Does verb bias modulate thematic role assignment?

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Many languages convey who does what to who through information provided in the verb phrase. For example, English sentences (1) and (2) show that *the man* is affected by the action 'push'. However, in sentence (3), the word 'raced' is often initially read as a main verb (*The horse raced…*) and must be reanalysed as a passive participle upon encountering 'fell.' Previous studies comparing passive and active structures have often inadvertently compared a common sentence structure with a less frequent one. Substantial evidence shows that syntactic frequency affects sentence processing at the behavioral level [1]. For instance, English active sentences are overwhelmingly more frequent than passives; thus, the agent-action-patient order is the dominant pattern for expressing thematic roles i.e., most verbs bias readers towards an initial active reading.

(1) The man was pushed by the woman.
(2) The woman pushes the man.
(3) The horse raced past the barn fell.

To investigate effects of verb bias on sentence comprehension, we focus on Austronesian languages, which frequently use both the passive structure and passive verb morphology. Specifically, we examine electrophysiological data from Standard Indonesian – a zero-marking language that lacks many morphosyntactic features found in Indo-European languages and yet has a relatively rigid word order. Examining verb bias in Indonesian can thus provide new insight, given that verb bias can interact with frequency and plays an important role in models of language processing [2]. For instance, verb bias in aphasic individuals affects sentence difficulty [3]: passive sentences with verbs more frequently used in a passive structure (i.e., 'passive-bias' verbs) are significantly easier to comprehend than those with 'active-bias' verbs. These findings raise questions about how verb bias impacts online sentence processing.

Standard Indonesian has evidence from acquisition [4], corpus [5], and aphasic data [6] showing that the use of passive is frequent and salient. A considerable number of verbs in this language exhibit a preference for the passive structure, allowing us to manipulate the bias. In this study, we use the Indonesian mixed corpus [7] to extract verbs into 'passive-bias' and 'active-bias'. The stimuli include 180 items: (a) passive sentences with either 'passive-bias' (4) or 'active-bias' verbs (5), (b) active sentences with 'neutral' verbs, and 120 filler sentences.

(4) *Pria itu* ***di****pecat kemarin oleh wanita itu*
man that **PAS**fire yesterday by woman that ('the man was fired by the woman yesterday')
(5) *Pria itu* ***di****dorong kemarin oleh wanita itu*
man that **PAS**push yesterday by woman that ('the man was pushed by the woman yesterday')

The passive voice in (4-5) is expressed by the *di-* prefix on the verb. We predict that if verb bias affects the processing of thematic role assignment in a way consistent with behavioral and aphasic data [3], passive sentences with active-bias verbs should incur higher processing costs than those with passive-bias verbs. Using a 64-channel EEG system, we tested 40 native Indonesian speakers. Sentences were shown through rapid-serial-presentation, with each word presented in the center of the screen for 500ms, with 100ms gap between words. Areas of interest for analyses were the verb as the critical region, the adverb, and the second noun phrase (NP2).

Using cluster-based permutation tests (300-500ms for N400, and 600-1000ms for P600), a significant difference was observed between the passive-bias and active-bias conditions. A broadly distributed (Fig. 1) negative shift on the adverb (p = .046) was observed with the cluster starting around 360ms (Fig. 2). While visually noticeable at around 300ms (Fig. 3), the cluster test at the verb region shows that the effect was not significant (p =.079). No significant effects were found for NP2, and no significant clusters related to P600 for the verb and adverb. Our results suggest that active-bias verbs in passive sentences elicit greater processing demands compared to passive-bias verbs, supporting [3]'s finding of verb bias effects. This would also explain the crosslinguistic differences in aphasic comprehension. English verbs are active-biased; using them in passives require greater processing load. Yet, languages that have relatively frequent passive structure result in aphasic speakers' preserved comprehension of passive sentences ([6] and [8]).

