

# Word concreteness and mental imagery underlie figurative language impairment in schizophrenia: The promise for the DISCOURSE approach

Federico Frau<sup>1</sup>, Luca Bischetti<sup>1</sup> & Valentina Bambini<sup>1</sup>

In collaboration with the Schizophrenia Research and Clinical Unit at IRCCS San Raffaele Hospital  
& Vita-Salute San Raffaele Hospital (PIs: Roberto Cavallaro & Marta Bosia)

<sup>1</sup>Laboratory of Neurolinguistics and Experimental Pragmatics (NEP), IUSS, Pavia, Italy

## THE PROBLEM: THE «PRAGMATIC» CONCRETISM

Lack of abstract thinking, often referred to as **concretism**, is a well-known psychopathological feature of schizophrenia, which includes the tendency to adhere to concrete aspects of stimuli and difficulties in understanding figurative language [1,2]. Here, we will present two studies where **computational** and **psycholinguistic** techniques were applied to investigate **lexical-semantic** and **mental imagery** processes underlying the pragmatic facet of concretism.

## 1. WORD CONCRETENESS

In the first study, inspired by the similarity between “concretism” as defined in **psychopathology** and “concreteness” as defined in **linguistics**, namely the semantic properties of words to refer to **perceptual experience**, we tested the idea that impairment in deriving figurative meanings could be related to impairment at the semantic level, involving word concreteness.

We analyzed the speech samples produced by **63 individuals with schizophrenia and 47 controls**, who were asked to explain the meaning of a series of figurative expressions (idioms, metaphors, and proverbs), by applying an **automated pipeline** to extract linguistic measures from participants’ speech samples (**Figure 1, Panel A**). Results are summarized in **Figure 1**: we observed that patients’ answers exhibited higher concreteness at the word level, especially in the verbal explanation of proverbs (**Panel B**), while not different in measures of lexical richness and in the pause-to-word ratio. Word concreteness in patients’ explanations was also predictive of their ability to understand proverbs (**Panel C**) and was indicative of their global pragmatic and cognitive abilities.

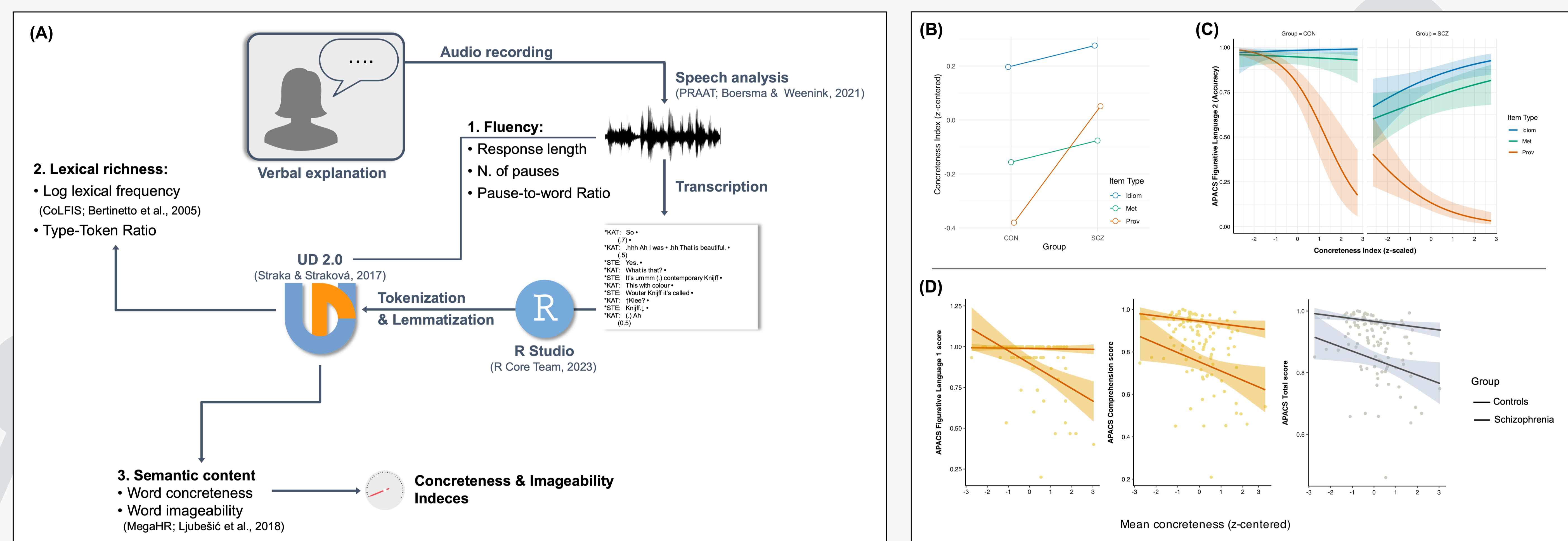


Figure 1. Automated pipeline used to extract linguistic measures (A) and results from group comparisons on word concreteness (B), as well as the effect of word concreteness on pragmatic performance (C-D).

