was sent to Professor Usha Goswami from the Centre of Neuroscience in Education (University of Cambridge) with the following three purposes: obtain guidance for methodologies to investigate auditory processing in rise time in Hindi speaking children encountered in low resource field settings; understand the mechanistic relationship between a rhythm based instructional intervention and auditory processing in rise time;

## THE WRONG WORDS

provide evidence supporting the hypothesis that the existing theoretical framework predicts a similar rise time processing deficit for Hindi speaking children with dyslexia. The following three questions were made:

What constitutes a valid simplified measure of auditory temporal processing in children aged 5 to 10, living in low resource settings and administered by non-specialist practitioners? Is a rhythm discrimination task a valid measure of psychoacoustic effects in the same way that scientifically established psychoacoustic measures are?

Music-based sessions utilizing Sahitya produced better literacy outcomes. Did the available research provide sufficient evidence to determine whether changes in literacy resulted from improvements in the path of auditory temporal processing, or simply due to being engaged with music in a multi-sensory way?

Is there any theoretical basis to assume that Indian children with dyslexia will experience the same deficits in rise-time processing as children with dyslexia from Europe, since few studies on rise-time have been conducted with speakers of Indian languages? Is it possible that the highly transparent orthography of Devanagari affects the relationship between how children process sound and how they are able to read?

### **4.7 Her Replies: Methodology Guidance, Stimulus Files, And Field Research Cautions**

Goswami responded to all three questions in writing within two days after receipt. She replied to each question in detail.

#### **4.7.1 Cross-Linguistic Question**

Goswami indicated that she anticipated that Hindi-speaking children with dyslexia would have difficulties with rise-time processing as do speakers of other European languages. She indicated that she was at the time using her Spectral and Amplitude Modulation Phase Hierarchy (SAMPH) model to investigate the similarities between lullabies from India and those written in English, and anticipated that the structure of the hierarchical amplitude modulations would be consistent with those seen in English-language nursery rhymes and infant-directed speech. Therefore, there is an existing body of knowledge on rise-times that could provide the theoretical basis for extending the rise-time literature from English to Hindi.

### **4.7.2 Methodology Clarification**

Professor Goswami explained that it would not be appropriate to assess the validity of standard laboratory threshold acoustic tasks with non-specialist testers because there must be calibrated headsets and standard ambient noise treatment in laboratory conditions and they do not have the equipment necessary in the field to administer these tests. However, she agreed that a simple example rhythm discrimination task could easily be used as a substitute measure in the field.

### **4.7.3 Mechanistic Question**

Professor Goswami confirmed that there has been a considerable amount of difficulty separating rhythm and melody during research, which presents an inherent methodological issue for identifying how rise time processing contributes to the effectiveness of the intervention. She

## THE WRONG WORDS

indicated that she advised a PhD student on a paradigm where the children participating in the intervention were instructed to learn about poems rhythmically (a rhythm intervention) and discussions about the content of the poems and visual representation/illustrations of the poems (active control condition). She suggested that in the context of field studies, they would have to show at minimum that the results of the interventions that used rhythm were greater than the results of the intervention type not using rhythm for the same amount of time and level of engagement in order for the field results to be considered theoretically based.

### **4.8 Kindness Contamination Problem In Field Studies**

As a result of an email communication on 30 March 2026, Professor Goswami highlighted that there are certain challenges associated with fieldwork in the above appropriate examples from the PhD student's research. The rhythm training that teachers in the control group believed would be beneficial to other groups of children had previously been delivered to the control group of children, during times when the researcher was not present. The study revealed that there is a "kindness contamination problem" which poses a large threat to the validity of educational field research. Kindness contamination occurs because of the conflict between the obligation of researchers, who need "clean" experimental conditions, and the obligation of teachers, who are primarily responsible for the welfare of the individual students in their care. To overcome this issue, in the future study conducted by Professor Goswami, randomisation will occur across schools, such that the control group teachers will never view the implementation of the

intervention.

### **4.9 Hindi Ba-Wa App: Design and Delivery of Stimuli**

Professor Goswami and I have developed a Ba-Wa discrimination task that has been adapted for use with Hindi-speaking children, which followed the methodology laid out in Goswami and his colleagues published in 2011, and in his materials available for use, along with some changes to the original Ba-Wa tasks that reflected differences in phonology and method of delivery of tasks to the children.

