New Chirp Stimuli for Hearing Screening

M. Cebulla [1], E. Stürzebecher [2], C. Elberling [3], Wafaa Shehata-Dieler [1]

1) ENT Clinic, Faculty of Medicine, University of Würzburg, Germany
2) WDH Denmark, c/o Petershagen, Germany
3) Oticon A/S Research Centre 'Eriksholm', Denmark

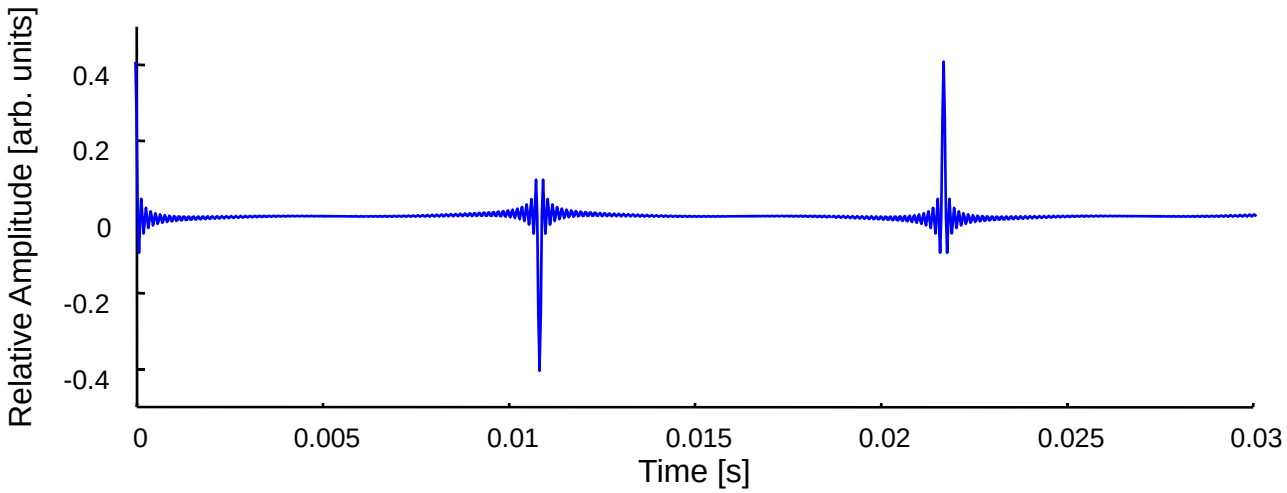
Introduction

- For automated ABR-based newborn screening it is desirable to use powerful detection algorithms and efficient stimuli
- ABR detection with modified version of Mardia's (1980) q-sample test
- Substituting the normal click with a chirp increases the ABR-amplitude significantly
- Effective, band limited stimuli for simultaneous stimulation of different frequency areas can easily be constructed from the broadband chirp

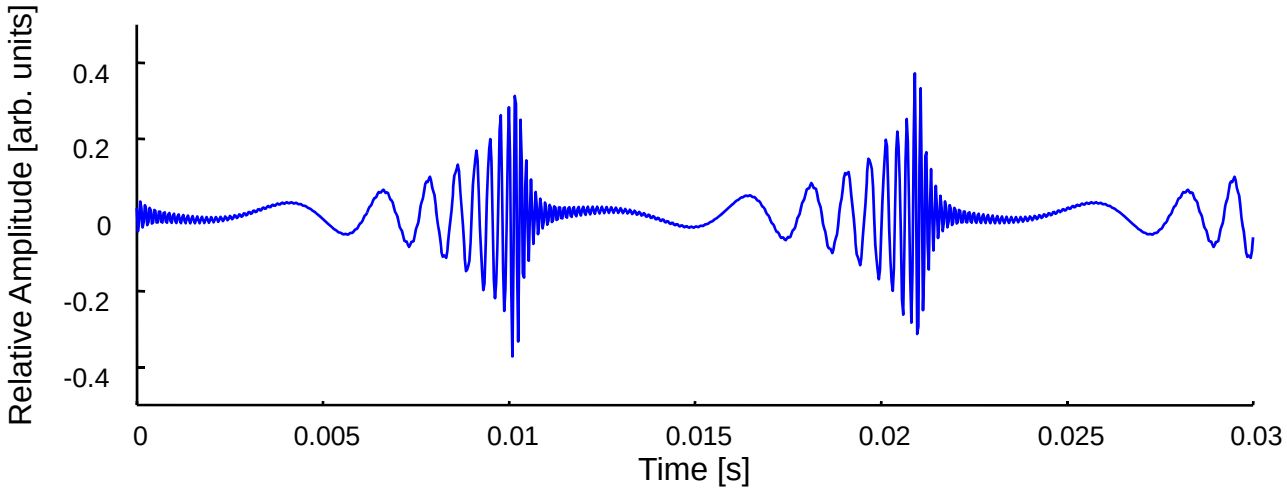
Newborn Hearing Screening with the BERAphon®

