



Medial olivocochlear reflex effects on amplitude modulation detection

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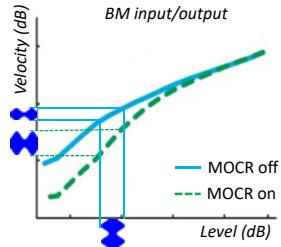
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Motivation and aims

Medial olivocochlear (MOC) efferents hyperpolarize outer hair cells [1] and linearize basilar membrane (BM) input/output functions [2]. Efferents can be activated reflexively by ipsilateral and contralateral sounds. Broadband noise (BBN) is a more effective MOCR elicitor than narrowband noise (NBN) [3].



The linearization of BM input/output curves produced by the MOCR may facilitate the representation of envelope fluctuations in the BM response. This possibility has been explored by measuring the effect of ipsilateral precursors (MOCR elicitors) on amplitude modulation (AM) detection [4]. The aims here were (1) to compare the effect of the ipsilateral, contralateral and bilateral MOCR on AM detection, and (2) to measure the effect of MOCR elicitor bandwidth on AM detection.

Assumptions

- The MOCR onset time is 280 ms [5]. Hence, a 50-ms probe is unable to activate the MOCR by itself.
- A 60 dB SPL BBN is capable of activating the MOCR without activating the middle ear muscle reflex [6].
- The effects of BBN MOCR elicitors are greater for a 1 kHz probe than for 0.5 or 4 kHz probes [3].

Methods

Aim 1

Participants

- N=7 (age M±SD = 35.1±12.5 yr.).
- Audiometric thresholds ≤ 20 dB HL.
- Tested in their left ear.

Stimuli

MOCR elicitor

- BBN (0.1-10 kHz).
- 60 dB SPL.
- Ipsi, contra, and bilateral.

Exp. 1. Absolute thresholds

- Pure tone probe (1.5 kHz).
- 50 ms (4-ms ramps).

Exp. 2. AM detection thresholds

Carrier

- 1.5-kHz sinusoid.
- 50 ms (4-ms ramps).
- 70 dB SPL and 25 dB SL.

Modulator

- 40-Hz sinusoid.
- Phase = $-\pi/2$.

Aim 2

Participants

- N=12 (age M±SD = 32.6±12.0 yr.).
- Self-reported normal hearing.
- Tested in their left ear.

Stimuli

MOCR elicitor

- BBN and NBN (0.1-1 kHz).
- 60 dB SPL.
- Contralateral.

AM detection thresholds

Carrier

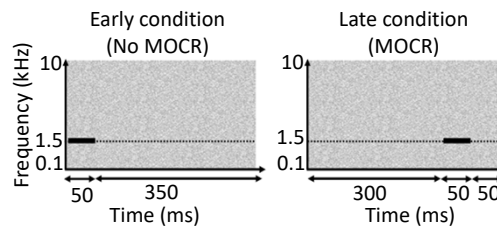
- 1.5-kHz sinusoid.
- 50 ms (4-ms ramps).
- 70 dB SPL.

Modulator

- 40-Hz sinusoid.
- Phase = $-\pi/2$.

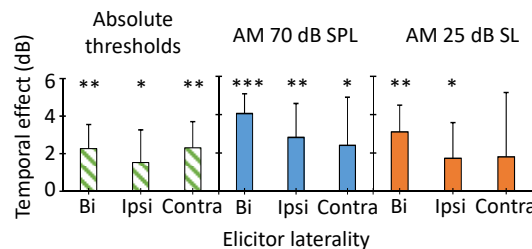
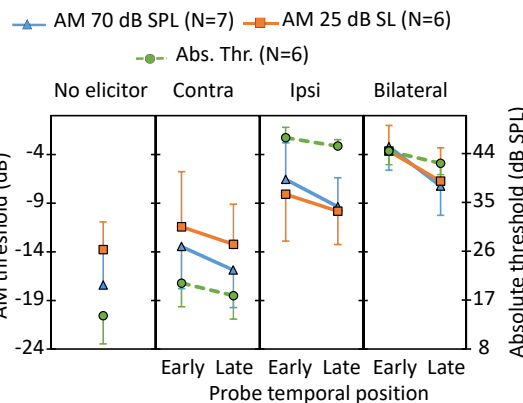
AM thresholds were expressed in dB = $20\log_{10}(m)$, with m = modulation depth.

Procedure



- 3AFC, 2-down, 1-up. 71% correct [7].
- Feedback provided.
- Tracked variables: AM depth (m) or probe level.

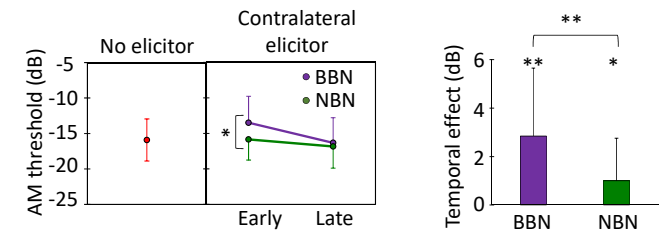
Results. Aim 1



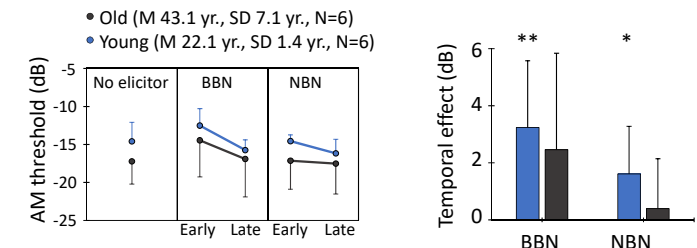
- There is a temporal effect on AM detection thresholds.
- The effect is not due to probe detectability issues (it occurred for equal-SPL and equal-SL probes).
- The effect is slightly larger for bilateral than for ipsilateral or contralateral MOCR elicitors, consistent with MOCR effects on SFOAEs [3] → supports MOCR origin.
- But AM thresholds in the early condition were affected by elicitor type despite no change in detectability → supports central masking/effects (?)

Results. Aim 2

- The temporal effect on AM thresholds was greater for the BBN than for the NBN MOCR elicitor, in agreement with MOCR effects on SFOAEs [3] → supports MOCR origin.
- But the BBN elicitor raised AM thresholds in the early condition → supports central effects/masking (?)



- Incidentally, older listeners had better AM thresholds than younger listeners but a lesser temporal effect (albeit differences were not significant) → consistent with elderly listeners having more linear BM responses and/or less effective MOCR.



Conclusions

- AM thresholds were better in the late than in the early condition, hence there is a temporal effect on AM sensitivity.
- The effect occurred for contralateral, ipsilateral and bilateral maskers.
- The BBN MOCR elicitor produced a larger temporal effect on AM thresholds than the NBN elicitor.
- The effect is not due to a temporal effect on probe detectability: the effect is probably due to MOCR enhancing the cochlear representation of AM.
- Nonetheless, data suggested some central effects on AM detection.

Acknowledgements

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References

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