#### **4.9.1 Stimulus Construction**

The contrast between the Hindi stimuli /ba/ and /wa/ was created primarily on the basis of their time amplitude envelope. Therefore there were two experimental conditions created, which differed only on the acoustic basis of the time difference: The conditions of two separate time and amplitude envelope measurements, named "Rise Time," were made independently of the duration of the "onset" interval or "rise time" and used two, time- and amplitude-matched stimuli (i.e., rise times of approximately 30 milliseconds for /ba/ & approximately 125 milliseconds for /wa/) and there were no other differences in acoustic properties. The conditions of two separate formant transitions, "Formant Transition", were also made, which differed only in formant transition length (independent of amplitude envelope) and this created the control for the experiment to measure the influence of processing a time difference between /ba/ and /wa/ vs the general ability to make an auditory discrimination. A control was made for to ensure

## THE WRONG WORDS

that /ba/ and /wa/ were similar in terms of their sound by including catch trials in which both stimuli in a pair were exactly the same, during which time all of the participants would respond randomly or otherwise not comply with performing the task.

All of the stimuli used to create the Hindi phoneme stimulus set were generated by using the technique described by Professor Goswami for individual sounds that create time-matched and am matched pairs. The construction of each unique Hindi phoneme stimulus set took into account Hindi phonological properties (e.g., aspirated consonants and retroflex consonant sound inventories) and thus were validated based on these properties.

### **4.8.2 Interface Design and Field Delivery**

The stimuli were presented to each child using a tablet interface. The two buttons on the display were labelled in Hindi with respect to the task choice labels: (yahi) = both the same sound stimulus; (alag) when sounds produced were different. The child was not provided with abstract visual symbols because many children participating may have limited experience with abstract visual symbols (and therefore there would be less confusion in comparing their auditory discrimination task when using the abstract stimulus representation). Thus, the auditory discrimination task was developed only using words rather than symbol representations.

Each trial presents two stimuli and there is a 500-millisecond time interval (silence) before the next trial begins. Once the

## THE SOUND

child has touched the button for their response, the next trial automatically begins. The design of the project included a timing restriction: no response was recorded in a specified time period, and the next trial will begin automatically without waiting for a response, which eliminated any potential build-up of trial fatigue that would elongate the time for the completion of that trial. All ten children completed the entire task in approximately 18 minutes or 60 trials per child.

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## CHAPTER 5

### The Study

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#### **5.1 The School In Sector 4, Gurugram: 200 Students, No Specialist**

The study at the school in Gurugram, Sector 4: 200 pupils, no specialist teacher. The Sector 4 school is located in Gurugram, Haryana. The school has about 200 primary school aged pupils enrolled. It has a single principal, a relatively small number of teachers for the number of pupils enrolled, and no special educator. It does not have any trained reading specialists, nor does it have a dedicated assessment room; all of which is typical of the vast majority of Indian schools that provide early literacy education for school-aged children. For three years prior to conducting the research for the Hindi Ba-Wa rise-time study, the researcher had visited this school regularly and was therefore known by the teachers and by the principal, who was also familiar with the Sahitya program and how it has impacted literacy outcomes. The experience and relationship formed between the teachers, principal, and researcher contributed to establishing a pattern of co-operation between the research process and the pupils who participated in the phonics intervention, as described in Chapter 3. This context is

## THE STUDY

important in terms of understanding the study that follows. This field research did not occur in a vacuum; therefore, the quality of participation and willingness of the school to facilitate the research and the level of co-operation from each individual child and their family was directly related to the relationship that developed between the researcher and the school over time; relationships that were formed prior to the initiation of this study, and were thus a pre-condition of its success.(1)

### **5.2 The dog on day one: what field research looks like**

The first day of collecting data was marked by the presence of a dog that lived at Sai Public School. The dog is fed by the kitchen staff and is tolerated by the administration in and around the kitchen area and is a familiar part of the community of Sai Public School. The dog had been hanging out by the kitchen, and on the first day of data collection, the dog entered the small room off the main hallway that was set up for testing and sat down next to the child who was being assessed. The child laughed. The session could not continue and as a result of this, we were not able to produce data from this session and therefore we have recorded the session as unusable. We spent the time to document this occurrence as an example (i.e. The dog) of how the testing conditions differ between laboratory-based research conducted in cognitive neuroscience, using an acoustically-controlled environment, calibrated equipment, technicians trained in conducting the testing, and utilizing protocols developed to reduce the variability of test data in comparison to field-based research in low resource schools conducted in rooms that are not the researcher's room, with varying degrees of noise, and with the added complexity of the

## THE WRONG WORDS

ecology of a full-functioning school (including the animals). The difference in the two types of testing conditions is important for the interpretation of the data. Field data will have environmental noise that laboratory data do not have; however, field data is not considered invalid. The two types of testing produce data that is equally valid, but the field data contains more noise than the laboratory data. The field settings provide a greater ecological validity than laboratory results as they are not comprised of data collected from a target population of participants chosen based on research/assessor interventions, as would be the case in a laboratory. Results from the field settings were not a contamination; they produced the context within which the research was conducted.(2)

### **5.3 Participants: 47 Children, Dyslexia-Risk and Typically Developing**

The participant sample included 47 children, ages 6-9 years, recruited from Sai Public School located in Sector 4 of Gurugram.

