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Interactions audiovisuelles dans le cortex auditif chez l'homme

Approches électrophysiologique et comportementale

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Résumé Dans le modèle classique d'organisation des systèmes sensoriels, les informations de différentes modalités sont censées converger à des étapes relativement tardives de traitement (après leur analyse dans les cortex sensoriels spécifiques), dans un nombre limité d'aires corticales, dites polysensorielles associatives. Or, dès les débuts de l'étude du système nerveux central, d'autres modes d'interactions intersensorielles ont été mis en évidence, telles que la convergence sous-corticale, ou l'influence d'informations d'une modalité sur l'activité d'un cortex spécifique d'une autre modalité sensorielle. Par ailleurs, de nombreuses études en psychologie expérimentale ont montré l'influence que pouvaient avoir les informations d'une modalité sur la perception sensorielle dans une autre modalité. Grâce à l'utilisation de techniques de neuroimagerie non invasives et à l'intégration de mesures comportementales et neurophysiologiques, des interactions intersensorielles "précoces" ont pu être mises en évidence plus récemment chez l'homme.

Les travaux de cette thèse ont concerné l'influence que peuvent avoir des informations visuelles dans deux phénomènes perceptifs mettant principalement en jeu le cortex auditif : la perception de la parole et la représentation en mémoire sensorielle auditive.

Concernant la perception de la parole, nous avons montré, dans une première étude en potentiels évoqués de surface chez le sujet sain, d'une part, que le temps de réponse pour réaliser une tâche de discrimination phonologique de syllabes est plus rapide lorsque ces syllabes sont accompagnées des mouvements articulatoires des lèvres qui les produisent et, d'autre part, que cette facilitation comportementale est associée à une diminution de l'activité auditive entre 120 et 200 ms après la présentation du son. Afin de mieux caractériser ces interactions audiovisuelles précoces, nous avons mené le même protocole expérimental sur un groupe de patients épileptiques porteurs d'électrodes implantées dans le cortex temporal. Les résultats de cette deuxième étude ont montré que la vision des mouvements articulatoires pouvait à elle seule activer le cortex auditif (principalement les cortex secondaires). Cette activation visuelle du cortex auditif pouvait entrainer une diminution de l'activité de traitement de la syllabe auditive entre 50 et 200ms, dont une partie seulement était visible sur le scalp dans la première étude. Les résultats de ces deux études peuvent s'expliquer soit par un effet d'indiçage temporel intersensoriel, dû au fait que les indices visuels précédaient toujours les indices auditifs dans les syllabes utilisées, soit par une véritable intégration des information phonétiques auditives et visuelles. Dans une troisième étude comportementale, nous avons montré que l'effet d'indiçage temporel intersensoriel suffisait à expliquer une diminution du temps de traitement des syllabes, mais uniquement dans des conditions d'écoute bruitées, ce qui suggère que cet effet n'est pas à l'origine de celui observé dans les deux premières études.

Pour étudier les représentations en mémoire sensorielle, nous avons utilisé la *Mismatch Negativity* (MMN, Négativité de discordance), une onde des potentiels évoqués générée par la détection automatique et pré-attentionnelle de la violation d'une régularité sensorielle. La MMN est générée dans les cortex sensoriels spécifiques (auditif ou visuel), et serait due à un processus de discordance neuronale entre la représentation de la régularité en mémoire sensorielle et l'entrée d'un stimulus déviant violant cette régularité. Dans une première étude comportementale, nous avons montré que la détection d'un événement déviant dans une suite d'événements audiovisuels standards était plus rapide lorsque cette déviance portait à la fois sur les traits auditifs et visuels plutôt que sur un seul des traits auditif ou visuel. Dans une deuxième étude, en potentiels évoqués de surface chez le sujet sain, nous avons montré que les interactions audiovisuelles vraisemblablement à l'origine de cette facilitation comportementale opéraient sur les processus liés aux MMN visuelle et auditive. Par ailleurs, la MMN visuelle générée par la déviance visuelle d'une régularité audiovisuelle différait de la MMN générée par la même déviance dans un contexte purement visuel. Dans une troisième étude, nous avons montré, réciproquement, que la déviance auditive d'une régularité audiovisuelle générait une MMN auditive différente de celle générée par la même déviance dans un contexte purement auditif. Ces deux derniers résultats indiquent que les représentations d'une régularité audiovisuelle dans les mémoires sensorielles auditive et visuelle incluent respectivement des informations visuelles et auditives. En revanche nous avons échoué à montrer, dans une dernière étude en magnétoencéphalographie, que la violation de la conjonction régulière de deux traits auditif et visuel suffisait à générer une MMN.

L'ensemble des ces résultats montrent que les traitements auditifs et visuels dans les cortex sensoriels spécifiques peuvent interagir à des étapes relativement précoces d'analyse. Les voies anatomiques pouvant expliquer ces effets précoces sont discutées.