

# De Neve T. 2019

'SALIS'

IOF ConcepTT:  
Ontwikkeling van  
leeftijdsspecifieke en  
geïndividualiseerde normering  
ivf. een veilig geluidsniveau van  
mp3-spelers

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Inhoud:  
debriefing  
SALIS  
ConcepTT

De Nefve T. 2019



Situering: SALIS



WP1: meetprocedure



WP extra: kop telefoons



WP2: kinderen en volwassenen



WP3: HATS



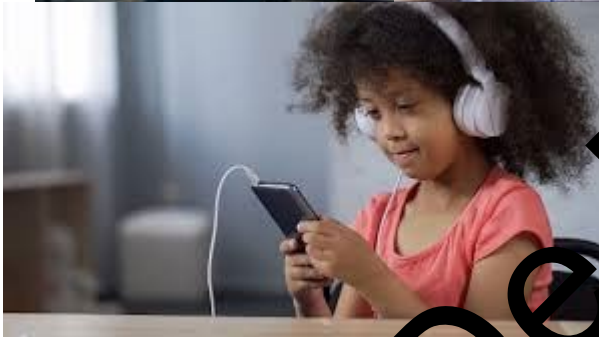
WP4: WP1-3



WP5: valorisatie en verder onderzoek

# Situering SALIS

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[PBD home](#)

[Documents & publications](#)

[Blindness](#)

[Deafness](#)

## Make Listening Safe



*Make Listening Safe*

1.1 billion teenagers and young adults are at risk of developing hearing loss due to the unsafe use of personal audio devices and exposure to damaging levels of sound in noisy entertainment venues. Under the theme "Make Listening Safe", WHO draws attention to the rising problem of noise-induced hearing loss due to recreational exposure to loud sounds.

### KEY FACTS



**1.1 billion** young people worldwide are at risk of hearing loss due to unsafe listening practices

**Over 43 million** people 12–35 years live with disabling hearing loss



### Among young people 12–35 years in middle- and high-income countries:



listen to unsafe levels of sound through personal audio devices (MP3 players, smartphones, and others)



are exposed to potentially damaging levels of sound at nightclubs, bars and sporting events

Deafness 2019

# Gehoorschade en mp3-spelers



- Risico op gehoorschade:
  - Blootstellingsduur
  - Niveau van de auditieve keten

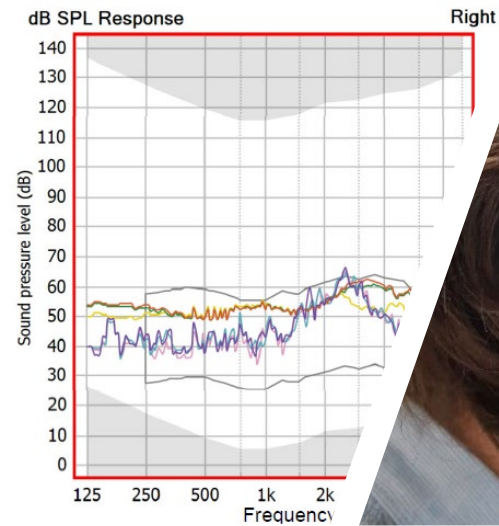
$$dose = \int_{t_1}^{t_2} (p_r(t))^{2+1}$$

- Richtlijnen van de ITU en WHO
  - ITU-T/WHO: H870: Guidelines for safe listening devices/systems
  - CENELEC EN 50332-3 (2017), Sound system equipment: Headphones and earphones associated with personal music players – Maximum sound pressure level measurement methodology



De referentie ?

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Doel ConcepTT: De noodzaak onderbouwen van een universele geluidsdosimetrie applicatie voor mp3-spelers die rekening houdt met leeftijdsspecifieke en individuele correcties





# Study setup



**Approval of the Ethical committee of the Ugent**



**Population: adults and children with no recent history of otological problems and absence of important amounts of cerumen in the ear canal.**

28 boys (mean age 7y)

33 girls (mean age 7y)

28 women (mean age 21y)

21 men (mean age 21y)



**Real ear measurements: G. Otitometrics (Natus) PMM module**



**Test signal: iPod touch: Program simulation noise (IEC 268-1) played at a level of +/- 75 dB SPL at the eardrum**



**Apple Earpods (IN ear) and Marshall Major type II (On ear)**

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WP1



Test-retest/ Validiteit

# Real ear measurements: Test – retest: ICC



ON Right

	250	500	1000	2000	3150	4000	8000	Total
Single measures	0,597	0,674	0,823	0,882	0,887	0,827	0,607	0,678
Average measures	0,816	0,861	0,934	0,937	0,959	0,935	0,822	0,863
Single 95% low	0,500	0,589	0,770	0,780	0,850	0,774	0,511	0,593
Single 95% upper	0,685	0,749	0,869	0,874	0,916	0,871	0,693	0,753
Average 95% low	0,750	0,811	0,910	0,914	0,944	0,911	0,758	0,814
Average 95% upper	0,866	0,900	0,952	0,954	0,970	0,953	0,872	0,901



IN Right

	250	500	1000	2000	3150	4000	8000	Total
Single measures	0,767	0,793	0,805	0,873	0,900	0,839	0,600	0,794
Average measures	0,908	0,920	0,925	0,954	0,964	0,940	0,818	0,920
Single 95% low	0,700	0,732	0,747	0,832	0,867	0,789	0,504	0,733
Single 95% upper	0,824	0,845	0,854	0,906	0,926	0,880	0,688	0,845
Average 95% low	0,875	0,891	0,899	0,937	0,951	0,918	0,753	0,892
Average 95% upper	0,934	0,942	0,946	0,967	0,974	0,957	0,869	0,943