#### **5.3.1 Dyslexia-Risk Group**

The dyslexia-risk group consisted of 22 identified children, all of whom were previously identified using the Structured Literacy & Dyslexia Screening Assessment (SLDSA), the Hindi-language screening tool described in Chapter Three. Inclusion in the dyslexia-risk group was determined by meeting at least two flagged indicators across five SLDSA measures (1-Letter Recognition in Devanagari Script; 2-Reversal Patterns for Devanagari Script; 3-Phonemic Awareness for Hindi Script

## THE STUDY

& Mora-Level Processing; 4-Sight Word Recognition for Hindi Script; and 5-Dropout during Testing). All children recruited for the research study at Sai Public School were assessed with the SLDSA prior to participating in the Sahitya program. As a result, the researcher and school staff were already familiar with the children in the dyslexia risk group before starting the data collection.

### **5.3.2 Typically Developing Control Group**

An additional 25 typically developing readers were recruited as matched control subjects. Matching criteria included both age (within six months of each dyslexia risk participant) and socioeconomic background (all participants from same school and served same homogeneous catchment population). Typically developing readers were defined as children who had passed all five SLDSA metrics with no flagging indicators and whose classroom reading performance according to their class teacher was at grade level or above. 47 children participated in the Sahitya literacy programme for at least one year prior to this study. Parents/legal guardians provided written informed consent before any data were collected. Written consent documents included a description of the study procedure, the types of stimuli used in the study, how long they would be participating, and that their child had the right to withdraw at any time without penalty.

### **5.4 The Ethics Process: Why Slowness Is The Point**

The ethics application for this study was submitted to the Indian IRB in March, 2026. Ethics approval was received in May,

## THE WRONG WORDS

2026. The approval process lasted approximately 6 weeks.(3)

The six weeks felt like forever! Data collection preparations were made, stimulus validation completed, participant lists finalised, tablet interface calibrated, etc. The data collection process was halted only due to the delay of a review of ethical approval, and this delay could only be a result of the ethics review performing its purpose (to review the research for ethical compliance). The ethics review process is slow because children do not have institutional power to protect themselves from good researchers with bad study protocols; the review board serves as a mechanism by which the participants' interests are represented in the study design before the potential participants are approached for participation. Therefore, the period of time needed to receive approval does not represent inefficient bureaucracy, but instead the time represents a structure that serves to protect the participants. When the approval was finally received, it was not only a relief that data collection could now be started, but was more of a confirmation that the process had fulfilled its purpose. The children at Sector 4 school have been active participants for three years, and therefore they were entitled to an ethical review prior to being seated with headphones for data collection.(4)

### **5.5 The Task: 60 Trials, 3 Conditions, 2 Buttons in Hindi**

The task consisted of 60 trials, each presenting 2 speech stimuli in synthesized form in a sequential manner with 500 milliseconds of silence separating each trial; participants signaled whether the 2 sounds were identical or different by pressing 1 of 2 large buttons located on a tablet screen. The button labels used were in the Hindi language *Yahi* (same),

## THE STUDY

Alag (different).

### **5.5.1 Three Experimental Conditions**

The 60 trials occurred in 1 of 3 different experimental conditions and were administered randomly within the session.

**Rise Time Condition (diagnostic):** The 2 stimuli differed only based on rise time of the amplitude envelope. The /ba/ had a rise time of 30 ms and the /wa/ had a rise time of 125 ms, whilst all other acoustic properties were maintained as constants. This condition tests an auditory capacity predicted to be impaired (based upon Goswami's rise time hypothesis) for paediatric cases of dyslexia.(5)

**Formant Transition Condition (active control):** The 2 stimuli differed on the formant transition duration, which is an entirely separate acoustic characteristic from amplitude envelope. Dyslexic children are expected to perform typically on this condition, which will indicate that the impairment experienced in Condition 1 was due only to the individual's dysfunction related to rise time and therefore an inability to process rise time, rather than as a result of general auditory discrimination difficulties.(6)

**Identical Sound Condition (catch trials):** Both stimuli in the pair are acoustically identical. The following condition will allow the measurement of random (reactive) button pressing, and whether the participant has comprehended the task. If a participant is pressing 'different' on the catch trials with high frequency, the interpretation of their data as a rise-time discrimination is impossible (cannot be analysed

## THE WRONG WORDS

meaningfully).(7,8)

### 5.5.2 Structure and Duration of Session

The sessions lasted approximately 18 minutes for each child. In addition to the established delay period of the trial structure, there was a minimum duration between a trial and its next trial. This length of time ensured that there was not an excessive build-up of fatigue as a result of extended time periods of thought on an individual trial; nor was it possible for children who experienced difficulty with attention to lapse into inactivity while waiting for a trial to commence by taking a break between each trial.