Cebulla et al., Univ.-ENT-clinic Würzburg

Stimuli used for
Hearing screening with broadband stimuli



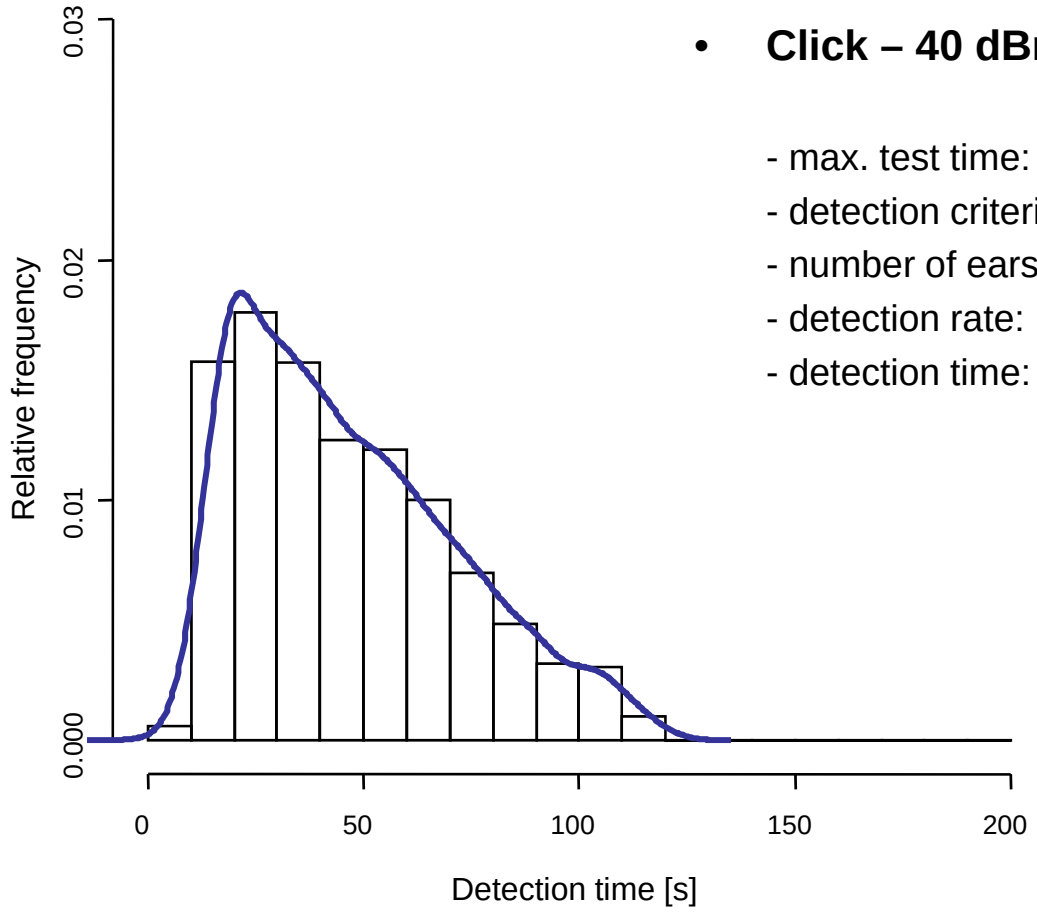
Click



Chirp

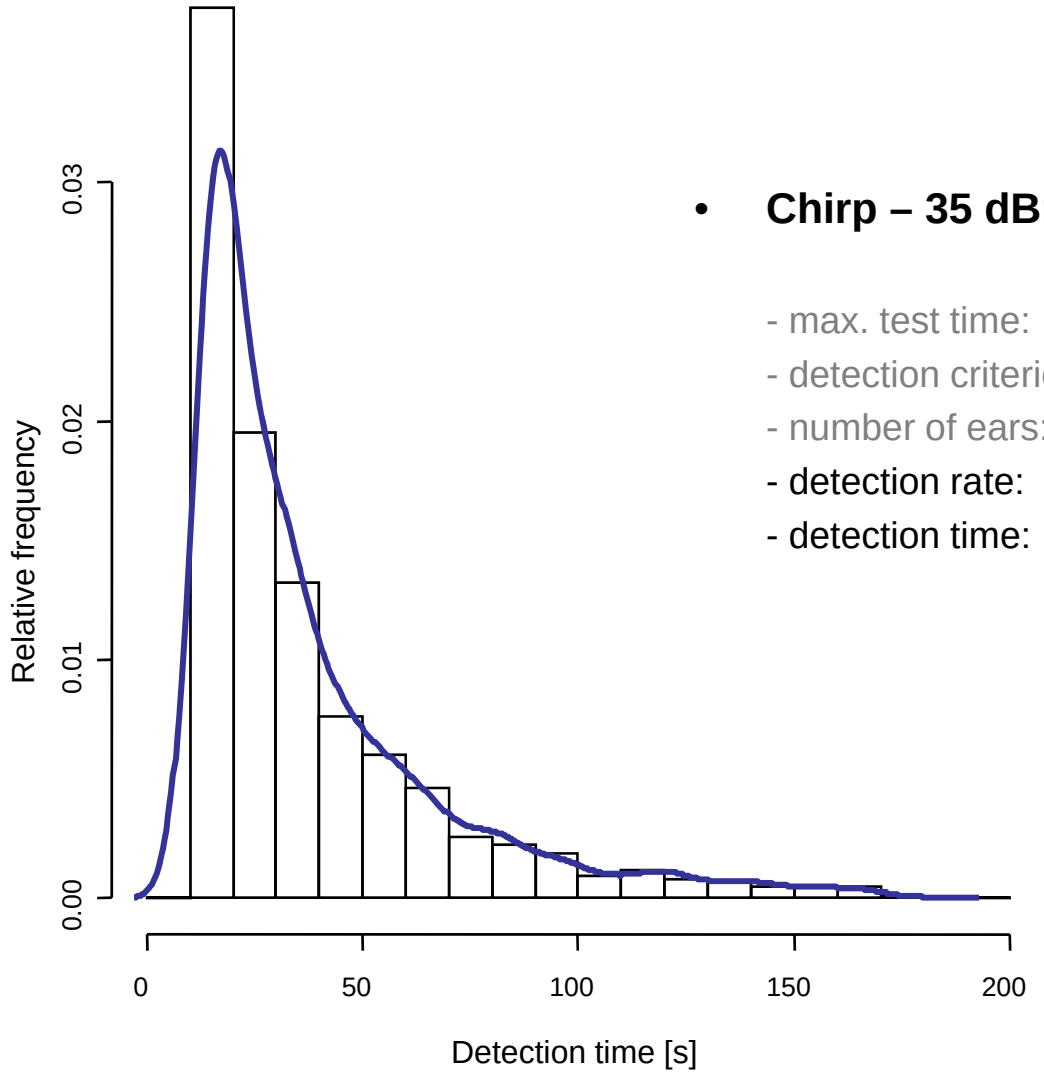
Hearing screening with broadband stimuli
Materials and Methods

Subjects	Newborns, mean age 2 days
Stimuli	Standard-click, chirp stimulus (phase compensation based on normative latencies of narrow-band ABRs)
Repetition rate	92/ s (ASSR)
Stimulus level	40 dBnHL (click), 35 dBnHL (chirp)
Application device	BERAphon (Surface electrodes, vertex and ipsi-lateral mastoid)
Signal detection	Modified Mardia's q-sample test, Significance level 0,1%



