

**SYSTEMATIC INVESTIGATION OF FACTORS CONTRIBUTING
TO MUSIC PERCEPTION BY COCHLEAR IMPLANT USERS**

by

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SUMMARY

Systematic investigation of factors contributing to music perception by cochlear implant users

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SUMMARY

Cochlear implant (CI) devices afford many profoundly deaf individuals worldwide partially restored hearing ability. Although CI users achieve remarkable speech perception with contemporary multichannel CI devices, their music perception ability is generally unsatisfactory. Improved CI-mediated music perception ability requires that the underlying constraints hindering processing of music-relevant information need to be identified and understood. This study puts forward a systematic approach, informed by the neurocognitive mechanisms underlying music perception in normal hearing (NH), for investigating implant-mediated music perception. Psychoacoustical experiments were used to explore the extent to which music-relevant information delivered to the central auditory system following peripheral electrical stimulation supports music perception. Task-specific stimuli and test procedures were developed to assess perception of pitch, rhythm and loudness information, both as separate and in combined form, in sound-field listening conditions. CI users' unsuccessful judgement of the musical character of short, novel single-voice melodies suggests that insufficient information reaches the central auditory processing system to effect a unified musical percept. This is despite sound field frequency discrimination behaviour being better than had been expected and rhythm perception ability with regard to short tone sequences of varying pitch and rhythmic complexity being comparable to that of NH listeners. CI listeners also performed similarly to NH listeners during pitch-dependent loudness perception tasks. Within the framework of a hierarchical, modular processing system underlying music perception, it appears that early pitch

processing deficits propagate throughout the music processing system to exert an overriding inhibitory perceptual effect. The outcomes of this study not only underline the importance of delivering sufficient pitch information to the electrically stimulated auditory system but also show that music perception in CI-mediated hearing should be investigated and understood as the outcome of an integrated perceptual system.

KEYWORDS

music perception; cochlear implants; psychoacoustic; sound field; neurocognition; frequency discrimination; pitch perception; rhythm perception; melody perception; loudness balancing

OPSOMMING

Sistematiese ondersoek na faktore wat bydra tot die musiekpersepsievermoë van kogleêre inplantingsgebruikers

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OPSOMMING

Kogleêre inplantings (KI's) maak dit vir talle erg-hardhorende mense wêreldwyd moontlik om gehoor in 'n sekere mate te herwin. Alhoewel KI-gebruikers merkwaardige spraakherkenningsvermoë met behulp van hedendaagse multikanaal-KI-toestelle toon, is musiekpersepsie egter in 'n groot mate onbevredigend. Deur die onderliggende beperkings wat prosessering van musiek-relevante inligting belemmer, te identifiseer en te verstaan, kan KI-bemiddelde musiekpersepsie moontlik verbeter word. Hierdie studie stel 'n sistematiese benadering, gebaseer op die neurokognitiewe meganismes wat musiekpersepsie in normale gehoor onderlê, daar om inplanting-bemiddelde musiekpersepsie te ondersoek. Met behulp van psigoakoestiese eksperimente kon ondersoek word in watter mate ouditiewe inligting wat ná perifere elektriese stimulasie die sentrale gehoorstelsel bereik, musiekpersepsie ondersteun. Doelgemaakte stimuli en toetsprosedures is ontwikkel om toonhoogte-, ritme en luidheidswaarneming in vryeveld luisteromstandighede te ondersoek, met inligting óf apart óf gekombineerd aangebied. KI-gebruikers se onvermoë om die musikale karakter van kort, onbekende eenstemmige melodieë te peil, dui daarop dat onvoldoende inligting die sentrale gehoorstelsel bereik om 'n persepsuele musikale eenheid te vorm. Dit is ten spyte daarvan dat vryeveld-frekwensiediskriminasievermoë beter blyk te gewees het as verwag, en ritmepersepsie met

betrekking tot kort toonreekse van wisselende toonhoogte- en ritmiese kompleksiteit wat vergelykbaar was met dié van normaalhorende luisteraars. KI-gebruikers het ook soortgelyke vermoë as normaalhorende luisteraars getoon tydens toonhoogte-afhanklike luidheidswaarnemings. Met inagneming van 'n hiërargiese, modulêr-gerangskikte prosesseringstelsel wat musiekpersepsie onderlê, blyk dit dat beperkte toonhoogtewaarnemingsvermoë wat vroeg in die prosesseringpad ontstaan, 'n oorheersende iniberende persepsuele invloed regdeur die musiekprosesseringpad uitoefen. Die bevindings in hierdie studie beklemtoon nie net die belangrikheid daarvan dat voldoende toonhoogte-inligting oorgedra moet word vir suksesvolle musiekwaarneming nie, maar ook dat KI-bemiddelde musiekpersepsie as die resultaat van 'n geïntegreerde persepsuele stelsel ondersoek en verstaan behoort te word.

SLEUTELWOORDE

musiekpersepsie; kogleêre inplantings, psigoakoesties; vrye veld; neurokognisie; frekwensiediskriminasie; toonhoogtepersepsie; ritmepersepsie; melodiepersepsie; luidheidsbalansering

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