> 0,8 preferred  
 > 0,72 adequate  
 < 0,72 not good

DEVELOP 2019





PMM versus ER-7C

dB SPL at eardrum



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Intra/inter transducer variation:  
measured on HATS

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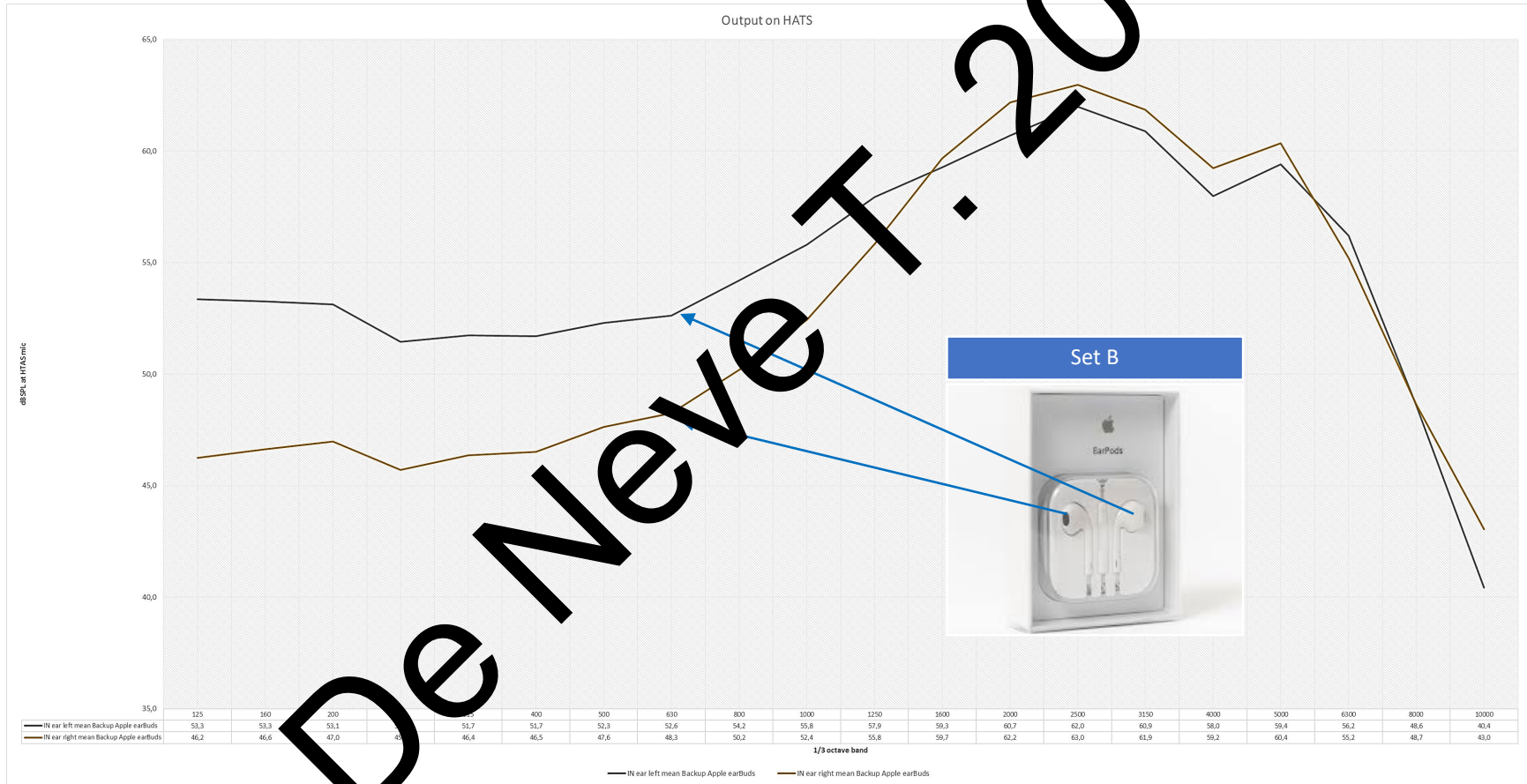


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left versus right  
ear: set B  
(within same set  
B)

In ear (Apple EarPods)

