Rezonator: Visualizing Resonance for Coherence in Dialogue

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Abstract

To meet the challenge of understanding coherence in extended dialogue, new methods are needed for analyzing the structure of resonance and engagement in interaction. To advance this work we introduce Rezonator, a powerful new tool designed to support human-in-the-loop annotation of discourse via intuitive, informative, and quantifiable visualizations of multilevel resonance. Rezonator is designed to produce scalable gold standard data via crowdsourcing and gamification. We illustrate with examples to show how interlocutors use multilevel resonance to build a unified structure for alignment, engagement, and coherence in naturally occurring conversation.

1 Introduction

Against the background of the triumphant success of Natural Language Processing and Artificial Intelligence in simulating linguistic behaviors such as question-answering and machine translation, a shadow is cast by the recurrent failure to meet a basic challenge of everyday language use: sustaining coherence in extended dialogue. The deep learning and related techniques that seem to work so well for answering a single question in isolation collapse once the task extends to modeling a sustained, two-way collaborative exchange. Noting the failure of state-of-the-art tools at this task, some leading researchers have called for renewed attention to the problem of coherence in dialogue as a critical frontier in the work of language production and comprehension (Lai & Tetreault, 2018; Li, Monroe, Ritter, & Jurafsky, 2016). A related line of research emphasizes the need for syntax and semantics to come to terms with how conversational participants coordinate their common ground
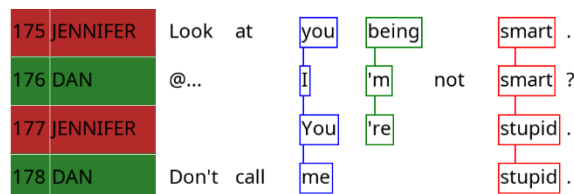

Figure 1: Diagraph representation of multilevel resonance in Rezonator. Resonance reflects paradigmatic *(you : I)*, inflectional *(being : 'm : 're),* semantic *(smart : stupid)*, and other linguistic equivalence classes, including surface word order that often overrides differences in syntactic rules applied. Here, parallel surface order of resonating lexemes aligns a finite main clause *(I'm not smart)* with a non-finite complement clause *(you being smart)*. Similarly, a second finite main clause *(you're stupid)* maps onto the reduced syntactic construction of a small clause *(me stupid)*.

(Ginzburg, 2012; Gregoromichelaki & Kempson, 2013).

These issues inform the present effort, which introduces Rezonator as a tool designed to support the annotation of multi-level resonance, a key factor in sustaining an attractive mix of coherence, informativeness, and novelty in extended dialogue.

1.1 Resonance

To address these issues, the current approach highlights the critical role that resonance plays in building coherence in extended dialogue. Resonance is defined as "the catalytic activation of affinities across utterances" (Du Bois, 2014, p. 372). Resonance is analyzed within the theory of Dialogic Syntax, which "encompasses the linguistic, cognitive, and interactional processes involved when speakers selectively reproduce aspects of prior utterances, and when recipients recognize the resulting parallelisms and draw inferences from them" (Du Bois, 2014, p. 366). For a quantitative analysis of resonance, see (Moscoso del Prado Martín & Du Bois, 2015).
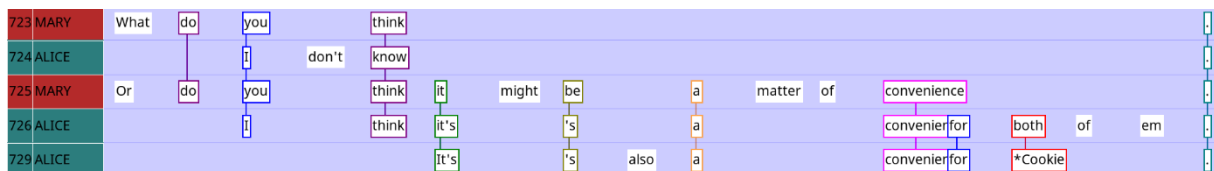
Figure 2: Rezonator representation of multilevel resonance, with structural parallelism of main clauses *(think : know)* and their clausal complements, where structurally aligned contrasts *(might be : it's)* frame the interlocutors' respective stances as relevant to collaborative epistemic problem-solving.

Figure 1 shows an annotation produced using Rezonator, which illustrates how even a brief excerpt may contain affinities at multiple levels of linguistic structure, including paradigmatic *(you : I)*, inflectional *(being : 'm : 're),* antonymy *(smart : stupid)*, argument structure, and clausal embedding, among others.

Resonances often come in clusters, organized via structural parallelism. This is illustrated again in Figure 2, where the structural parallelism serves to foreground subtle differences in epistemic stance. Such convergence of resonance across lexical, morphological, syntactic, semantic, and pragmatic levels is precisely what Rezonator is designed to study. Rezonator is designed to make it easy for annotators to mark their perceptions of resonance relations at all levels, yielding a rich representation of complex patterns of resonance. Inter-annotator agreement can be assessed by recruiting multiple annotators to independently evaluate the same conversations.

2   Resonance and priming

While evidence for priming seems compelling to many (Bock, 1986; Branigan & Pickering, 2016; Pickering & Ferreira, 2008), controversy remains: Is priming significantly syntactic, or is it merely reducible to lexical priming (Patrick G.T. Healey, Purver, & Howes, 2014)? More troubling is the lack of agreement on the function, if any, of structural priming: Why align? One prominent suggestion holds that priming "makes conversation easy" (Garrod & Pickering, 2004). But broad-spectrum analysis of the full range of syntactic constructions in naturally occurring conversation sometimes yields negative results (Patrick G.T. Healey, Howes, & Purver, 2010; Patrick G.T. Healey et al., 2014). The approach favored here sidesteps the lexical vs. syntax debate by combining the effects of resonance at all linguistic levels, positing a surface-oriented representation of how interlocutors build a single unified alignment structure for resonance and coherence in dialogue.

3   Future development

Because corpus annotation is very labor-intensive, some researchers have sought new ways to incentivize the work, whether through appeals to "citizen science" (Cieri, Fiumara, Liberman, Callison-Burch, & Wright, 2018) or "games with a purpose", (Habernal et al., 2017; Jurgens & Navigli, 2014; Poesio et al., 2019). Rezonator was designed from the ground up using game design software (GameMaker Studio). This will support our development of "games of resonance" that feel like real games to the players.

For future development, Rezonator stands to benefit from incorporating relevant NLP tools such as word2vec, sense2vec, and pair2vec, several of which are integrated in a recently released toolkit for analyzing linguistic alignment in dialogue, ALIGN (Duran, Paxton, & Fusaroli, 2019).

3.1   Availability

Rezonator is free and open-source software, distributed at https://rezonator.com under the MIT license, with source code and documentation at https://github.com/johnwdubois/rezonator.

4   Conclusions

In this paper we introduce Rezonator, a tool for representing the complexity of multilevel resonance in dialogue. Rezonator leverages the node-link data structure of the directed acyclic graph to create a unified, holistic, surface-level representation of resonance between utterances. Rezonator further innovates in using gamification to provide new incentives for human-in-the-loop production of gold standard annotations, scalable to crowd-sourced levels suitable for training data, in support of the analysis of naturally occurring conversation. We argue that such explicit, quantifiable representations can help to clarify how interlocutors use multilevel resonance to build a unified structure for alignment, engagement, and coherence in extended dialogue.

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