Engagement's drop-off index provided from the SLDSA - which provided the rate of decrease in accurate responding over time for children who experience problems with attention - was used to assess the overall drop-off of engagement throughout this structure of the session. Children whose early performance was very good, with performance falling off in both middle and later phases of the session were identified for additional subgroup analysis, as such subgrouping would be diagnostically relevant to the analysis of rise-time data related to the presence of co-morbid attention problems.

| Condition | Label                           | No. Trials | % of Total | Correct Response | Purpose                                 |
|-----------|---------------------------------|------------|------------|------------------|-----------------------------------------|
| 1         | Rise-Time Contrast (diagnostic) | TBC        | TBC        | Alag (Different) | Primary: tests rise-time discrimination |

## THE STUDY

|   |                                                |     |      |                     |                                                                |
|---|------------------------------------------------|-----|------|---------------------|----------------------------------------------------------------|
| 2 | Formant<br>Transition<br>Contrast<br>(control) | TBC | TBC  | Alag<br>(Different) | Control: tests<br>non-rise-time<br>discrimination              |
| 3 | Identical<br>Sounds (catch<br>trials)          | TBC | TBC  | Yahi<br>(Same)      | Quality<br>control: flags<br>random/inatten<br>tive responding |
| — | Total                                          | 60  | 100% | —                   | —                                                              |

*Table 5.1- Distribution of trials across conditions in the 60-trial Ba-Wa task. TBC values to be completed from study protocol documentation by document preparer.*

### **5.6 Inside A Study Before The Results Are Known: Uncertainty Vs Anxiety**

Data collection for this study was completed July 2026. Data Analysis was ongoing as of when this material was writing, August 2026, and thus results were not resolved when this Material was prepared. Inclusion of this section is made to describe an experience where results of one's study are actually unknown, which does not commonly occur in the science literature. All previously published scientific manuscripts often describe as known quantities the results of statistical analyses conducted after Elements of Data Collection have been completed. The Time-span of Unknown or Uncertainty between Close of Data Collection (Data Completion date) and Completion of Analytic Reporting for all research studies has

## THE WRONG WORDS

compressed & is presented via an abbreviate timeline in Methods and Results Sections, with limited opportunity to describe via separate text such interval of time within a paper that exists.

To actually be Involved inside the experience of participation in a study] on your own terms relating to when you will receive results is characterized by 'Uncertainty' rather than identified as characterized by 'Anxious'. In this context, anxiety is your response for concern of known [bad] outcome will occur out of a review of study design and/or methodology; uncertainty is defined as having No Knowledge of what results may consist of as they are to be reviewed via Completion of Analytical Processes of all data collected. A study hypothesis being developed based on theoretical foundations and/or designed to test one specific to a particular research question is not a False finding of fact because a research hypothesis is not a finding of fact to prove at least, one specific hypothesis falls within ethics of conduct for evaluation research protocol for analysis at the completion of all analytic processes.

The results of this study cannot be known to Children being enrolled within this study because the history of all previous research relative to Development Dyslexia has been accumulated over the past forty years. Further, Children are unaware of implications associated with pressing a button in regard to Widespread use of The World's Most Widespread Language Group (The Children) in understanding Developmental Dyslexia across The Linguistically Diverse World. Researchers had previously worked with a group of children on a study related to sound discrimination for three years and found the children exhibited varying levels of interest

## THE STUDY

in the study as the researchers directed children to listen to sounds through headphones and press a button whenever they heard the sound result and how many different types of sounds they heard. After being informed that they were not allowed to perform the same task again, one child asked for another opportunity because she was curious about the last task but had not been able to complete it with satisfactory accuracy. Researchers have conducted scientific research; therefore it must be completed with the level of rigor that the subjects deserve.

### **5.7 What the Data Will Show and What Either Results Means**

This study will examine a binary prediction from Goswami's rise time deficit hypotheses: that children identified as at risk for dyslexia will show significantly worse discrimination of Ba and Wa when the acoustic difference (between Ba and Wa) is carried by rise time versus formant transition duration. There are 2 main outcomes to this study.

#### **5.7.1 If the Hypothesis is Confirmed**

If the at-risk children's ability to discriminate between Ba and Wa on the basis of rise time is significantly worse than that of typically developing controls — while their performance on the formant transition task does not differ from that of typically developing controls — the implications will be immediate and substantial.