# Left versus right ear Apple EarPods set B





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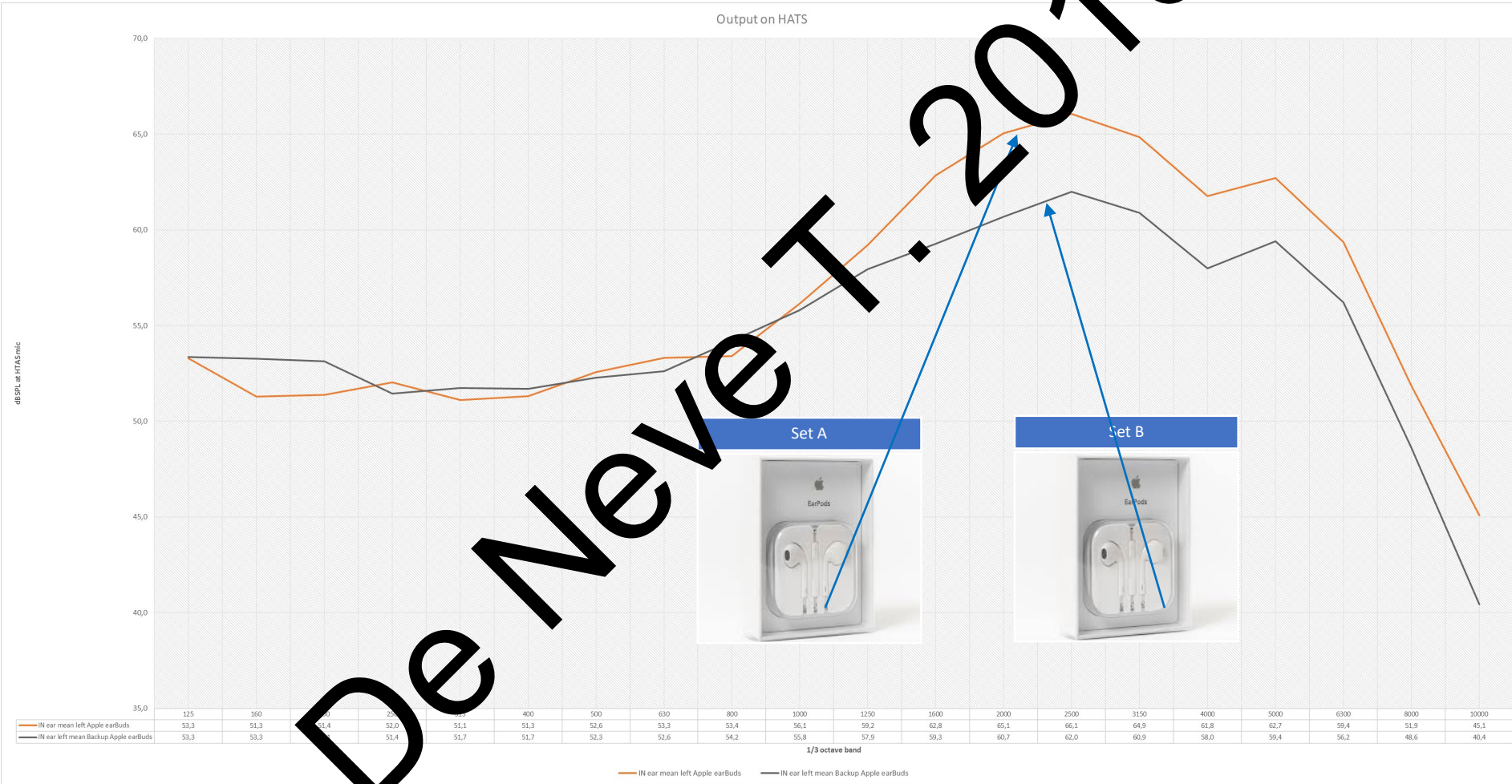
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left ear: set A  
versus set B

In ear (Apple EarPods)

# Left ear Apple EarPods: set A versus set B

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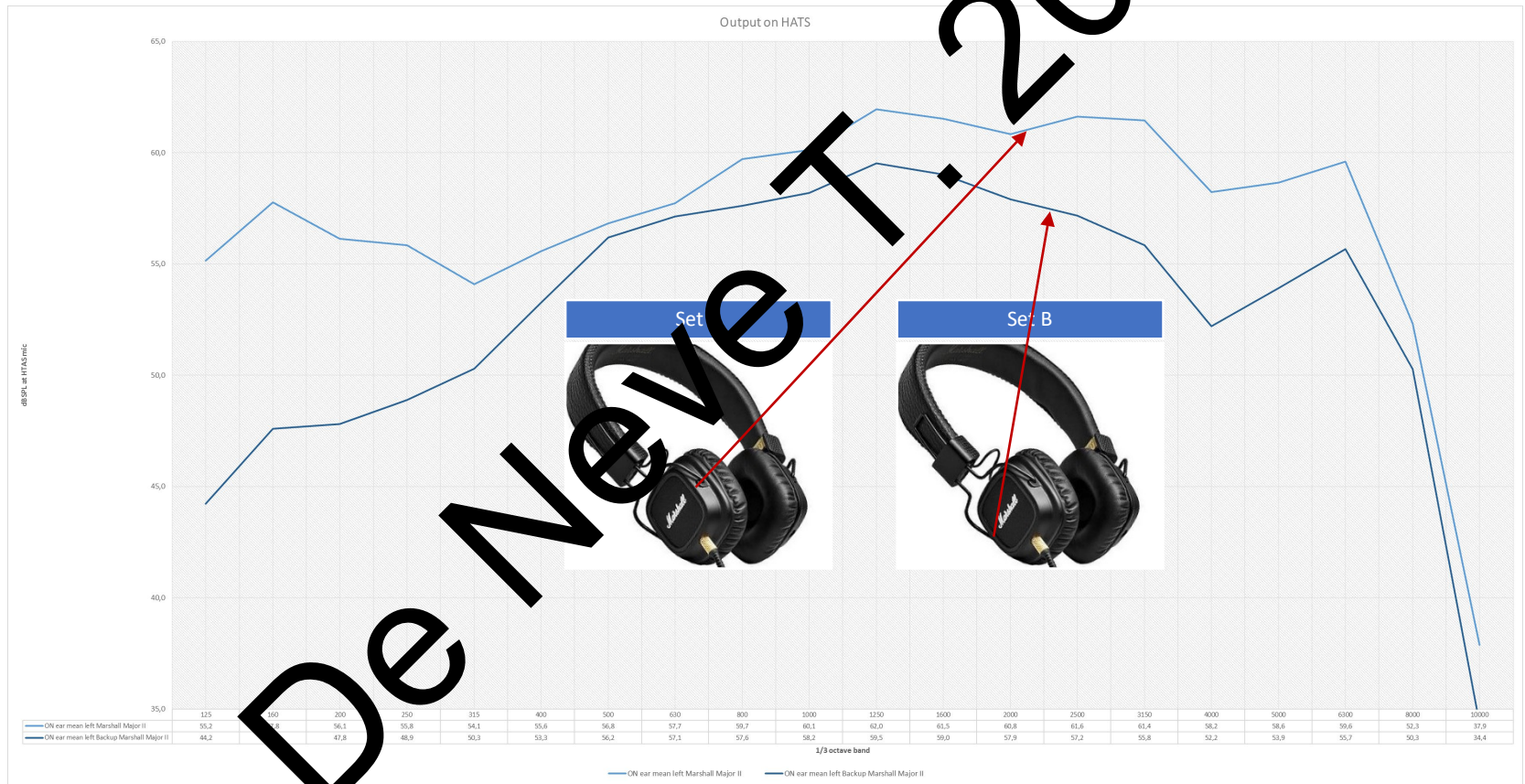