## 2. THE ROLE OF MENTAL IMAGERY

In this second study, we further explored the underlying processes of pragmatic concretism by testing the hypothesis that **concrete interpretations** in schizophrenia might be linked to **greater and longer** activation of **visual images generated by metaphorical expressions**. We grounded our hypothesis on theories from linguistics and psychology accounting for the **role of mental image generation during metaphor processing** [3,4], as well as on literature documenting a link between word imageability and concreteness [5], the latter being shown to be altered in schizophrenia [see study 1].

Here, a sample of **66 individuals with schizophrenia and 70 healthy controls** were administered a novel **metaphor priming paradigm**, where metaphors (e.g., *Wisdom is a flashlight*) were used as primes for target words associated based on visual (e.g., *microphone*) vs. semantic features (e.g., *lamp*), see **Figure 2, Panel A**.

While in healthy participants metaphors activated semantically associated words, in individuals with schizophrenia metaphor primed visually related words, with an effect lasting 1400 ms (Panel B). Correlation analysis showed that **the greater the visual priming effect the lower the metaphor comprehension skills** in patients (Panel C).

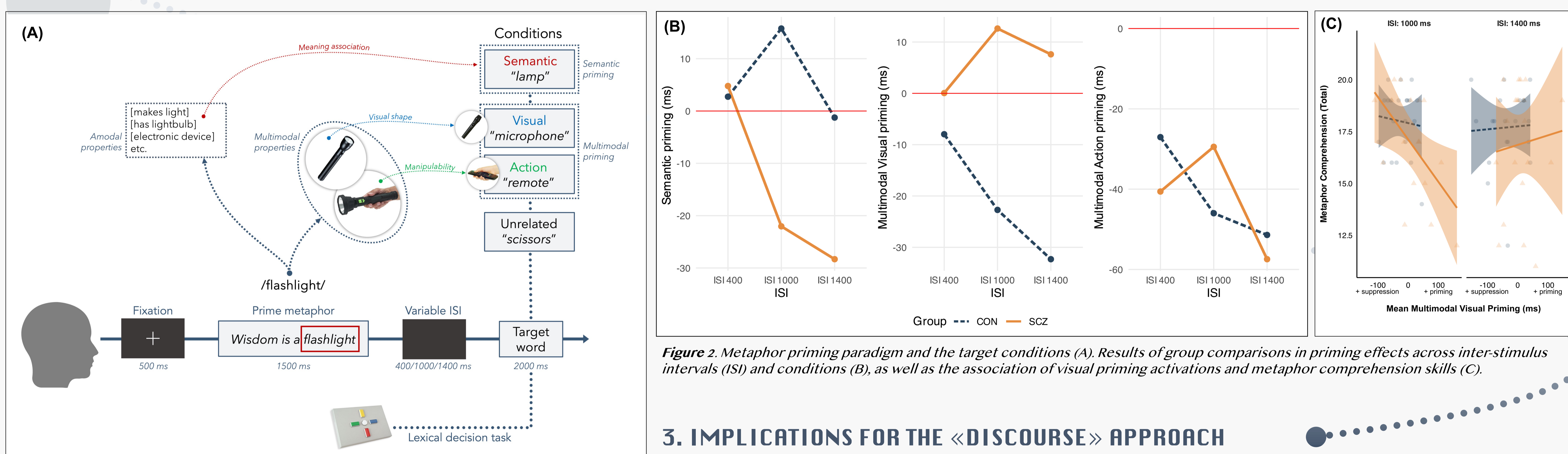


Figure 2. Metaphor priming paradigm and the target conditions (A). Results of group comparisons in priming effects across inter-stimulus intervals (ISI) and conditions (B), as well as the association of visual priming activations and metaphor comprehension skills (C).

## 3. IMPLICATIONS FOR THE «DISCOURSE» APPROACH

In these studies, we highlighted significant dimensions involved in figurative language understanding difficulties in schizophrenia, ranging from **lexical/semantic to imagistic** processes. More broadly, we disclosed relevant links between **linguistic impairment** and **other cognitive processes**, such as mental imagery, which can potentially intercept altered perceptual experience in schizophrenia. We also showed how such dimensions can be captured by applying and combining **computational** and **psycholinguistic** approaches.

These studies also disclose new areas of interest in the automated analysis of speech in psychosis for a better characterization of the linguistic profiles as well as for identifying **relevant linguistic dimensions** in relation to **clinical** and **outcome** aspects. More importantly, now that the interest in NLP applications in psychosis is growing, we highlighted that less investigated linguistic aspects – e.g., **figurative language** – should be integrated in these methodological developments, given their link with patients’ **psychopathology, cognition, and daily functioning** [6,7].

1. Harrow (1974). *Arch Gen Psychiatry* 31(1):27–33. 2. Bambini et al. (2020). *Neuropsychologia* 139:107332. 3. Gibbs & Matlock (2008). In Gibbs (Ed.), *The Cambridge Handbook of Metaphor and Thought*. Cambridge University Press, pp. 161–176. 4. Paivio & Walsh (1993). In Ortony (Ed.), *Metaphor and Thought*. Cambridge University Press, pp. 307–328. 5. Paivio (1979). *Imagery and Verbal Processes*. Psychology Press. 6. Bambini et al. (2016). *Compr Psychiatry* 71:106–120. 7. Agostoni et al. (2021). *Neuropsychology* 35(1):42–56.