- **Click – 40 dBnHL**

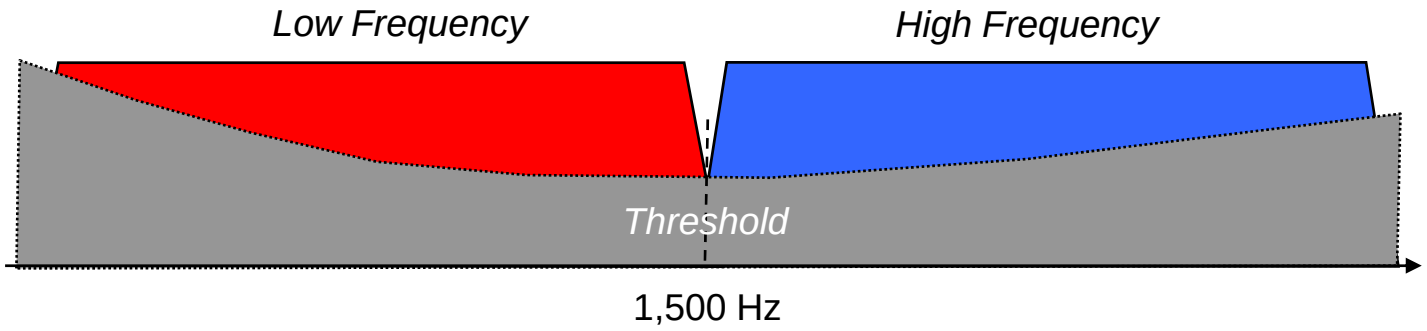
- max. test time:	120 s
- detection criterion:	0.1 %
- number of ears:	1744
- detection rate:	97.2 %
- detection time:	42 s (median)

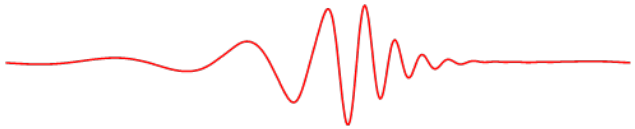


- **Chirp – 35 dBnHL**

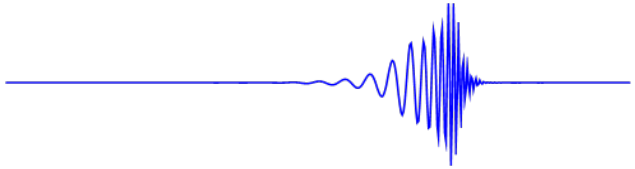
- max. test time:	180 s
- detection criterion:	0.1 %
- number of ears:	1833
- detection rate:	98 %
- detection time:	28 s (median)