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right ear: set  
A versus set B

ON ear (Marshall Major II)

# Left ear Marshall ON : set A versus set B

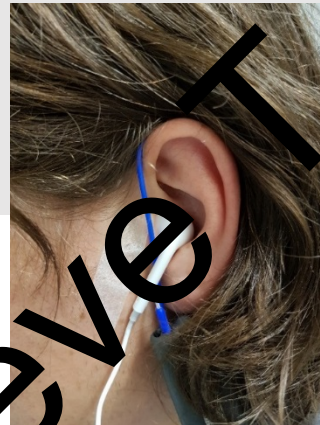


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WP2



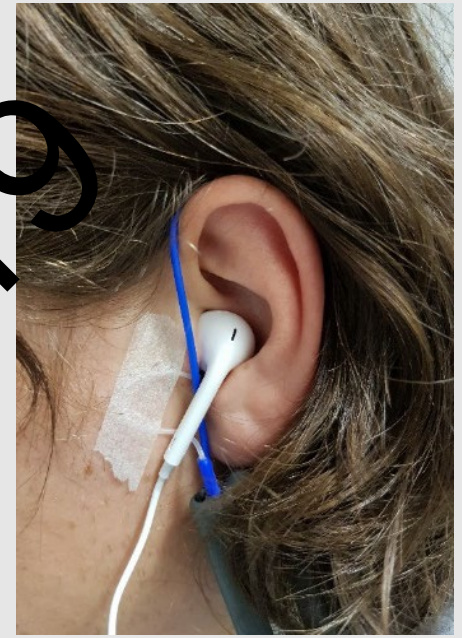
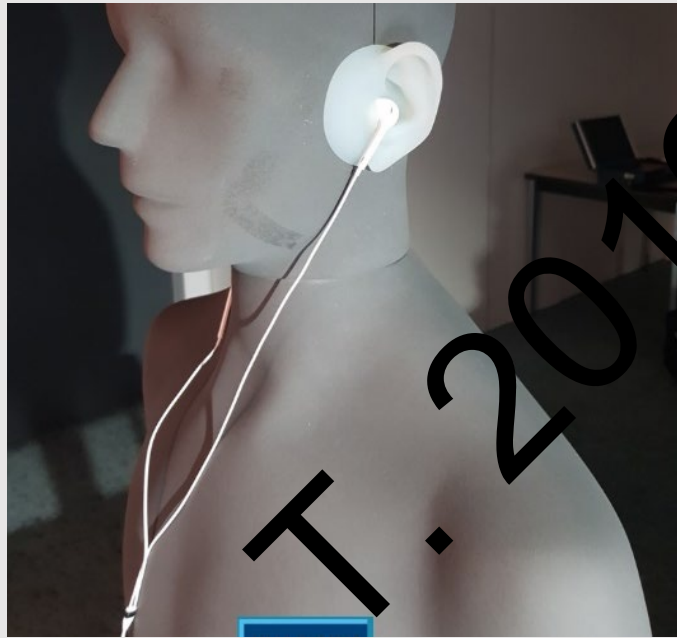
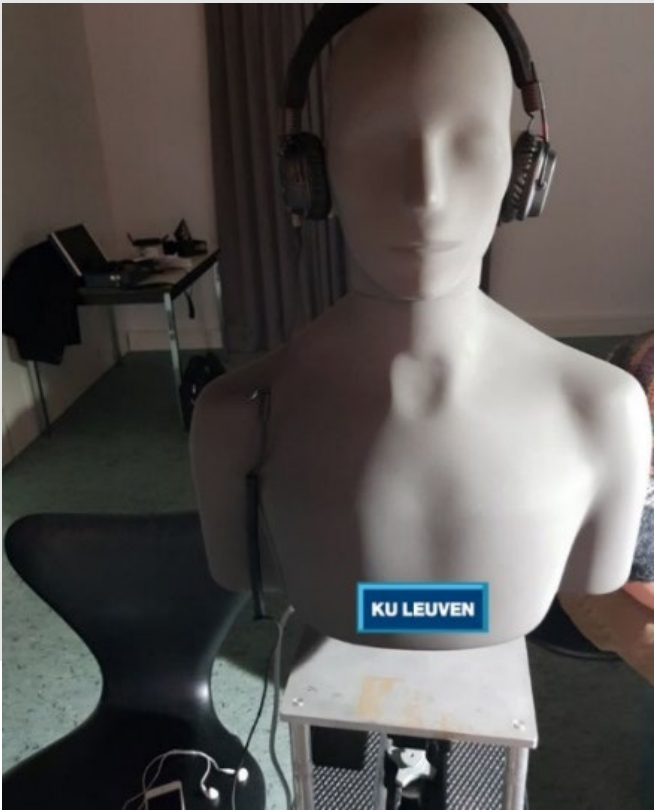
Inter subject variation for headphones  
(measured at the eardrum)

