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- 主題文章：Introduction of cross-modal plasticity in hearing-impaired: Summary of presentation by Anu Sharma
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主題文章

Introduction of cross-modal plasticity in hearing-impaired:

Summary of presentation by Anu Sharma

Anu Sharma

The neural behavioral in cortices will be altered when one sensory modality is degraded. Evidences showed when deprivation in hearing input, the activation of the auditory cortex are recruited in response to visual or vibrotactile stimulus by cross-modal re-organization. Some key points of cross-modal plasticity in hearing-impaired summarized from my presentation in IALP conference on Aug. 2019. By the newsletter of Speech-Language-Hearing association shared with the audiologists in Taiwan.

- **What is the phenomenon of cross-modal plasticity?**

The cross-modal plasticity is one form of cortical neuroplasticity. When deprivation insults in one sensory modality, the alteration of connectivity between sensory cortices made the cortical resources of the deprived modality recruited by intact sensory modalities. For example, once the decreased auditory input from deaf or hearing loss, the auditory cortex becomes vulnerable and partial function of auditory cortex is recruited by the remaining intact sensory modality, like visual and somatosensory modality. Then, the auditory cortex becomes repurpose. The phenomenon occurs across lifespan.

- **When will cross-modal plasticity begin after the onset of hearing loss?**

It is hardly to say the exact time of the change take place. According to one case experience, the time frame of deprivation-induced visual across-modal plasticity would be referenced. A 62 year-old male sustained a sudden mild sloping-to-severe bilateral sensorineural hearing loss, cross-modal plasticity by vision was recruited in response a visual-motion stimulus. Very little recruitment of auditory cortex after hearing loss onset, but multiple activation cortical regions in visual, temporal auditory and frontal areas in response to the same stimulus in 3 months after initial onset of the hearing loss. Then, one year after sudden onset of the hearing loss, the recruitment of visual, temporal and frontal cortices continued. The cross-modal plasticity might occur prior to 3-month time point after the onset of hearing loss.

- **What factors will lead to the cross-modal plasticity?**

The age of hearing loss, the age of intervention, or the durations of deafness could have impact on the cross-modal re-organization. For pre-lingual deafness children with early-implanted CI (approximately age was 3 years), an additional activation of right temporal cortex for processing a visual motion stimuli compared to the activation of cortical regions in normal hearing children. For pre-lingual deafness children with late-implanted CI (approximately age was 11 years), a significant activation post-central gyrus in somatosensory cortex in response to a speech stimulus. In addition, temporal cortex may be recruited for

somatosensory processing for children with CIs in response to vibrotactile stimulus. For adults with early-stage, mild-moderate hearing loss showed additional recruitment of frontal cortical networks in response to auditory stimulus. These evidences showed cross-modal re-organization by visual, somatosensory or frontal cortices for the deaf or hearing loss in response to sensory inputs in a multimodal way

- **Can the phenomenon of cross-modal plasticity reverse after auditory intervention?**

It might be possible. The evidence showed the changes of cross-modal plasticity from a progressive single-side deafness pediatric case. We recorded his cortical auditory, visual and somatosensory evoked potentials pre-CI and post-CI. The SSD child demonstrated a cortical cross-modal plasticity in response to visual motion and vibrotactile stimulus in pre-CI ear. These evoked potentials evidences showed more typical cortical auditory activation restored in the SSD ear after 14 months post-CI. We can also see a reversal of cross-modality plasticity after hearing aid use in adults. It means the auditory intervention changed the cortical networks by including a complete reversal of recruitment of auditory cortex, partial reversal for visual modality or reduced frontal activation.

- **How to implement cross-modal plasticity?**

Cross-modal plasticity occurs as a result of auditory deprivation. Evidences showed pediatric CI with good speech perception demonstrated activation of visual areas for visual motion processing, suggesting minimal or no recruitment of auditory cortex. In contrast, the average CI performer showed additional activation of associated with auditory processing in response to the visual motion stimulus, suggesting of cross-modal recruitment by vision. Cortical cross-modal re-organization could help to manage and predict the outcomes of individualized rehabilitation and training programs for deaf children. In the future, focusing on the markers of changes in cortical resource allocation helps us understanding the time points of cross-modal plasticity in hearing impaired populations. And individualized cortical organization profile helps draft audiological rehabilitation strategy and programs, make outcomes of auditory intervention for patients with hearing loss optimized.

Since our lab is working develop clinical tools for assessing neuroplasticity including cross-modal plasticity in clinical patients. Given that Taiwan is one of the leading countries using electrophysiology clinically for patients with hearing loss, the potential for both scientific and clinical developments in this area in Taiwan could be the future prospects.

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