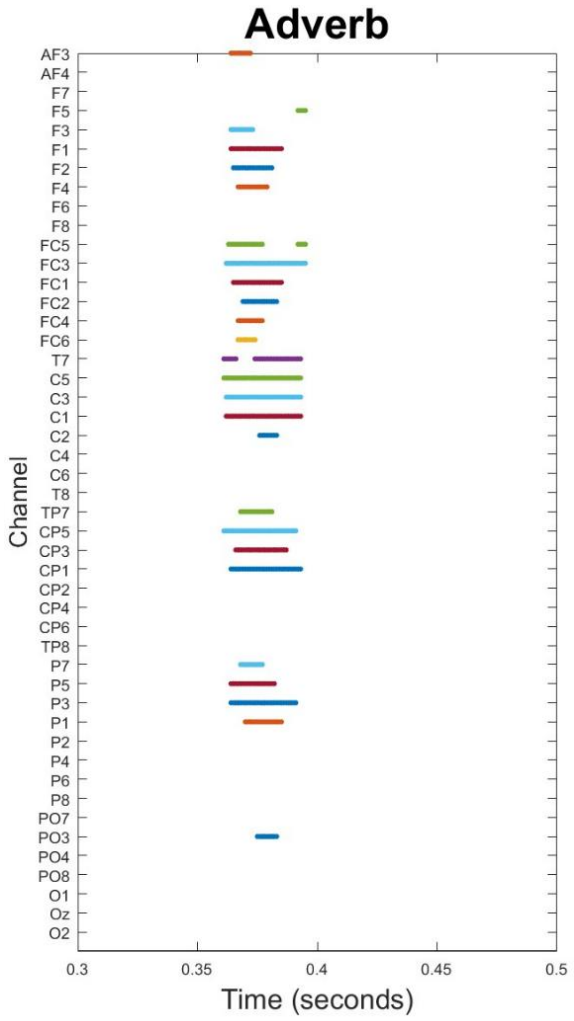

Figure 1. Raster plot of ERPs in Adverb area

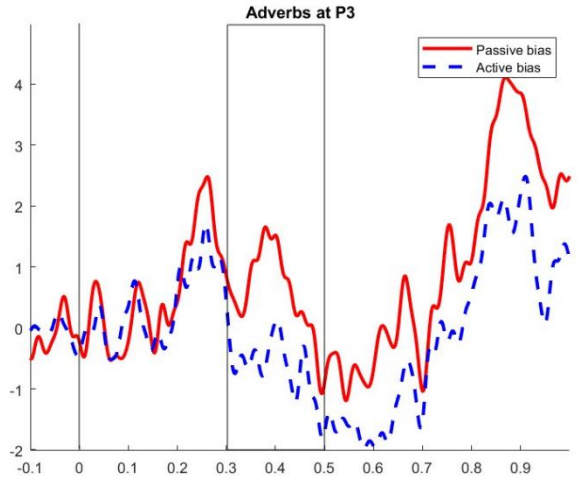

Figure 2. Adverb ERP at P3

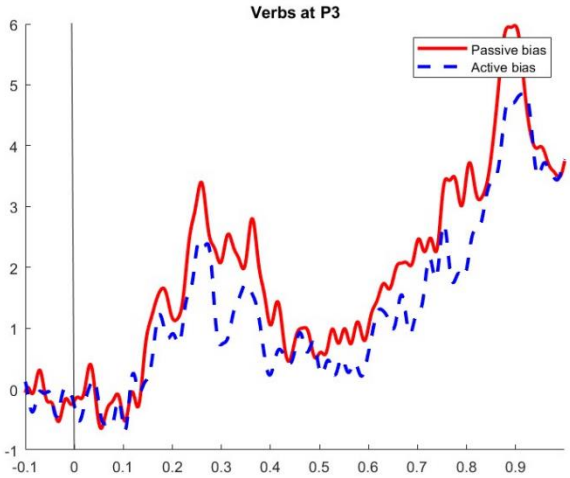

Figure 3. Verb ERP at P3

Selected references [1] Ferreira, F. (2003). The misinterpretation of noncanonical sentences. *Cognitive psychology*, *47*(2), 164-203. **[2]** Boland, J. E. (1997). The relationship between syntactic and semantic processes in sentence comprehension. *Language and Cognitive Processes*, *12*(4), 423-484. **[3]** Gahl, S., Menn, L., Ramsberger, G., Jurafsky, D. S., Elder, E., Rewega, M., & Audrey, L. H. (2003). Syntactic frame and verb bias in aphasia: Plausibility judgments of undergoer-subject sentences. *Brain and Cognition*, *53*(2), 223-228. **[4]** Gil D. (2008) The acquisition of voice morphology in Jakarta Indonesian. In: Gagarina N., Gulzow I. (eds) The Acquisition of Verbs and their Grammar: The Effect of Particular Languages. Studies in Theoretical Psycholinguistics, vol 33. Springer, Dordrecht **[5]** Kaswanti Purwo, B. (1991). Perkembangan bahasa anak: Pragmatik dan tata bahasa. In S. Dardjowidjojo (Ed.),PELLBA 4(pp. 157–202). Jakarta: Penerbit Kanisius. **[6]** Jap, B. A., Martinez-Ferreiro, S., & Bastiaanse, R. (2016). The effect of syntactic frequency on sentence comprehension in standard Indonesian Broca's aphasia. *Aphasiology*, *30*(11), 1325-1340. **[7]** Leipzig Corpora Collection (*2013*): Indonesian mixed corpus based on material from 2013. Leipzig Corpora Collection. Dataset. **[8]** Bondoc, I. P., O'Grady, W., Deen, K., & Tanaka, N. (2018). Agrammatism in Tagalog: Voice and relativisation. *Aphasiology*, *32*(5), 598-617.