

Motor system involvement during listening without bodily movement

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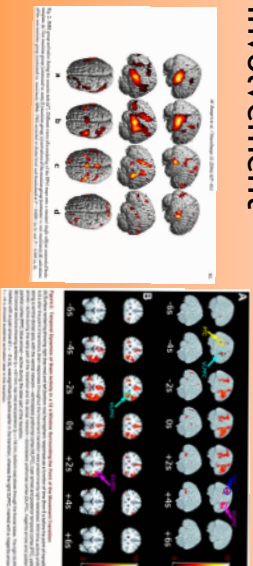
Listening sensorimotor hypothesis

The classical and most widely accepted model on how sound (speech and music) is perceived, posits that its production and perception happens on separate processes. The motor system has not a functional role to play in passive or active perception of the sound. Recent research in cognitive neuroscience has revealed causal involvement of motor areas in immobile agents (passive listening tasks) engaged in auditory tasks. But so far the role of this activation still remains unclear. However, sensorimotor activation model of perception predicts involvement of motor activity, but has been challenged by the fact that listening apparently does not involve movement. The aim of this research is to bear on the current issues in auditory neuroscience, using sensorimotor enactivist perspective to try to explain the findings of motor activation and sensorimotor coupling during “passive” listening.

Theories of auditory and speech perception

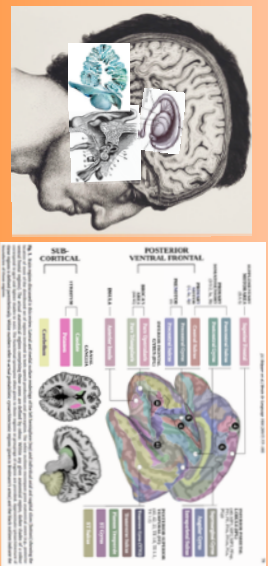
Theories of auditory and speech perception	Major claims	Authors	Predictions	Empirical evidence for passive listening
Bottom-up (classical)	Speech production and perception are separate processes. The motor system has no functional role to play in passive or active perception of the sound. Recent research in cognitive neuroscience has revealed causal involvement of motor areas in immobile agents (passive listening tasks) engaged in auditory tasks. But so far the role of this activation still remains unclear. However, sensorimotor activation model of perception predicts involvement of motor activity, but has been challenged by the fact that listening apparently does not involve movement. The aim of this research is to bear on the current issues in auditory neuroscience, using sensorimotor enactivist perspective to try to explain the findings of motor activation and sensorimotor coupling during “passive” listening.	Miller & Liberman (1969), Liberman & Miller (1967), Liberman (1978), Liberman & Delattre (1966), Liberman & Delattre (1968), Liberman & Delattre (1970), Liberman & Delattre (1972), Liberman & Delattre (1974), Liberman & Delattre (1976), Liberman & Delattre (1978), Liberman & Delattre (1980), Liberman & Delattre (1982), Liberman & Delattre (1984), Liberman & Delattre (1986), Liberman & Delattre (1988), Liberman & Delattre (1990), Liberman & Delattre (1992), Liberman & Delattre (1994), Liberman & Delattre (1996), Liberman & Delattre (1998), Liberman & Delattre (2000), Liberman & Delattre (2002), Liberman & Delattre (2004), Liberman & Delattre (2006), Liberman & Delattre (2008), Liberman & Delattre (2010), Liberman & Delattre (2012), Liberman & Delattre (2014), Liberman & Delattre (2016), Liberman & Delattre (2018), Liberman & Delattre (2020), Liberman & Delattre (2022), Liberman & Delattre (2024)	Speech production and perception are separate processes. The motor system has no functional role to play in passive or active perception of the sound. Recent research in cognitive neuroscience has revealed causal involvement of motor areas in immobile agents (passive listening tasks) engaged in auditory tasks. But so far the role of this activation still remains unclear. However, sensorimotor activation model of perception predicts involvement of motor activity, but has been challenged by the fact that listening apparently does not involve movement. The aim of this research is to bear on the current issues in auditory neuroscience, using sensorimotor enactivist perspective to try to explain the findings of motor activation and sensorimotor coupling during “passive” listening.	Miller & Liberman (1969), Liberman & Miller (1967), Liberman (1978), Liberman & Delattre (1966), Liberman & Delattre (1968), Liberman & Delattre (1970), Liberman & Delattre (1972), Liberman & Delattre (1974), Liberman & Delattre (1976), Liberman & Delattre (1978), Liberman & Delattre (1980), Liberman & Delattre (1982), Liberman & Delattre (1984), Liberman & Delattre (1986), Liberman & Delattre (1988), Liberman & Delattre (1990), Liberman & Delattre (1992), Liberman & Delattre (1994), Liberman & Delattre (1996), Liberman & Delattre (1998), Liberman & Delattre (2000), Liberman & Delattre (2002), Liberman & Delattre (2004), Liberman & Delattre (2006), Liberman & Delattre (2008), Liberman & Delattre (2010), Liberman & Delattre (2012), Liberman & Delattre (2014), Liberman & Delattre (2016), Liberman & Delattre (2018), Liberman & Delattre (2020), Liberman & Delattre (2022), Liberman & Delattre (2024)