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WP3



HATS versus real subjects

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WP4

# WP1-WP4



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Inter/intra- transducer variation

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Intersubject variation

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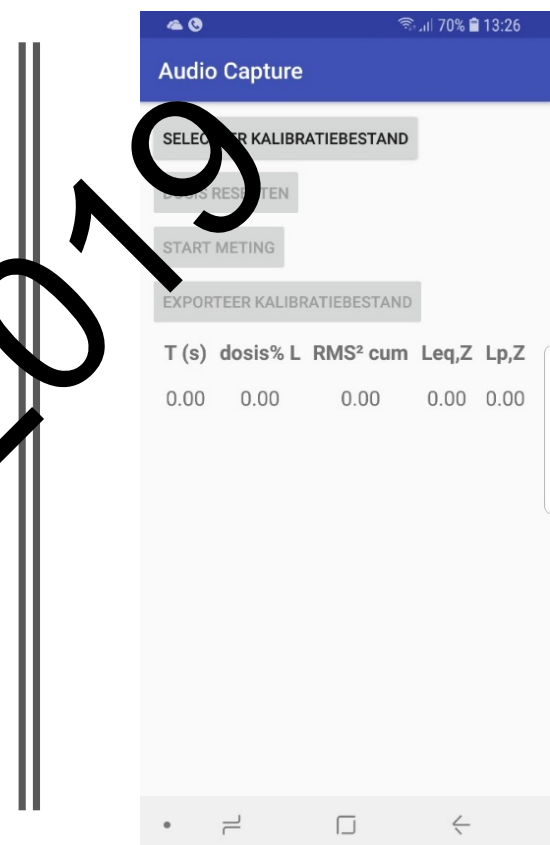
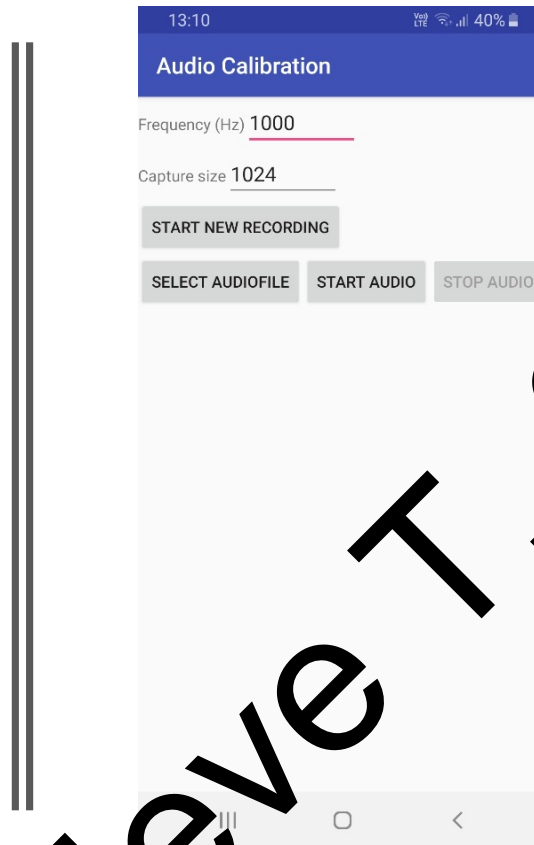
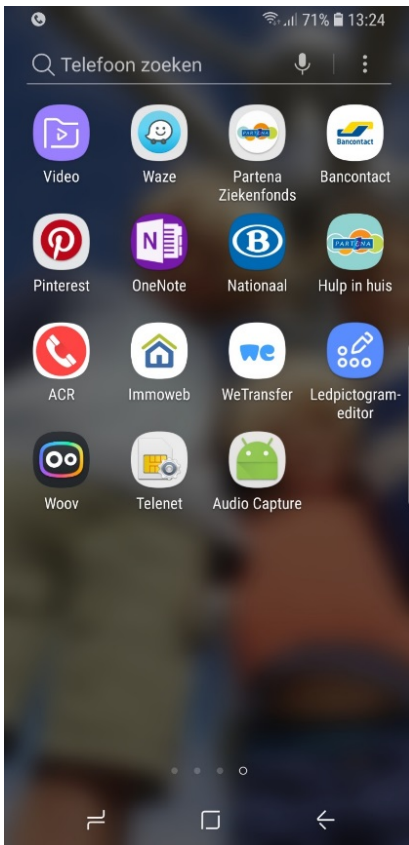
Difference between HATS and the real population

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**HATS cannot possibly be the reference in a dosimetry app = need for individual calibration**

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WP5



INDIVIDUAL NOISE DOSE (IND) APP BETA  
VERSION: 'AUDIO CAPTURE'