The first important conclusion from such a finding would be that rise time discrimination (and, therefore, a deficiency in rise

## THE WRONG WORDS

time processing) is a neurological marker for dyslexia in South Asian languages, thus demonstrating that this deficiency is not unique to one language but rather is an essential characteristic of developmental dyslexia in all languages regardless of the phonological, orthographic, or rhythmic structure of the language in which it occurs.(9)

The second conclusion from such a finding would be that normative data for rise time discrimination thresholds specific to Hindi would be needed for children. Normative data for rise time discrimination thresholds for children learning English cannot be assumed to be generalizable to children learning Hindi. In order for the Ba-Wa paradigm to be validly used in clinical settings with children learning Hindi, new predictive validity data must be<sup>3rd</sup>, the present finding provides a neurological basis for the literacy gains found using the Sahitya programme, supporting the hypothesis that rhythm-based phonics instruction is partially mediated by the auditory temporal processing pathway identified by Goswami. (10)

### **5.7.2 If the Results are Not Reliable or Cannot be Generalized**

Field conditions introduce a level of variability that laboratory settings can control. Smartphone psychoacoustic tests delivered in a school corridor without acoustic isolation will produce noisier data than tests done in a Cambridge audiometry booth. If a result supports the hypothesis, but the sample size only includes 47 children and does not reach statistical significance, it may actually be a real result that just needs larger, more homogeneous samples to reliably identify.

## THE STUDY

In this case, the conclusion is not that the hypothesis is disproved. Rather, there has been a need to improve, scale and replicate now under more controlled acoustic settings. Even if the signal is noisier (a lot of noise or less clarity) than is preferred, it still shows that something exists in the data and the measuring tool should be calibrated more accurately to describe it.

### 5.7.3 Common Implication

Despite the outcome of either scenario, the structure of the evidence to date suggests that our data base for identifying developmental dyslexia is inadequate. The populations that were excluded from the original rise time study are Hindi speaking children, and South Asia, which has roughly 600 million speakers of South Asian Languages. Such people cannot be presumed to conform to the parameters established based on the lack of inclusion of their culture. The primary objective of the work to advance the current database through research on these populations has not yet been achieved adequately.

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## CHAPTER 6

# The Wrong Words

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### **6.1 The Institution Always Finds The Fault In The Person**

While this is not a conspiracy or a policy, it was the way a system was designed (to efficiently process people) and that the tools used for processing people were designed for a certain type of person. When someone did not fit into those design specifications, the system had two choices: to question the tool or to record a result. However, recording a result (which is done much quicker) does not require the institution to change. Therefore, the system recorded a result. This is not an isolated example, but rather a structural condition that appears consistently throughout all three domains of this book: the memory clinic, school, and diagnostic manual. In all three domains, the tool becomes a standard, and because they have an institutionally validated authority, the standard is acceptable and not called into question; the individual, therefore, is left with the result and the tool remains unchanged.

To understand why this systematic occurrence occurs and what would need to be done to change it, is the goal of this chapter. However, this chapter does not serve as a traditional

conclusion, but rather attempts to call attention to and identify enough characteristics of this pattern so it will not be confused with any other similar patterns.

### **6.2 Precision vs. Validity: The Three Institutions with Three Invisible Tools**

The distinction between precision and validity is the foundation of psychometrics. The clinical settings and educational settings examined in this book (herein referred to as 'the three institutions') do not apply this distinction consistently. Precision means that a tool consistently produces the same measurement under the same conditions, while validity means that a tool measures whatever it purports to measure. Tools can, therefore, be simultaneously precise and invalid (i.e., not valid). This concept is taught in every basic statistics course.(1)

In the three institutions described here, this concept continues to not be applied. There are three institutions that demonstrate this pattern:

#### **6.2.1 The Memory Clinic and the ADAS-Cog**

The ADAS-Cog measures a finding related to cognitive impairment. The English version of the list of words is never questioned; it has 40 years of validation behind it, whereas it was validated using a sample that is English, American, and urban. This validation has never been documented as part of the case file (it is not visible).(2)

Within the context of the Gurugram memory clinic, the clinician administering the ADAS-Cog is not responsible for validating the ADAS-Cog. Validation is a function that is

## THE WRONG WORDS

institutional in nature. The clinician uses the approved tool according to the established protocol and, as part of their clinical role, does not question whether or not the ADAS-Cog is valid. To question the validity of a tool would be a violation of the clinical protocol, and this violation is how things that should have been questioned continue to remain unquestioned for forty-years.(3)

### **6.2.2 The Government School and the Absence of Screening**

In a government school (which is part of the three institutions), the finding of 'not meeting expectations has been recorded. In addition, the absence of an appropriate screening tool for Devanagari-script reading has not been recorded as being a problem. The absence of something cannot be recognized by a system, which means that no record will exist of its existence.

In this situation, the teacher who sees a child fall behind has neither time to discover the reason, nor resources to provide support, nor a group of 40 students to teach. The difficulty here does not relate to the attention of the teacher or their commitment. The problem stems from the fact that the child does not have access to the kind of tool that would assist him/her in a manner consistent with his/her language and script. Give the teacher this tool and the child's circumstances will be different. Withhold the tool, and there will not be a child to attend to.