ASSR in response to band limited stimuli - presented simultaneously

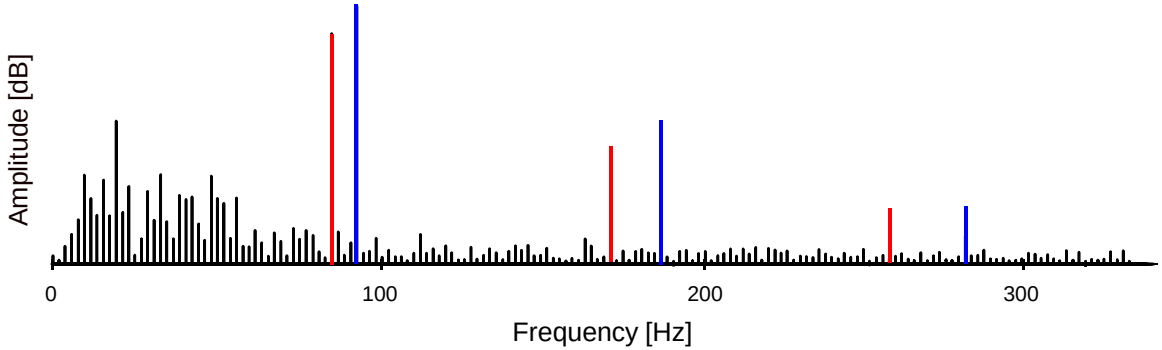




Lo: 135 – 1,500 Hz



Hi: 1,500 – 8,000 Hz



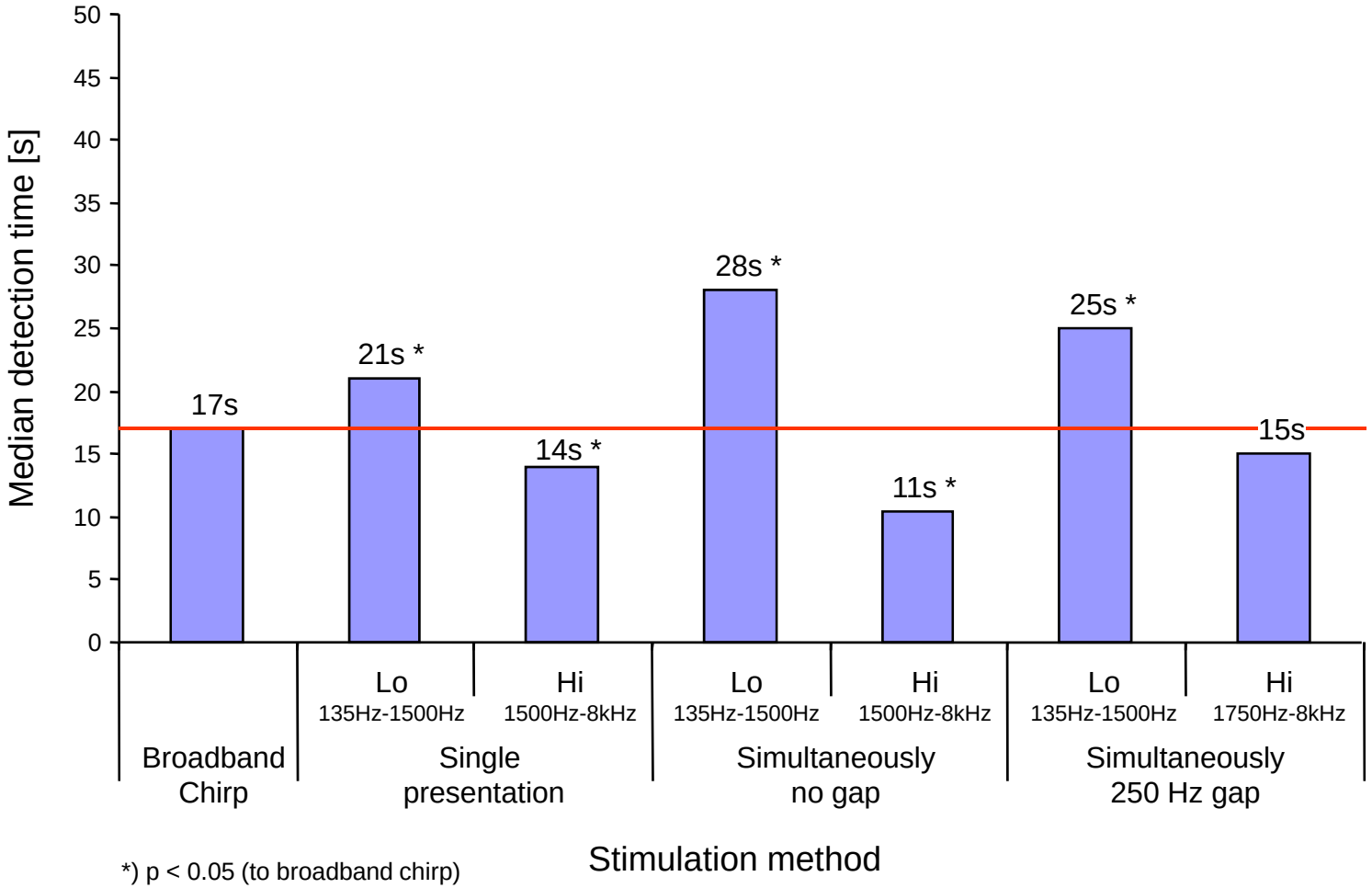
Spectrum ASSR

Hearing screening with band limited stimuli
Materials and Methods

Subjects	79 newborns, mean age 2 days
Stimuli	Single broadband stimulus Band limited stimuli: 135Hz-1500Hz, 1500Hz-8kHz Stimulation: single (one at the time), simultaneously with and without gap
Repetition rates	~ 92/ s
Stimulus level	35 dBnHL
Application device	BERAphon (Surface electrodes, vertex and ipsi-lateral mastoid, max. 180s measuring time)
Signal detection	Modified Mardia's q-sample test, Significance level 0,1%

Hearing screening with band limited stimuli

(N = 79, detection rate = 100%)



*) $p < 0.05$ (to broadband chirp)

Summary

- Chirp stimuli evokes clearly greater ASSR-amplitudes than standard clicks resulting in significantly reduced detection times
- The detection time for the low frequency stimulus is slightly longer than the detection time for the high frequency stimulus
- The detection time for the high frequency stimulus is lower than for the broadband stimulus – is this due to interaction ?
- „Frequency specific“ hearing screening with two, band limited stimuli presented simultaneously seems to be possible