Motor resonance theory	Activation of the motor system during speech perception is a result of the motor system's involvement in the process. This theory predicts that the motor system is activated during speech perception, leading to a more accurate understanding of the speech signal.	Liberman & Delattre (1966), Liberman & Delattre (1968), Liberman & Delattre (1970), Liberman & Delattre (1972), Liberman & Delattre (1974), Liberman & Delattre (1976), Liberman & Delattre (1978), Liberman & Delattre (1980), Liberman & Delattre (1982), Liberman & Delattre (1984), Liberman & Delattre (1986), Liberman & Delattre (1988), Liberman & Delattre (1990), Liberman & Delattre (1992), Liberman & Delattre (1994), Liberman & Delattre (1996), Liberman & Delattre (1998), Liberman & Delattre (2000), Liberman & Delattre (2002), Liberman & Delattre (2004), Liberman & Delattre (2006), Liberman & Delattre (2008), Liberman & Delattre (2010), Liberman & Delattre (2012), Liberman & Delattre (2014), Liberman & Delattre (2016), Liberman & Delattre (2018), Liberman & Delattre (2020), Liberman & Delattre (2022), Liberman & Delattre (2024)	Activation of the motor system during speech perception is a result of the motor system's involvement in the process. This theory predicts that the motor system is activated during speech perception, leading to a more accurate understanding of the speech signal.	Liberman & Delattre (1966), Liberman & Delattre (1968), Liberman & Delattre (1970), Liberman & Delattre (1972), Liberman & Delattre (1974), Liberman & Delattre (1976), Liberman & Delattre (1978), Liberman & Delattre (1980), Liberman & Delattre (1982), Liberman & Delattre (1984), Liberman & Delattre (1986), Liberman & Delattre (1988), Liberman & Delattre (1990), Liberman & Delattre (1992), Liberman & Delattre (1994), Liberman & Delattre (1996), Liberman & Delattre (1998), Liberman & Delattre (2000), Liberman & Delattre (2002), Liberman & Delattre (2004), Liberman & Delattre (2006), Liberman & Delattre (2008), Liberman & Delattre (2010), Liberman & Delattre (2012), Liberman & Delattre (2014), Liberman & Delattre (2016), Liberman & Delattre (2018), Liberman & Delattre (2020), Liberman & Delattre (2022), Liberman & Delattre (2024)
Motor theory of speech perception	Speech perception is based on the motor system's involvement in the process. This theory predicts that the motor system is activated during speech perception, leading to a more accurate understanding of the speech signal.	Liberman & Delattre (1966), Liberman & Delattre (1968), Liberman & Delattre (1970), Liberman & Delattre (1972), Liberman & Delattre (1974), Liberman & Delattre (1976), Liberman & Delattre (1978), Liberman & Delattre (1980), Liberman & Delattre (1982), Liberman & Delattre (1984), Liberman & Delattre (1986), Liberman & Delattre (1988), Liberman & Delattre (1990), Liberman & Delattre (1992), Liberman & Delattre (1994), Liberman & Delattre (1996), Liberman & Delattre (1998), Liberman & Delattre (2000), Liberman & Delattre (2002), Liberman & Delattre (2004), Liberman & Delattre (2006), Liberman & Delattre (2008), Liberman & Delattre (2010), Liberman & Delattre (2012), Liberman & Delattre (2014), Liberman & Delattre (2016), Liberman & Delattre (2018), Liberman & Delattre (2020), Liberman & Delattre (2022), Liberman & Delattre (2024)	Speech perception is based on the motor system's involvement in the process. This theory predicts that the motor system is activated during speech perception, leading to a more accurate understanding of the speech signal.	Liberman & Delattre (1966), Liberman & Delattre (1968), Liberman & Delattre (1970), Liberman & Delattre (1972), Liberman & Delattre (1974), Liberman & Delattre (1976), Liberman & Delattre (1978), Liberman & Delattre (1980), Liberman & Delattre (1982), Liberman & Delattre (1984), Liberman & Delattre (1986), Liberman & Delattre (1988), Liberman & Delattre (1990), Liberman & Delattre (1992), Liberman & Delattre (1994), Liberman & Delattre (1996), Liberman & Delattre (1998), Liberman & Delattre (2000), Liberman & Delattre (2002), Liberman & Delattre (2004), Liberman & Delattre (2006), Liberman & Delattre (2008), Liberman & Delattre (2010), Liberman & Delattre (2012), Liberman & Delattre (2014), Liberman & Delattre (2016), Liberman & Delattre (2018), Liberman & Delattre (2020), Liberman & Delattre (2022), Liberman & Delattre (2024)

Evidence of motor system involvement



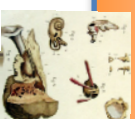
Bangert et al, 2006 Sridharan et al, 2007

Audio-motor coupling



Further research

Role of ear bones and middle ear muscles in audio-motor perception
Role of locomotor system



References

Bangert, M., Peschel, T., Schlaug, G., Rotte, M., Drescher, D., Hinrichs, H., ... & Altenmüller, E. (2006). Shared networks for auditory and motor processing in professional pianists: evidence from fMRI conjunction. *NeuroImage*, 30(3), 917-926.

Sridharan, D., & Menon, V. (2007). A sensorimotor account of working memory and executive function deficits in attention deficit-hyperactivity disorder: brain network and language. *Developmental Neuropsychology*, 32(1), 105-125.

Sridharan, D., et al. (2007). Neural dynamics of event segmentation in music: converging evidence for dissociable ventral and dorsal networks. *Neuron*, 55(1), 521-532.