The right ear advantage (REA) in dichotic listening (DL) depends on the absence of the sound-locali-zation feature of the "common first-wave-front (cFW)"

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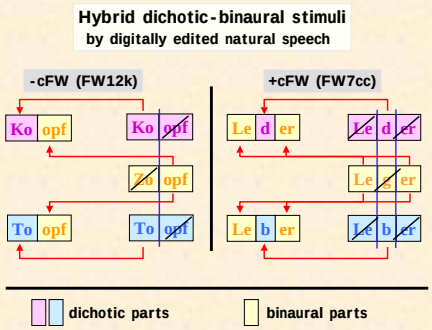
Hybrid dichotic-binaural stimuli

Dichotic fused words tests consist of rhyming word pairs, which are simultaneously presented to the right an the left ear. Although two words are presented, the subjects can made to believe, that they have heard only one. In most of the cases they report the word from the right ear. i. e. they show the typical right ear advantage (REA), if their left hemisphere is dominant for language functions.

In the construction of the stimuli for dichotic tests, the original aim was to make the two rhyming words as similar as possible. The single words were created from digitally edited natural speech, by composing a new word from elements of other different, but rhyming words.

As a consequence of this procedure, the resulting word pairs are not completely dichotic nor are they completely binaural: they are hybrid. Because of their binaural parts, hybrid stimuli can be lateralized in space, despite their dichotic parts. If there is a typical inter aural time difference (ITD) between the two stimuli, the subjects can lateralize those stimuli - more or less correct - as if they would come from the left or the right side of their head. But at the same time, the subjects can be asked, which word they have heard, because the stimuli are dichotic too. This offers the opportunity to study the interaction between the spatial interpretation of the stimuli and the generation of the REA.



The correct spatial interpretation of the stimuli (side correct) and the generation of a REA should be mutually exclusive. REA should appear more often in trials, when the response for the side is false.

Introduction: In binaural hearing, acoustic objects are localized in surrounding space by comparing the ipsilateral with the contralateral auditive impression. The usual dichotic stimuli (DS) are missing the main cue for sound localization, namely the feature of the cFW. The structural hypothesis of DL explains REA by the suppression of the anatomically weaker ipsilateral auditory pathways. Only the two remaining contralateral pathways are competing, and the winning pathway comes from the ear contralateral to the speech dominant hemisphere.

Purpose: We analyzed by two experiments the effects on the REA, if localization information is introduced into DS.

Exp.1: We compared the REA of DS with and without a cFW (cFW stimuli: +cFWs vs. -cFWs). Exp.2: Secondly we introduced a interaural time difference (ITD) into the two types of stimuli, to support their spatial localizability. By this means we expected to enforce in DS the ipsilateral pathway processing and induce a reduction of the REA.

Methods: All subjects were healthy, right-handed, had normal hearing and had a REA in the DL test FW12k. All stimuli consisted of digitally edited natural German speech from the same speaker.

Exp.1: +cFWs and -cFWs were presented to N=31 subjects. The -cFWs differed in their initial consonant (Topf-Kopf, FW12k), the +cFWs differed in their central consonant (Leber-Leder, FW7cc).

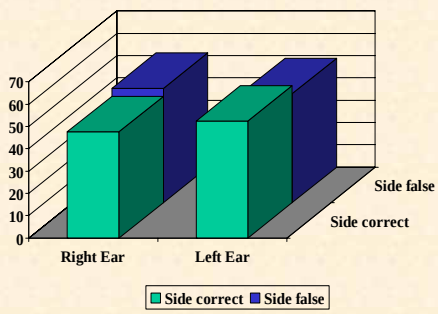
Exp.2: Both types of stimuli were presented with ITD=408µs (~25°) to either side and with ITD=0µs (0°) to N=25 subjects. Subjects were asked to report the word they have perceived and the side in space from which it seemed to come.

Results:

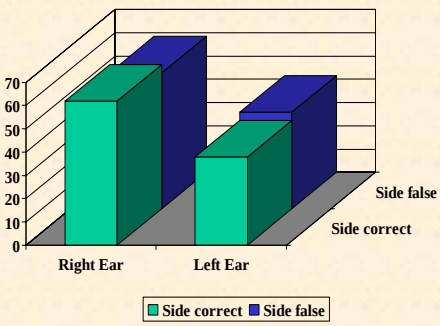
Exp.1: The laterality index lambda (λ=ln(ROP/LOP)) was significantly higher in -cFWs (M(+cFWs)=0,146, M(-cFWs)=1,193, t=3,2978, FG=30, p=0,0025).

Exp.2: +cFWs can be localized significantly better than - cFWs. Compared to the FW12k-λ, REA dropped significantly in the condition with ITD=0µs in both stimulus types. When ITD was present in the stimuli, REA dropped further in the +cFWs and was re-increased in the -cFWs.

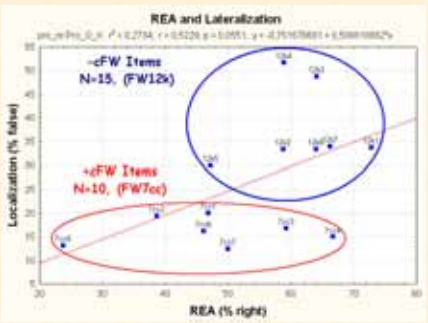
+FW (FW7cc), 1120 trials, N=10



-FW (FW12k), 1680 trials, N=15



Item Analysis, Exp.1



Conclusion

Conclusion: For DS, being dichotic is not sufficient to create a REA. Dichotic word pairs consisting of words with a common first-wave-front (+cFWs) can be localized perfectly in space but do create a lesser REA. The localizability of DS and their ability to produce a REA tend to be mutually exclusive. Although +cFW stimuli are dichotic, they are presumably processed without ipsilateral pathway suppression. At this point the structural theory needs specification. (for further details www.ohr- punkt.de)

References

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