Connecting neural and communication processes during teamwork

Teamwork is fundamental to accomplishing a variety of human tasks and occurs in a variety of contexts such as medical, sports, and military settings, because when people work as a team, they can accomplish more than when they work alone. Interestingly, when people work together as a team, neural, perceptual, motor, and cognitive processes develop across team members that would not otherwise develop individually. Recent research aims to understand how team dynamics help shape neural and behavioral processes in individuals working on a team. Concomitant changes across neural and behavioral levels as teams interact are called “cross-level” effects.

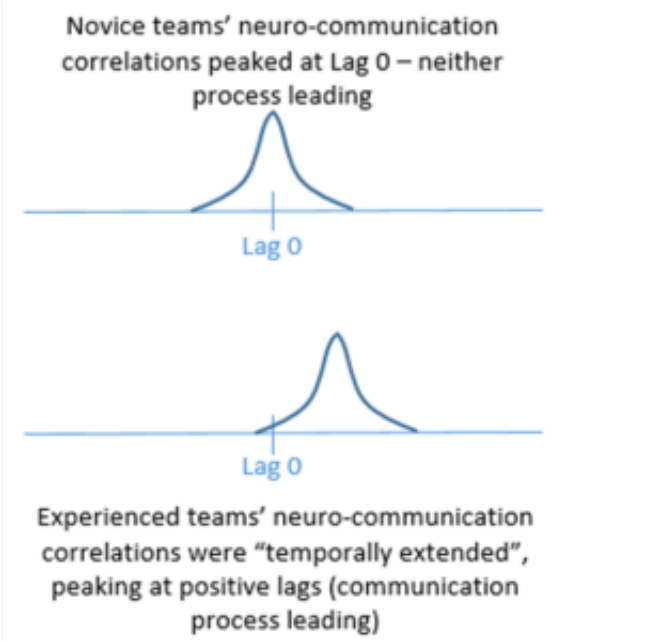

Fig. 1. A schematic depicting the temporal shift in peak neuro-communication correlation as a marker of team experience.

Over the past decade or so, research relevant to the phenomenon of cross-level effects has revealed that processing motor-based language (e.g., “Jane ran across the road”) is a lot like processing motor-based images (e.g., a movie showing Jane running across the road) because both tasks involve activation of motor processing (“motor simulation”) in the brain. Specifically, communication content modulates information processing in the brain. This mechanism is thought to underlie cross-level effects in teams; however, teams use a much wider range of speech when communicating. For example, interpretation-based communication should lead to a different neural pattern than motor-based communication, but both patterns should be neurally synchronized

across speakers. In this way, cross-level effects may present a new picture of what it means to be “on the same page” when people work as a team.

A recent study comparing cross-level effects in novice and experienced submarine navigation crews has shed light on how neural and communication processes change together as teams gain experience. Specifically, researchers determined whether cross-level effects exist between brainwaves measured through electroencephalography (EEG) and communication content using Latent Semantic Analysis in novice and experienced teams and how cross-level effects change as teams develop. Moreover, they hoped to determine whether changes in cross-level effects might be useful diagnostically as an index of team skill development. What they found is that cross-level effects exist even at the novice level but that the nature of the correlations between brainwaves and communication change as teams gain experience.

Neural processes across team members were correlated with the amount of domain-relevant content of speech (here, submarine navigation commands) during a simulated navigation scenario, such that more densely-packed (“efficient”) communication was associated with increased neural flexibility across team members. What this means is that when teams need to be more neurally flexible (e.g., to respond to unexpected challenges in their task environment) they tend to communicate in a more terse, efficient manner. However, the exact nature of this cross-level effect also depended on amount of team experience. For novice teams, the correlation existed only in the “here and now” and “in the moment”; whereas for experienced teams, the correlation extended backward in time, such that as teams gain experience, changes in communication content portend changes in neural pattern. This latter signature, which the researchers call a “temporally extended cross-level effect” may be a key indicator of team skill development.

Investigating cross-level effects could ultimately lead to new ways to assess neural and behavioral processes in individuals as they communicate with others. For example, verbal coordination of motor-based language between native and non-native language users might be detectable in their shared neural patterns rather than relying on exact syntax matches or parsing of their speech. As a means for understanding when individuals are “on the same page”, neural correlation with speech content could be used to assess coordination between speakers in new ways.

Publication

Cross-Level Effects Between Neurophysiology and Communication During Team Training.
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Hum Factors. 2015 Sep 21