Speech Delivery Style Modulates Inter-Brain Synchrony:
A Magnetoencephalography Study of Neural Alignment

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Abstract: Charismatic speech delivery enhances inter-brain synchrony in listeners, particularly in beta-band oscillations across right temporal and parietal cortices. Using MEG, we show that charismatic delivery modulates attention, cognitive engagement, and alignment within the social brain. These effects are both spatially widespread and frequency-specific.

Keywords: Charisma, MEG, Inter-brain Synchrony, Inter-subject Correlation, Beta Band

Introduction

Charisma, the capacity to inspire and influence others through compelling personal presence and expressive communication, has long intrigued psychologists and neuroscientists alike. Charismatic individuals can affect social perception and group dynamics far beyond the informational content of their speech. Such delivery has been linked to enhanced emotional engagement, memory retention, and behavioral compliance in listeners.

While behavioral research has demonstrated that delivery style can amplify message impact, its neural basis is less understood. Studies using electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) suggest that emotionally salient or persuasive messages engage the social brain network, including the medial prefrontal cortex (mPFC), anterior cingulate cortex (ACC), and insula [1], [2]. In particular, neural synchrony, the alignment of brain responses across individuals, has emerged as a potential marker of shared attention, emotional resonance, and communicative effectiveness [3].

Inter-subject correlation (ISC) analysis offers a data-driven approach to quantify shared neural processing during naturalistic stimuli. Magnetoencephalography (MEG), with its high temporal resolution, is especially suited for ISC by capturing rapid neural dynamics across frequency bands. Prior ISC studies have shown increased synchrony during attention-grabbing or emotionally charged narratives [3], [4], suggesting that delivery style could play a crucial role in driving neural alignment.

The present study aimed to examine whether charismatic delivery elicits greater ISC across listeners, particularly in brain regions associated with the observing-executing (OE) system, auditory and visual processing, and persuasion-related areas. We expected to find enhanced ISC in the beta and gamma frequency bands during charismatic delivery in cortical areas such as the superior temporal gyrus, fusiform gyrus, inferior parietal lobule, and insula.

Methods

We recruited 40 healthy, right-handed Hebrew-speaking university students (21 males, 19 females; aged 21–32). Each participant viewed two short video clips featuring the same actor delivering an identical political-style speech in either a charismatic or non-charismatic manner. Charismatic delivery included dynamic vocal modulation, expressive gestures, and emotive facial expressions. In contrast, non-charismatic delivery was monotonous and rigid, with minimal expression or gesture. A silent control video of the same actor was also presented. Order of presentation was counter-balanced between participants.

Brain activity was recorded using a 248-channel MEG system (4D-Neuroimaging) at a sampling rate of 1017Hz inside a magnetically shielded room. Data were processed using FieldTrip Toolbox and Matlab. After artifact rejection using independent component analysis (ICA), The data were bandpass filtered into five frequency bands of interest: Delta (1-4Hz), Theta (4-8Hz), Alpha (8-12Hz), Beta (12-25Hz), and Gamma (25-40Hz). Source activity in 1169 voxels in the brain was estimated with LCMV beamforming for each frequency band. We reduced the spatial distribution of brain activity into 72 cortical areas, based on the AAL atlas, calculating the average activity of each area for each frequency band. The signals were Hilbert transformed and low-pass filtered at 0.8 Hz, and down-sampled to 100 Hz. ISC was computed by correlating each subject's neural time course with the mean of all others, producing a Fisher Z-transformed ISC value for each brain area and frequency band. Behavioral measures—PANAS (affect), trust, efficacy, and perceived charisma—were collected after each video.

Results

Behavioral ratings confirmed the efficacy of the delivery manipulation: a statistically significant difference between the average scores of the charismatic delivery style ($M=4.53$, $SD=1.26$) and non-charismatic style ($M=3.42$, $SD=1.29$), $t(39)= 4.02$, $p=.001$. Analysis of MEG power in each frequency band analysis showed that the charismatic condition was associated with greater reductions in alpha and beta power ($F(2,39)=11.634$, $p<0.01$, $F(2,39)=4.464$, $p=0.01$, respectively), in posterior and parietal regions, reflecting heightened attentional processing. ISC analysis revealed higher synchrony in the charismatic condition across all frequency bands except delta ($p<0.001$ for all F's$(2,39)$). Beta-band ISC was especially prominent, with widespread synchronization in the right superior and middle temporal gyri, supramarginal gyrus, rolandic operculum, and bilateral parietal-occipital regions. Gamma-band ISC increases were found primarily in right fusiform and parietal cortices. Theta and alpha-band ISC effects were more spatially limited but significant in left parietal and right fusiform regions. Only one region (right orbitofrontal cortex, theta band) showed significantly greater ISC in the non-charismatic condition. Regression analysis found that positive affect ratings significantly predicted ISC (R^2=0.080, β=0.3236, p<0.05), particularly in the beta and gamma bands.

Discussion

Our findings demonstrate that a charismatic delivery style drives stronger neural alignment across listeners, most prominently in the beta band, which is associated with top-down attentional control and language processing. The spatial distribution of these effects overlaps with the OE system—responsible for action understanding and mirroring—and the persuasion network.

Beta ISC in right temporal and parietal areas may reflect prosodic and acoustic processing, as charismatic speech often features varied pitch, rhythm, and tone. This aligns with known right-hemispheric specialization for vocal modulation. Meanwhile, increased ISC in the fusiform gyrus suggests that charismatic speech may enhance visual-attentional synchrony through expressive facial cues and gestures. Interestingly, while frontal areas such as the medial prefrontal cortex (mPFC) showed power modulation during charismatic speech, they did not exhibit significant ISC. This may indicate that higher-order social cognition is more idiosyncratic across individuals or that its temporal dynamics are not well aligned across listeners.

These findings imply that charisma functions not merely through persuasion, but through a neural entrainment mechanism—synchronizing cognitive and affective processes across individuals. Such synchronization could facilitate collective attention, memory formation, and social bonding. The dissociation between power and ISC also emphasizes the value of analyzing both indices, as each captures distinct dimensions of neural processing.

Conclusions

This study provides compelling evidence that charismatic speech delivery enhances neural synchrony across listeners, particularly in beta-band activity within parietal and temporal cortices. These findings advance our understanding of the neural mechanisms underpinning social influence, suggesting that delivery style plays a critical role in aligning listeners' cognitive and emotional states. The frequency- and region-specific ISC effects indicate that charisma operates through dynamic neural entrainment, potentially facilitating collective attention, emotional resonance, and group cohesion. These results have practical implications for education, leadership, and media communication, where engagement and influence are paramount. Furthermore, ISC may serve as a neurobiological marker for assessing communicative effectiveness in real-world settings.

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