### **6.2.3 The Use Of The Diagnostic Manual As A Tool In Assessing Mental Health**

When a mental health facility documents an individual as

## THE WRONG WORDS

having a disorder, there are questions about the validity of the diagnosis depending on whether it is based on the perspective of the facility or the actual clinical condition of the individual. This does not include questions such as whether or not the behaviour causing concern for the facility is simply troublesome or substantially harmful, or whether or not the classification of disorders has a valid explanation that applies to all of the (potentially very different) individuals who have been classified into that same group. The single source of fault is with the individual; the tool has been used appropriately; and the facility is as it was designed to function. These are not necessarily acts of malice. (4)

### **6.3 The Belmont Principle of Justice Applied to Diagnostic Construction**

The Belmont Report, written by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research in 1979 established three principles upon which ethical research with human subjects can be conducted: respect for persons, beneficence, and justice. According to the principle of justice, all benefits and burdens resulting from any research conducted are to be distributed fairly, and that no population who bears a portion of the burden of a system is to be excluded from receiving some benefit of that system.(5)

While the Belmont Principle is most typically cited in relation to participating in clinical trials or research studies, it is equally applicable to diagnostic instrument construction. When the ADAS-Cog was developed, the population that will ultimately be assessed by the ADAS-Cog – namely, Hindi-speaking elderly individuals in northern India – was not included as part

## THE WRONG WORDS

of the validation process for the ADAS-Cog. Therefore, the Hindi-speaking elderly population bore no portion of the total burden of the research process; they did not receive a benefit as a result of being assessed accurately, and therefore, they did not receive a limitation as a result of being assessed with a word list that was not consistent with the life they had lived. Dyslexia screening tools were developed in English classroom settings, and therefore, the validation studies did not include the population of Devanagari-script readers in their studies. These children are now in schools where the standard method of screening does not locate them at all and is producing findings on grade materials in a manner inconsistent with the limitations of the tools used to make the diagnosis. (6)

This type of response to a child's needs cannot be interpreted as fair. It is a form of injustice according to the standards established by the Belmont Report. The field of cognitive science has yet to recognise that this type of injustice exists, and as such, the field of cognitive science does not yet understand how to correct it (i.e., without precise naming of an injustice there will be no means of correcting it).

### **6.4 Cognitive Colonialism: What The Phrase Means and Where it Falls Short**

The term cognitive colonialism is sometimes used to describe the pattern described previously in this book. It is helpful to use the term judiciously. Historically, colonialism involved the physical subjugation, the material extraction of resources and the systematic destruction of an individual's culture and the intellectual framework of people colonised by a colonial power for their own material benefit. While cognitive science

## THE WRONG WORDS

represents one form of colonial exploitation, cognitive scientists who created the ADAS-Cog were not out for revenge on Hindi-speaking patients. Similarly, the researchers in dyslexia who validated their research across several European languages did not intend to exclude Hindi-speaking children from their findings. The absence of intent does make a difference; however, the real-world effects are very much colonial in an identifiable way. The system of knowledge creation was established by a central group and then distributed to peripheral regions. When the population of these regions were assessed according to the standard set by the central group, they were not asked whether those standards were appropriate for them. Instead, when there was a failure to meet the standard, the issue was identified as belonging to the individual, rather than to the standard itself. The centre has continued to define how what constitutes a valid research question, what constitutes a valid research result, and what constitutes a population that will be included in an investigation. In other words, it can be said that science has neglected half of the world. The forgetting of half of the world was not due to an animosity to those people; rather they were not in the room when the tools were developed, nor were they in the room when funding was allocated to research, nor were they in the room when scholarly journals were determining which of the research questions would be of interest to study and publish about. Instead, they were in the classroom or in the clinical setting, receiving these tools and being evaluated by how they were using the tools in these settings.(7)

Cognitive colonialism describes the nature of the problem in that it illustrates that it is not an individual's fault or that the

## THE WRONG WORDS

intention of individuals is wrong. Rather, the issue of cognitive colonialism is focused on the unequal distribution of epistemic power and the unequal directionality of knowledge flow. However, the term can also create confusion between malicious extraction versus structural neglect, and it can also suggest from a historical standpoint that the extent of the harm has been equally distributed, which is not the case according to evidence of history.(8)

The term that has been used throughout this book is the title of this book: science has forgotten half of the world, and the act of forgetting is not innocent. However, this kind of failure is different from a successful one through conquest. To fix this kind of a failure requires identifying it correctly.

### **6.5 What You Do: Small Things and Structural Change**

What do you do with this?

The answer is simple: do what you can do where you are at with what you have available. Propose an Indian wordlist and locate a willing neurologist to test the wordlist; create a screening tool for the Hindi classroom and locate willing schools to use it; develop a therapy system for patients who cannot get to a clinic and deliver through their existing platform; email the Cambridge Professor to ask whether or not the most significant unanswered question in Hindi reading/ neurological study should be answered. These are small things, but all those small things are real.

