

Auditory training – a natural way to affect impaired tone matching in dyslexia

Korpilahti P.^{1,2,3}, Zachau S.^{2,3}, Heinänen, K.^{2,3}, Ervast L.^{2,3}, Rytky S.²

¹ School of Finnish and General Linguistics, University of Turku, Finland

² Cognitive Laboratory, Clinical Neurophysiology, Oulu University Hospital, Finland

³ Department of Finnish, Information Studies and Logopedics, University of Oulu, Finland

Background

Introduction and Intervention

- Deficient auditory processing is often reported in dyslexia^{1,2}.
- Impairment in tone matching is quite permanent and in most cases stays unchangeable even in adulthood³.

IADT® (Individual Auditory Discrimination Training) has its background in the theory of Tomatis⁴. The auditory perceptual profile (both monaural and dichotic testing in tones and words) is used as a starting point for the intervention to increase sensitivity for the central frequencies of the speech.

IADT® is based on synthesized music that is moulded individually according to the hyper- and hypoactive features when compared with the optimum hearing reference curve by Tomatis. In many individuals suffering from sensory problems, atypical auditory sensations and primitive reflexes are related to each other, so the auditory intervention is often combined with sensorimotor training.

- SynAmps, Scan (NeuroScan), 1000Hz sampling rate, on-line band-pass 0,05-200 Hz, off-line band-pass 0,5-20 Hz, reference: linked mastoids, artifacts rejected if +/- 150 µV

Subjects and Stimuli

Young adult dyslexics, N = 10, mean 18,6 years (range 17-20 yrs)
Typically developed, age matched controls, N = 10

The oddball paradigm was used to declare:

- 1) if the brain activation can be normalised by intensive auditory training
- 2) if simultaneous changes can be seen in behavioural skills: technical and comprehensive reading, naming (Table 1.), and profiles of adaptive and maladaptive behaviour (ASEBA⁵).

Intervention 6 months (15 minutes per day) in controlled conditions

Auditory ERPs recordings: **at the beginning of the study**
after 6 months training
after 3 months follow-up

ERP conditions: **sine tones** 1800/2000/2200 Hz and 3600/4000/4400 Hz, 100 ms
syllables AMA/ANA/ALA, 400 ms (each deviant p=.10)

Results and Conclusions

Baseline: In dyslexics the ERP pattern was atypical for adults. The latency of N1 was long, showing immature response and primary deficits in auditory orienting.

After training: Latencies of N1 decreased statistically (1800/2000/2200 Hz, p=.009; 3600/4000/4400 Hz, p=.017) especially over the LH (Fig. 1). The intervention activated auditory potentials (both for standards and deviants), and after the follow-up also the discriminative component MMN was growing in amplitude, Fz p=.003 (Fig. 2). The lateralization for verbal stimuli was normalized to the LH, and the amplitude of MMN was increasing, Cz p=.013 (Fig. 3). **Our results show that adult brains have plasticity for auditory training and that dyslexic learning difficulties can be relieved with individually planned and intensive intervention.**

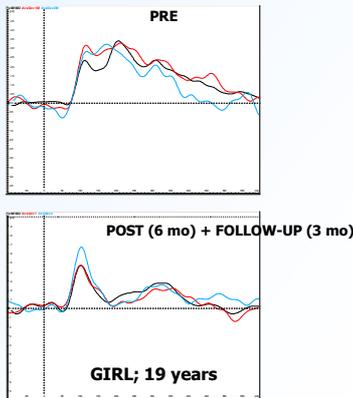


Fig. 1. N1 elicited by 1800/2000/2200 Hz. Black: standard 1800 Hz. Red: deviant 2000 Hz. Blue: deviant 2200 Hz.

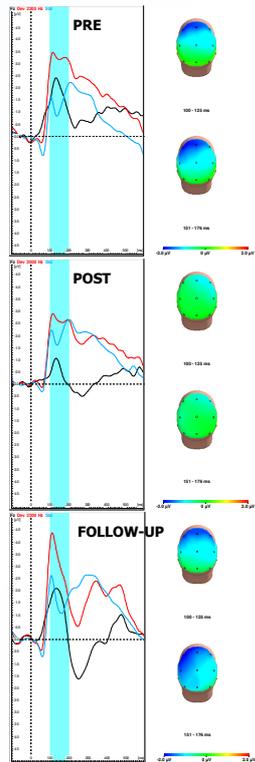


Fig 2. Non-verbal 1800/2200 Hz (dev 10 %).

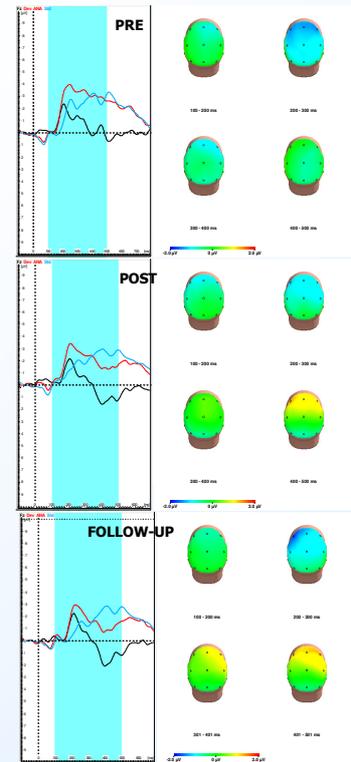


Fig 3. Verbal AMA/ANA (dev. 10 %).

Testing	Reading age in ALLU yrs; mo	Spelling (subtest in technical reading)	Boston Naming Test
PRE	8;9	18,5	45,6
POST + FOLLOW-UP	9;8	29,4 ** P = .006	48,2

Table 1. Changes in behavioral skills. Mean values (N=10).

Panels on the left: **standard, deviant, MMN**.
Maps: MMN distribution over the scalp.
Top: before training. Middle: after intervention (6 mo). Bottom: follow-up (3 mo).

Literature & Framework

Supported by:
Finland's Slot Machine Association, RAY awarded to Dyslexia Association in Ylä-Savo, Finland

- 1 Habib M (2000) The neurological basis of developmental dyslexia: an overview and working hypothesis. Brain, 123, 2373-2399.
 - 2 Kujala T (2002) The MMN as an index of auditory dysfunction in dyslexia. In E Witruk, AD Friederici & T Lachmann (Eds.) Basic functions of language, reading and reading disability. Dordrecht: Kluwer Academic Publishers, pp. 359-368.
 - 3 Shaywitz SA, Fletcher JM, Holahan J, et al. (2002) Persistence of dyslexia. Pediatrics, 104, 1-9.
 - 4 Tomatis, A.A. (1991) The conscious ear. New York: Station Hill Press.
 - 5 Achenbach, T.M. & Rescorla, L.A. (2001). Manual for the ASEBA School-Age Forms & Profiles. Burlington, VT: University of Vermont.
- IADT © (Individual Auditory Discrimination Training); Modified and further developed by H. Hätenen (www.pekuoy.fi) from the method of K. Johansen, Baltic Dyslexia Research Lab ApS.

Correspondence:
Pirjo Korpilahti, Logopedics, School of Finnish and General Linguistics, Itäinen Pitkätatu 3a, 20014 University of Turku, Finland
pirjo.korpilahti@utu.fi