**Heuristic-before-algorithm architecture in sentence processing: Evidence from Korean**

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The 'good-enough' processing account argues that, in dealing with the task at hand, a linguistic processor favours computationally less costly and more accessible options from memory—*heuristics*—over deep and complex algorithms (Christianson, 2016; Ferreira, 2003). This is due to the processor's propensity that seeks to achieve cognitive equilibrium at the earliest opportunities and to remain in this state as long as possible, as claimed in the *online cognitive equilibrium* hypothesis (Karimi & Ferreira, 2016). A core force that yields comprehension heuristics, which comprise morpho-syntactic typicality and semantic-pragmatic plausibility (Ferreira, 2003), comes from *frequency in use* (Ambridge et al., 2015; Goldberg, 2019; Lieven, 2010).

With this background, we investigate how frequency-based heuristics are intertwined with algorithmic computation generated by a morphological cue (i.e., an early-arriving cue which guides the following interpretation vs. a late-arriving cue which requires evaluation of initial interpretation; Pozzan & Trueswell, 2015) in the course of sentence comprehension in Korean. We specifically focus on Korean morphological causative and suffixal passive constructions, which are contrastive in terms of form-function mapping of case-marking (typical for the causative vs. atypical for the passive) and the role of verbal morphology (causative: valency-increasing vs. passive: valency-decreasing & disambiguation of case-marking facts), by modulating word order: canonical (frequent and context-neutral) vs. scrambled (infrequent and subject to a particular context) (Tables 1&2).

**Methods**. Forty native speakers of Korean ($M_{age}$ = 23.6; *SD* = 4.05) participated in self-paced reading (SPR; a non-cumulative moving-window paradigm + comprehension questions) and acceptability judgement (AJ; a 6-point Likert scale from zero to five) tasks sequentially. Along with fillers, 32 test sentences were created by crossing two construction types (causative; passive) and two canonicity types (verb-final; verb-initial) (Table 3). Sentences for the AJ were adapted from those for the SPR (i) by reducing Regions 5 and 6 and by putting the topicalised direct object back in the original place (i.e., between an indirect object and a verb) and (ii) by reducing Regions 1, 5, and 6 for the passive. The raw AJ data were trimmed by excluding any data point whose reaction time was less than 1000 ms or more than 10000 ms (data loss: 4.32%) and were *Z*-transformed for data normalisation. The raw SPR data were trimmed by excluding (i) data from participants who failed to pass the comprehension questions and (ii) outliers below or above a three-standard-deviation cut-off point (data loss: 7.50%), were log-transformed for data normalisation, and were further residualised to adjust for the variability in word length and individuals' reading speed. The pre-processed data from each task were fitted to separate linear mixed-effects models for statistical analysis.

**Results** (Figure 1 & Tables 4-5). (AJ) Participants rated the canonical condition significantly more acceptable than the scrambled condition. This indicates that their judgements were affected by the word-order-related typicality and plausibility (i.e., no contextual motivation for scrambling) across the board. (SPR) By-region global models revealed only interaction effects in Regions 3 to 6. Post-hoc analyses ($\alpha$ = .025) showed two points: (i) when controlling for *Canonicity*, participants spent significantly more time for the passive condition than for the causative condition in Regions 5 and 6 only for the scrambled condition; (ii) when controlling for *Construction*, they spent significantly more time for the scrambled condition than for the canonical condition in Regions 3, 5, and 6 only for the passive condition (the numeric difference in R4 for the causative condition was insignificant).

Together, our findings point to the reduced impact of an early-arriving morphological cue on real-time processing of both construction types (and particularly of the suffixal passive). This is ascribable to the asymmetries found in language use involving these constructions (Table 2), with the frequency-based heuristics taking precedence over the algorithmic computation from verbal morphology. The results thus lend support to the good-enough processing account in sentence comprehension, appealing to the idea that the processor operates in a way that maximises cognitive equilibrium in online processing.