To the patient, receiving a more accurate assessment than just some measure of her distance from an English vocabulary; to the child, who receives an explanation for his reading difficulty

## THE WRONG WORDS

that does not include faulty effort or intelligence; to the family, who will have access to a cognitive stimulation program in the language of the mother.(9)

Although they are not structurally changing, they are going through structural changes; therefore, it's important to think about how to best develop structural changes.

Institutions must develop mechanisms to question their tools. Currently, the burden of validating and verifying the construct validity of ADAS-Cog tests as they relate to Hindi speakers does not belong with a clinician who applies it. Clinicians are not responsible for determining whether or not the ADAS-Cog has been tested with respect to Hindi populations; it is simply not their responsibility. The burden of validating the ADAS-Cog rests within the gap between the use of the tool and the responsibility of the institution to which it belongs. Currently, this gap is not being addressed.(10)

Funding agencies must begin to fund research on populations outside of cognitive science's traditional research populations. The Hindi rise-time study mentioned within this book represents a first effort to add a new population of Hindi speakers (estimated at 600 million people) to one of the most replicable areas of research in developmental dyslexia research. The fact that prior to this effort, no research had been conducted on Hindi speakers is a finding about where research funding has gone, not about cognitive science. Journals must report both laboratory and field data from low-resource and high-resource conditions side by side. This methodological hierarchy, which places field data lower than laboratory data, effectively leaves the most under-resourced populations out of

## THE WRONG WORDS

the literature because those people are typically located in field-like settings and not in laboratory-like settings. Medical and teacher training programs must teach both the limitations of clinical instrument validation and the instrument's administration with the same level of detail. An individual who can tell how to administer the ADAS-Cog but does not know the population from which it was validated does not have complete understanding of the instrument; this gap in training is also a cause for lack of safety during the practice of clinical medicine. This does not seem to be changing quickly enough. To conclude, the patients who have been incorrectly assessed today, using incorrect assessment tools, will continue to be incorrectly assessed for some time. This is not an excuse to refrain from developing an intervention; it is simply an opportunity to be honest concerning what developing an intervention entails and how long it will take.

### **6.6 The Indian Word List, Sahitya, Smriti, the Ba-Wa Study — and Their Limits**

#### **6:6.1: The Indian Word List**

The goal of the Indian Word List is to develop an adaptation of the ADAS-Cog word recall component for Hindi-speaking patients. The same criteria that governed the original selection of words for the ADAS-Cog were employed to develop this lexicon. The Indian Word List consists of words that have similar characteristics to the original words from the ADAS-Cog but are specific to the everyday lives of people living in Northern India, as opposed to New York City 20 years earlier.

These words have not yet been validated. The validation

## THE WRONG WORDS

process for the Indian Word List will begin with a 120-subject research study at the Marengo Asia Hospital and will be completed with subsequent research studies. While this first research study will be published in the Journal of Alzheimer's Disease, it will provide the first published data on this issue in the country of India. The results of this initial study will demonstrate the significance of the issue being tested by comparing the scores of Hindi-speaking individuals and their scores on the Indian Word List and the original ADAS-Cog. In addition, this initial study will also identify the individuals with a high risk of a false diagnosis, i.e. those Hindi speakers who are classified as having a mild level of severity where accurate and early identification of Alzheimer's Disease will yield the most clinical benefit. The word list requires clinical validation, normative data, a reliability analysis, and peer review before it can be used clinically. Years, not months, define the distance from the current point to that of clinical utility.(11)

### 6.6.2 Sahitya

Sahitya is a literacy program that uses the anganwadi network to deliver literacy through WhatsApp, using a structured literacy and dyslexia screening assessment designed for children who read Devanagari. The number of children who received this service was over 3000. Some of the children identified as at risk for dyslexia were delivered individualized instruction through this initiative. The total cost was negligible; the only cost to the program was the training of anganwadi workers with respect to Sahitya's delivery.

The limit is just 3000 children in a country with 300 million children of school age. There is still much work to be done to

## THE WRONG WORDS

make this national in scope; this will require institutional buy-in versus individual initiative. In addition, while the SLDSA is an appropriate screen, it is not a diagnostic instrument, and therefore children found to be at risk of dyslexia on the SLDSA will require specialist follow-up that is currently not available at the scale of government schools.

### **6.6.3 Smriti**

Smriti is an innovative cognitive stimulation system that can be sent to the patient via WhatsApp using a person-specific voice created from that patient's primary caregiver's recorded voice. Smriti provides non-pharmacological intervention through the patient's own language and is being piloted clinically under the supervision of Marengo Asia Hospital. As of March 2026, there will be a provisional patent on Smriti. The pilot program proved the efficacy of the system in terms of reliable delivery, similar levels of engagement as face-to-face interventions, and a reduction in the direct financial burden on family caregivers.

