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Sequential meaning-making in language and visual narratives

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Introduction

The last two decades have seen emerging research on the structure and cognition of visual narratives, like those found in comics and picture stories (Cohn & Magliano, 2020). A primary characteristic of this research has been the comparison between the meaning-making in sequencing of pictures and that of sequential words or sentences in language. This comparison has extended across research methods and their findings.

First, research on visual narratives has drawn on linguistic theories and methods, including both behavioral and neurocognitive experimentation (Cohn, 2020; Loschky, Magliano, Larson, & Smith, 2020) and the development and analysis of corpora. This comes alongside emerging work using computational modeling to analyze both experimental and corpus data (Laubrock & Dunst, 2020).

Second, visual narratives have been found to involve similar structures and neurocognitive mechanisms as language. For example, linguistic theories have effectively modeled the structures of visual narrative sequencing, and manipulation of these constructs have yielded similar neurocognitive signatures as measured by event-related potentials (ERPs; e.g., N400, LAN, P600) as those evoked in psycholinguistic experiments (Cohn, 2020).

In this symposium, we further explore these comparisons between language and visual narratives in four presentations exploring visual narrative sequencing. These studies span various methodologies of corpus research along with behavioral and neurocognitive experimentation, and they probe several fundamental topics of meaning-making found in both the verbal and visual modalities: the expression of motion events, the generation of inferences, anaphoricity and co-reference, and information density.

Inferential techniques in visual narrative storytelling

A primary area of research for both visual and verbal narratives has been the exploration of inference: how do we understand what is not provided overtly in a text. In this

presentation, *Bien Klomberg* examines the use of different methods which help visual narratives elicit bridging inferences. Most studies on visual and verbal narratives have deleted a key event entirely, but naturally occurring visual narratives use patterned methods to replace the original climactic event with a conventionalized inferential technique alluding to the original event. This presentation will thus compare the processing of these inferential techniques using self-paced reading experiments measuring how long participants viewed each panel in a sequence. These experiments both compared inferential techniques (Experiment 1), as well as investigated to what extent combining techniques alters processing (Experiment 2). In addition, this project tested whether comprehension differed across underlying features used to describe similarities and differences among the techniques. Experiment 1 found that the processing of the inferential techniques differed both at the panels where they omit events, and at the subsequent image where a resulting inference would be generated. However, Experiment 2 found no effect of combination-panels beyond a uniform increase of processing time at the critical panel. Nevertheless, further analysis of their underlying features indicates that a balance of traits predicts the processing of the inferential techniques. Altogether, these results support the distinctiveness of conventionalized inferential techniques, while also highlighting that inference resolution is not a straightforward additive process.

Linguistic typology of motion events in visual narratives

Languages use different strategies to encode the same situation, such as motion events, and linguistic research has shown that these distinctions fall into predictable typological categories. Some languages use particles or “satellites” to describe a path of motion (S-languages like English), while others typically use the main verb as a path verb (V-languages like French). The manner of motion is easy to convey in S-languages since the slot of the main verb is open for manner, unlike the V-languages, which require additional phrases for conveying the manner information (Slobin, 2000). In this presentation *Irmak Hacimusaoglu* explores whether these typological differences might motivate artists to differ in the way they depict motion events in visual

narrative sequencing. Prior work has suggested that the differences of encoding motion events in S- and V-languages influence how people describe visual narratives and how they translate the texts of visual narratives. However, few studies have directly examined the depiction of paths themselves in visual narratives around the world on the basis of their authors' native languages. Here, we analyzed a corpus of 85 comics from S-languages (the United States, China, Germany) and V-languages (France, Japan, Korea) for properties of their motion events. We examined both the depictions of path segments (source, trajectory, and goal) and their visual cues signaling the path and manner of motion (e.g., motion lines, character postures). Overall, panels from S-languages were found to depict trajectories more often than panels from V-languages. Additionally, panels from S-languages used more visual cues than those from V-languages. A positive correlation between motion lines and trajectories suggested that these were a primary indicator of motion events, and indeed these motion lines cueing trajectories (thus the manner) appeared more often in S-languages than in V-languages. These findings reveal the influence of spoken languages on depiction of motion events in visual narratives.

An oscillatory perspective on visual narrative comprehension

The primary method of analyzing the neurocognition of visual narratives has used ERPs. This work has shown that visual narratives elicit ERPs similar to those elicited by linguistic stimuli, suggesting that similar neurocognitive processes are involved in both domains. Yet, recent work has shown that electroencephalogram (EEG) data can also be analyzed with a time-frequency approach, which allows for a decomposition of the involved processes via their modulations of oscillatory activity. Thus, *Cas Coopmans* here reports on the first ever time-frequency analysis of visual narrative comprehension. Thirty-two Dutch participants watched short visual narratives while their EEG was measured. Each visual narrative contained one “refiner panel” that “zoomed in” on the contents of a “full panel”, to which it was co-referentially related. We analyzed the oscillatory EEG activity elicited by both refiner and full panels, and took into account whether they preceded or followed the panel to which they were co-referentially related (i.e., were cataphoric or anaphoric). We found that refiner panels elicit stronger theta-band power (3-7 Hz) than full panels (~200-400 ms after panel onset). Compared to cataphoric panels, anaphoric panels elicit a decrease in alpha-band power (8-15 Hz) around 300-800 ms. In line with previous research, we suggest that the theta effect reflects an attempt to reactivate information from working memory. We interpret the alpha-band effect as alpha suppression, which reflects reduced inhibition of the brain areas involved in establishing a co-referential relationship between an anaphoric panel and its antecedent. Our results show that time-frequency analysis of oscillatory power provides a novel perspective on the neurocognitive processes underlying

ual narrative comprehension, similar to the oscillatory correlates of semantic processing in language (Nieuwland, Coopmans, & Sommers, 2019).

Information density in visual narrative units and sequences

Finally, like verbal language, sequencing of narrative images must negotiate how information gets packaged in either the units of a visual narrative or distributed across its sequence. To investigate these issues of information density, *Neil Cohn* here presents an analysis of a cross-cultural corpus of 38,000+ panels from over 300 comics spanning Europe, North America, and Asia. First, when collapsing across cultures, we show that the information density of panels follows a Zipfian-type distribution, where panels that are most dense with information (showing whole scenes) are twice as frequent as those with single characters, which are in turn more frequent than less informative paneling. However, cultures differ in their distributional tendencies of this paneling. Specifically, Asian comics use units with more constrained information than those with full scenes. We then show that this variation relates to another trend in languages: the tradeoff of information density in morphology (units) and grammar (sequencing). Here, we show that despite culturally instantiated profiles of both paneling and narrative sequencing, visual narrative around the world demonstrate a clear negative correlation between the information density of the units and the complexity of their sequencing. This suggests a tradeoff in the complexity of units and sequencing. Altogether, these findings suggest that visual narratives negotiate constraints for expressing information in units and sequencing similar to those found in language.

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