**Table 1**. Examples of Korean suffixal passive and morphological causative constructions

| | verb-final (canonical) | Verb-initial (scrambled) |
|---|---|---|
| Morphological causative | Ciwu-ka Mia-eykey<br>Ciwu-NOM Mia-DAT<br>umsik-ul mek-i-ess-ta.<br>food-ACC eat-CST-PST-SE<br>'Ciwu made Mia eat food.' | mek-i-ess-ta Ciwu-ka<br>eat-CST-PST-SE Ciwu-NOM<br>Mia-eykey umsik-ul<br>Mia-DAT food-ACC<br>'Ciwu made Mia eat food.' |
| Suffixal passive | Ciwu-ka Mia-eykey an-ki-ess-ta.<br>Ciwu-NOM Mia-DAT hug-PSV-PST-SE<br>'Ciwu was hugged by Mia.' | an-ki-ess-ta Ciwu-ka Mia-eykey.<br>hug-PSV-PST-SE Ciwu-NOM Mia-DAT<br>'Ciwu was hugged by Mia.' |

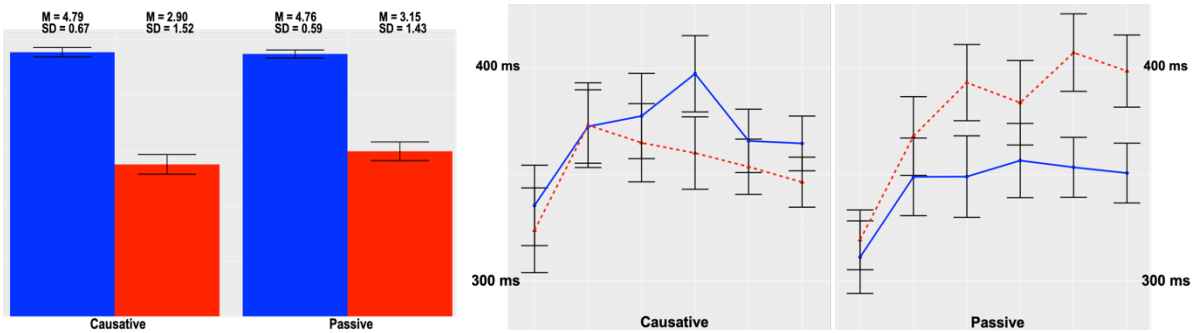
**Table 2**. Summary: By-pattern characteristics of the two construction types

| Construction | Pattern | Form-function mapping of case-marking | Word order |
|---|---|---|---|
| Morphological causative | Verb-final | Typical (NOM~agent; DAT~recipient) | Canonical & context-neutral |
| | Verb-initial | | Non-canonical & context-dependent |
| Suffixal passive | Verb-final | Atypical (NOM~theme; DAT~agent) | Canonical & context-neutral |
| | Verb-initial | | Non-canonica& context-dependent |

**Table 3**. Scheme of test sentences: SPR

| Construction | Pattern | R1 | R2 | R3 | R4 | R5 | R6 |
|---|---|---|---|---|---|---|---|
| Morphological causative | Verb-final | N3-~~ACC~~, I heard that | N1-NOM | N2-DAT | V-CST | yesterday | night |
| | Verb-initial | | V-CST | N1-NOM | N2-DAT | | |
| Suffixal passive | Verb-final | | N1-NOM | N2-DAT | V-PSV | | |
| | Verb-initial | | V-PSV | N1-NOM | N2-DAT | | |

*Note*. English translations in R1/5/6 are only for the readers' sake; all sentences were presented in Korean. To precisely conduct region-by-region comparisons, we topicalised the direct object of the morphological causative instances.




(a) AJ. X-axis: pattern; Y-axis: rating (b) SPR. X-axis: region; Y-axis: reading time

**Figure 1**. Results (raw; after data trimming). Blue: verb-final; Red: verb-initial. Error bars indicate 95% CIs.

**Table 4**. Statistical model (global; $\alpha$ = .05): AJT (*Z*-transformed)

| | *β* | *SE* | *t* | *p* |
|---|---|---|---|---|
| Construction | –0.016 | 0.071 | –0.227 | .820 |
| Canonicity | –1.450 | 0.071 | –20.316 | < .001*** |
| Construction * Canonicity | 0.240 | 0.143 | 1.679 | .094 |

**Table 5**. Statistical model (global; $\alpha$ = .05): SPR (log-transformed & residualised)

| | *p*-value | | | | | |
|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | R5[(a)] | R6[(a)] |
| Construction | *ns* | *ns* | *ns* | *ns* | *ns* | *ns* |
| Canonicity | *ns* | *ns* | *ns* | *ns* | *ns* | *ns* |
| Construction * Canonicity | *ns* | *ns* | .024* | .017* | .010** | .003** |

*Note*. (a) = F1 analysis (with only *Participant* as a random effect). *ns* = no significance.

**Abbreviations**. ACC = accusative case maker; CST = causative suffix; DAT = dative marker; N = noun; NOM = nominative case marker; PST = past tense marker; PSV = passive suffix; SE = sentence ender; V = verb