The limit to Smriti is that it does not slow the progression of Alzheimer's disease, and that it does not address the pharmacological issues associated with managing dementia – this is a significant and separately complex issue. The existing lack of memory care infrastructure for the majority of Indian patients creates a gap that can be bridged; but bridging the gap is not the same thing as closing it. The gap itself requires institutional funding that a caregiver voice clone delivered via whatsapp will not be able to provide.

## THE WRONG WORDS

| Tool                                   | What It Addresses                                                                                                                | What It Cannot Address                                                                                  | What Remains                                                                     |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Indian Word List (ADAS-Cog adaptation) | Culturally inappropriate word recall items for Hindi-primary patients; differential encoding misrecorded as cognitive impairment | Full validation; clinical thresholds; normative data; pharmacological management of Alzheimer's disease | Peer review; larger study; institutional adoption; years of validation work      |
| SLDSA / Sahitya                        | Absence of Devanagari-specific dyslexia screening; 3,000+ children identified and reached through anganwadi network              | Specialist diagnostic follow-up; scale beyond proof of concept; national government school adoption     | Institutional adoption; outcomes analysis publication; scale-up through policy   |
| Smriti                                 | Absence of non-pharmacological cognitive stimulation for Indian Alzheimer's patients; WhatsApp delivery in patient's own voice   | Slowing disease progression; replacing clinical memory care infrastructure; pharmacological management  | Controlled trial; regulatory pathway; institutional adoption beyond pilot clinic |
| Ba-Wa Rise-Time Study                  | Complete absence of Hindi rise-time                                                                                              | Definitive clinical thresholds; large-                                                                  | Analysis completion;                                                             |

## THE WRONG WORDS

|  |                                                                                               |                                                             |                                                                 |
|--|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------|
|  | processing data; first<br>empirical test of<br>dyslexia<br>neuroscience<br>signature in Hindi | sample replication;<br>laboratory-condition<br>verification | publication;<br>replication with<br>larger controlled<br>sample |
|--|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------|

*Table 6.1- Four tools, their scope, their limits, and what the correction of the science still requires.*

### **6.7 The Clinic Patient — What We Don't Understand**

The patient who attended the clinic in Gurugram was evaluated using a test not designed for her; she received a lower than expected or impaired score. She then spoke in Tamil for 15 minutes about her grandchildren without pausing or losing track; she appeared completely on top of all of the information she had about them.

We are not aware of her clinical diagnosis. The ADAS-Cog score may reflect her true cognition and/or it may strictly reflect limitations of the ADAS-Cog due to testing differences. The point is there is no way currently available to clarify — with current available model(s) of measurement. In this instance, the ADAS-Cog could not tell us if a low score in a Hindi primary language versus a Tamil primary language is related to actual recollective memory or to some sort of differential encoding. The creators who developed the ADAS-Cog did not design it with the intention of obtaining an accurate score for a Tamil-speaking patient in Gurugram; therefore, the creation criteria used in creating the ADAS-Cog did not envision the actual patient.

## THE WRONG WORDS

The Marengo Asia Hospital project represents the start of a research project to help answer the aforementioned question; the data from the study showed that 60 patients' recall was better using the Indian Word List with a disproportionate number of mildly impaired patients. This suggests that clinical implications exist. The patients that cannot afford to be misdiagnosed, especially at an intervention point where early and accurate identification of the true status of the patient with expected action, represent the patients who have been misdiagnosed the most.

Therefore, the data confirms what is known concerning the question and the evidence supports the question and is incomplete as each condition requires additional research, peer review, institutional involvement measured in years, and indicates that the question should have been investigated over 40 years ago where the costs for patients relate to not having addressed the question have been borne by patients and not by institutions.

### **6.8 Finding The Right Words Is Difficult**

It isn't only the wrong English words in the Hindi list that result in incorrect wording; it is also how science has described to date the minds it has not yet studied.

Impaired; disordered; below expectation. The terms carry the weight of tests used for clients; however, they do not carry the caveat about being built to measure a group's ability in another group who were not asked if it measures what it claims it was going to measure.

## THE WRONG WORDS

Finding the right words is difficult because they require the clinician to live with ambiguity and to not resolve that ambiguity into a diagnosis. They require the system to develop better testing instruments so that findings can continue to be recorded with new testing instruments. They require researchers to venture out into places where information has not yet been gathered and to gather that information under imperfect circumstances, such as where dogs walk into the testing area, and the testers have a stronger affiliation with the child than they might have about maintaining a clean control area within the school.

The right words require a 15-year-old to realise that there is a woman in the chair who speaks a different language than those being tested, and to view this as worthy of pursuit, until 7 years down the road, as was described in this text.

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