Toepassingen  
IND app  
(android  
versie)

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Universele  
dosimetrie app: met  
HATS  
correctiewaarden



Universele dosimetrie  
app: met gemiddelde  
real ear corr waarden



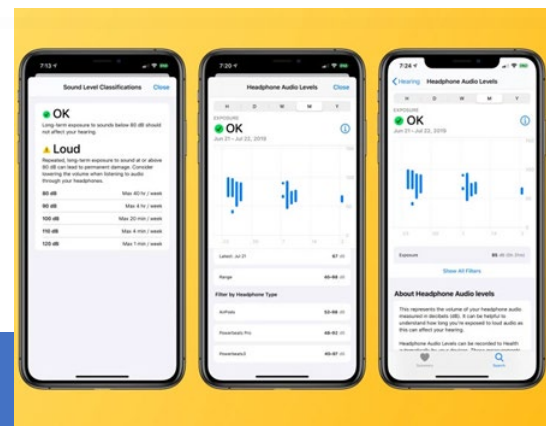
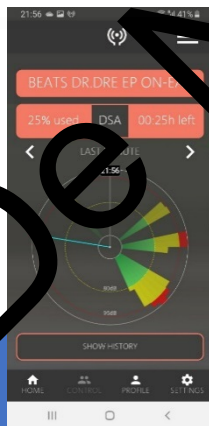
Universele dosimetrie  
app: met individuele  
calibratie

Knelpunt: IOS  
versie IND  
applicatie:

- Commerciële app circuit:
- Ugent/ KU Leuven softwareontwikkelaars:
- Weinig tot geen toepassingen gebruiken de audio eindtrap
- Ongoing: IOS app die FFT leest, onduidelijk op welk niveau het totaal niveau kan gelezen worden

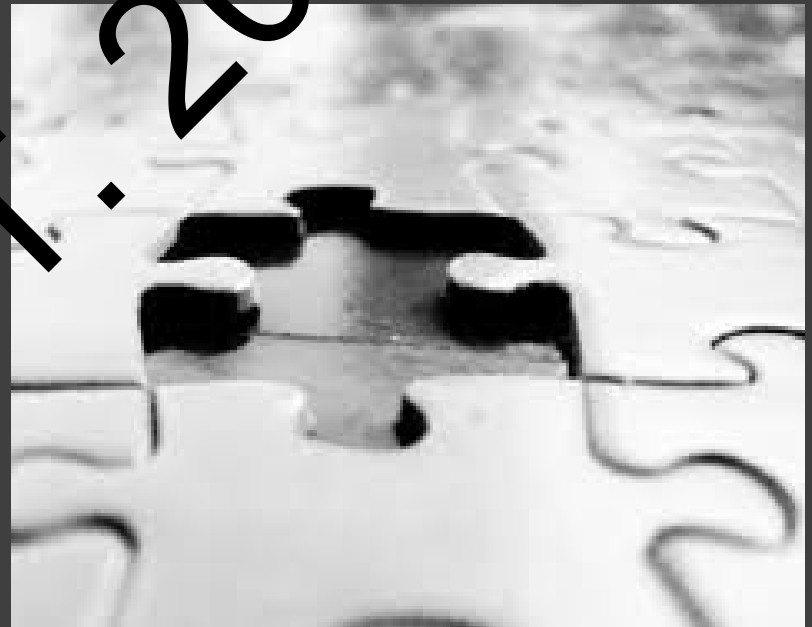
# IDF: dosimetrie applicaties

App	IOS	Android	Compatible headphones	Freq. specific correction	Individual ear canal acoustics	Inter-Transducer variation
Hear Angel	NO	YES	App database headphones	?	NO	NO
Headphone Audio Level (ios13)	YES	NO	Made for iPhone	?	NO	NO
Db Track	YES	YES	1. Weststone	?	YES	YES
IND	To be developed	YES	ALL	YES	YES	YES



# Marktnood

- Android en IOS dosimetrie applicatie compatibel met alle
  - spelers
  - koptelefoons
- Oplossing voor
  - Intertransducer variatie
  - Intersubject variatie
  - HATS – real ear variatie



