Argument role alignment affects oscillatory activity during sentence planning in the brain

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Virtually all theories of grammar assume that linguistic expressions share overlapping syntactic configurations, modeled by derivation (Adger, 2003; Chomsky, 1995) or inheritance (Hilpert, 2014; Pollard & Sag, 1994) mechanisms. One of the most prominent overlaps is known as argument role alignment and manifests itself for example in the frequent alignment of intransitive S ('sole') arguments with transitive A (agentive) arguments in the form of nominative marked "subjects". It remains open, however, whether role alignments are are only computational patterns (in Marr's sense) or whether they are also relevant at the neural level of language processing (Embick & Poeppel, 2015; Marr, 1982/2010). To explore whether role alignments are neurophysiologically detectable during sentence production, we conducted a combined eye tracking and EEG picture description experiment (Griffin & Bock, 2000) in Hindi. Here, we focus on the dynamics of event-related desynchronization (ERD) in the EEG α band during the structural encoding phase of sentence planning (Ferreira, 2010). α ERD is a pattern of desynchronization of neural oscillations in the frequencies of 8 to 13 Hz and is associated with a wide range of functions, including sentence-level processing during comprehension (Kielar, Panamsky, Links, & Meltzer, 2015; Meyer, 2018) and more general memory and attentional processes (Hanslmayr, Staudigl, & Fellner, 2012; Klimesch, 2012). Hindi is especially suited to explore the effect of role alignment because this language exhibits a split-ergative case marking system (Bickel & Nichols, 2009). S and A arguments align in an unmarked nominative case in the imperfective aspect (A=S) while in the perfective, A arguments carry ergative case marking (-ne), distinct from S (A≠S). We hypothesized that α ERD during structure planning should be sensitive to this difference in alignments if these are neurally relevant. Specifically, we predicted that the planning of transitive sentences with nominative As leads to larger α ERD responses because speakers need to plan a structure that overlaps with intransitives (A=S), whereas ergative As show no such overlap. Fifty Hindi speakers described pictures of events using intransitive SV and transitive APV sentences with nominative or ergative subjects, while EEG was recorded (between subjects, N = 25 per group). Analyses of the time course of α band activity during structure planning phases (400-1000 ms after stimulus onset (Sauppe, 2017); speech onset was always > 1500 ms) revealed larger α ERD for nominative A sentences and nominative S sentences than for ergative A sentences. The effect was distributed broadly over frontal, central

and parietal electrode sites (based on a combination of growth curve regression and decision trees (Fokkema, Smits, Zeileis, Hothorn, & Kelderman, 2018; Mirman, 2016), statistically controlling for nuisance variables, including speech onset and NP length). Thus, planning sentences with role alignment (A=S) engenders more α ERD responses than planning uniquely specified configurations (A≠S). Our findings suggest that role alignment is relevant for the neural processes subserving sentence planning and it increases attentional and selectional demands during sentence planning (Sadaghiani & Kleinschmidt, 2016).

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