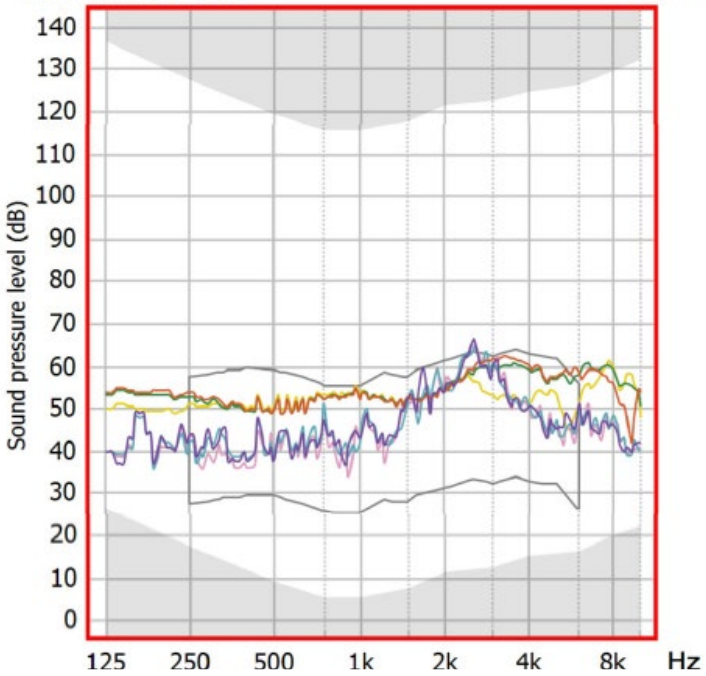


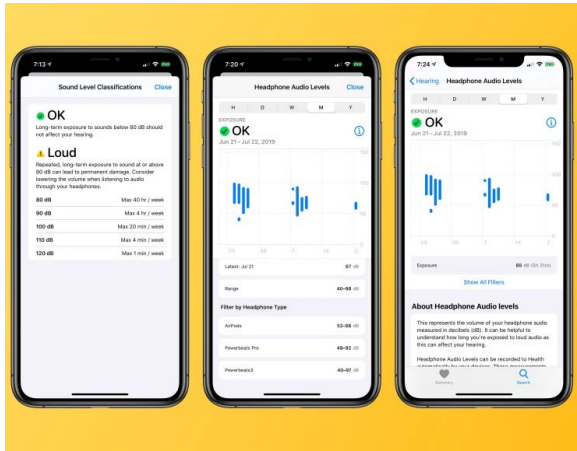
Images

Measuring real ear  
output of headphones  
at the eardrum

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dB SPL Response Right





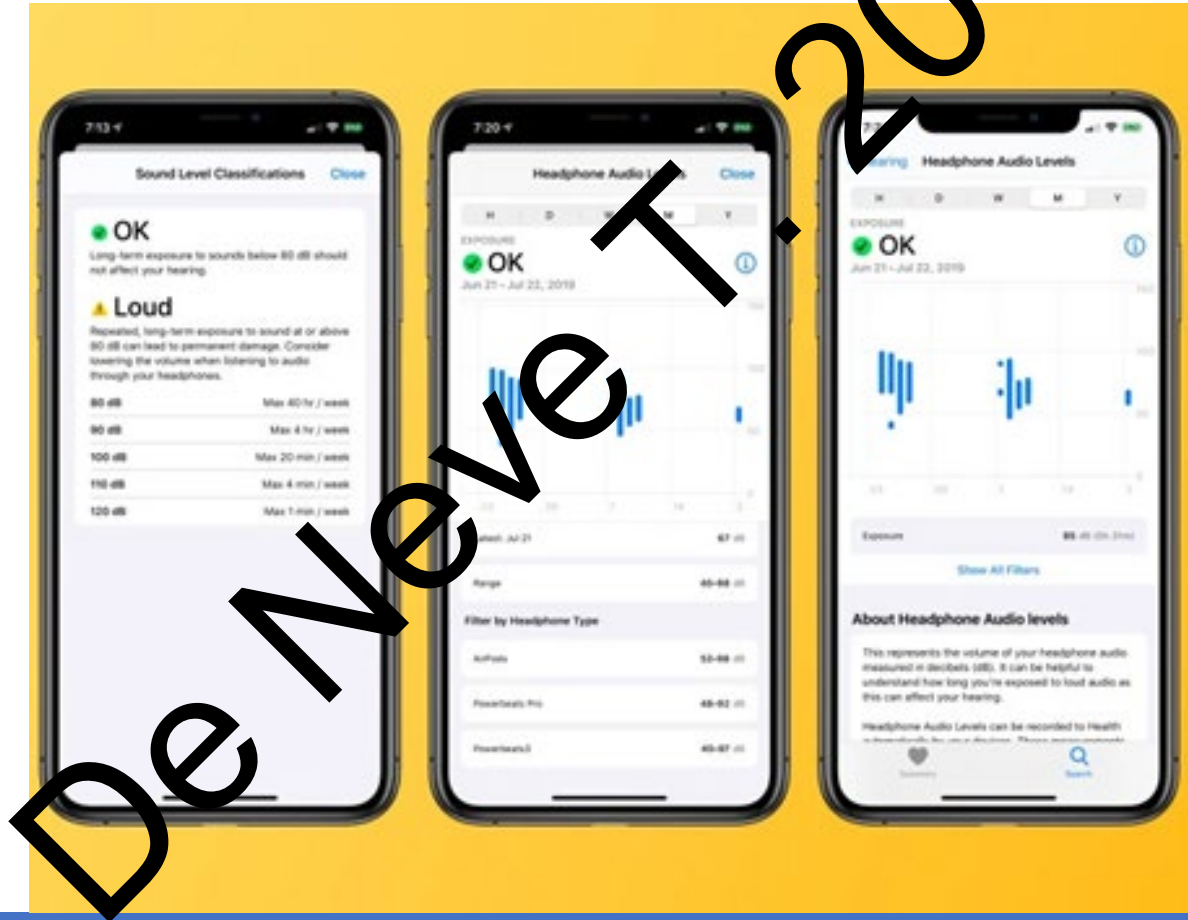
Apple takes care of your ears:  
'Headphone Audio Level' in the  
latest IOS (13)

- [How to protect your hearing with iOS 13](#)
- [The Apple Health App's Volume Tracker](#)

Apple iOS 13

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# Apple iOS 13



Apple says: 'These measurements are most accurate when using Apple or Beats headphones. Audio played through other headphones or speakers connected via a wire can be estimated based on the volume of your device.'

What about all other headphone combinations ?

How accurate is that 'estimation' ?

What about inter/intra transducer variation ?

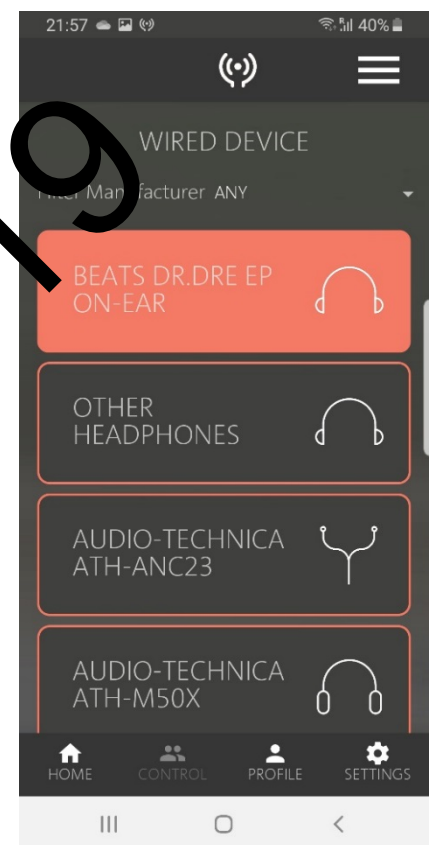
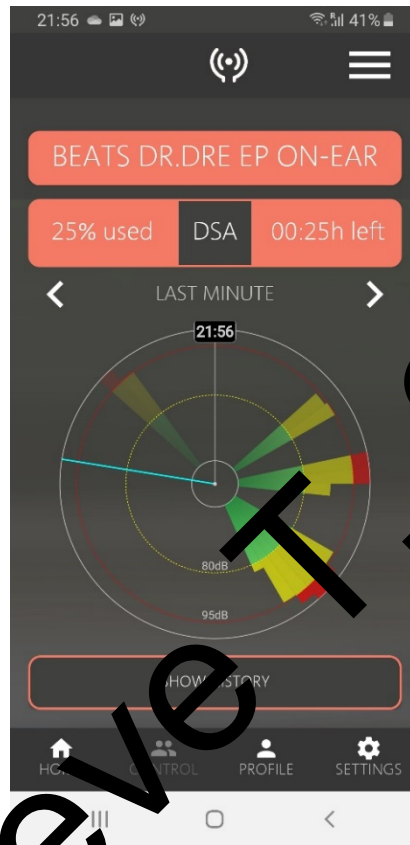
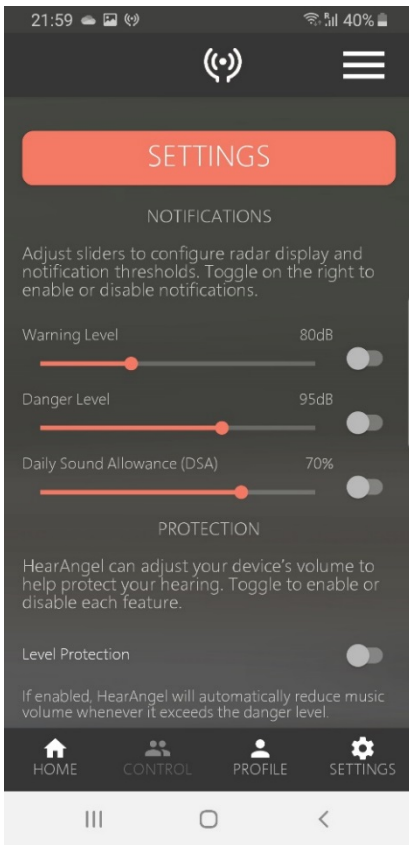
What about intersubject variation ?

Which reference does Apple use to make statements about the output ? HATS ?

Concerns about 'Headphone Audio Level'

Tom De Neve

26/04/2021



# 'HearAngel' android app

What about inter/intra transducer variation ?

What about intersubject variation ?

Which reference does Hear Angel use to make statements about the output ? HATS ?

Concerns about 'Hear Angel' app

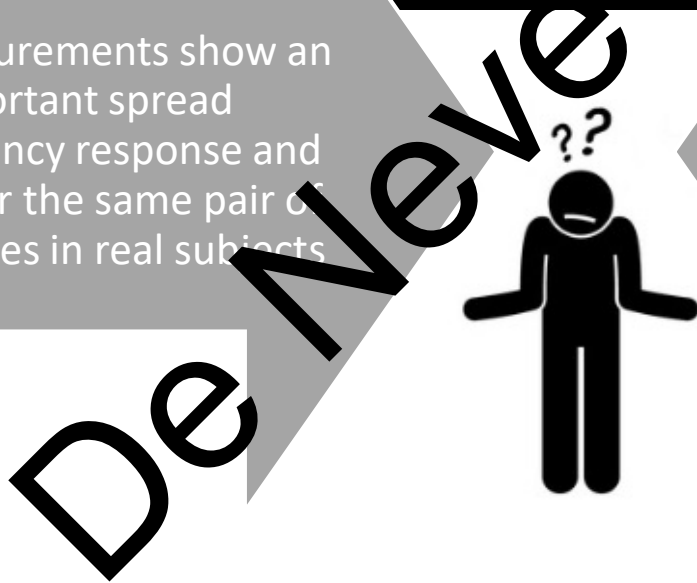
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# Conclusions from our measurements

Our measurements show an important spread in frequency response and output for the same pair of headphones in real subjects

Dosimetry based on player-headphone characteristics measured on HATS ?







inter subject variation for  
headphones (measured at the  
eardrum)

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Chapter 2