Automating Text Propositionalization: An Assessment of *AutoProp*

Stephen W. Briner, Philip M. McCarthy, and Danielle S. McNamara
Department of Psychology
University of Memphis
Memphis, TN 38152

{sbriner, pmccarthy, d.mcnamara} @mail.psyc.memphis.edu

Propositions are psychological representations of textual units that capture the overall gist of a sentence or clause (Kintsch, 1988; Kintsch, 1998). Such is the complexity of constructing these propositions that no computational system has yet been able to match human hand-coded examples.

The recent advent of major computational projects such as iSTART (McNamara, Levinstein, & Boonthum, 2004) and Coh-Metrix (Graesser et al., 2004) has highlighted the need for an automated tool capable of accurately converting thousands of sentences into propositional units. In this study, we introduce a working prototype of a propositionalization tool, *AutoProp*, and assess its automated output of propositions against a corpus of published hand-coded propositions.

AutoProp, written in Visual Basic, first directs text through the Charniak parser (Charniak, 2000) before allocating the parsed data into propositional units. A final proposition is displayed *on AutoProp's* interface, and can be saved to a file or printed upon request. As an example, the sentence *The hemoglobin carries the oxygen* is represented by Kintsch (1998) as CARRY[HEMOGLOBIN,OXYGEN]. *AutoProp* separates the sentence into primary elements (pe) and sub-propositional elements (sub prop) rendering the Kintsch sentence above as:

carries (the {pe} hemoglobin, {pe} oxygen)
  sub prop: the ({pe} hemoglobin)
  sub prop: ({pe} oxygen)

For an initial test of the tool's effectiveness, we constructed a corpus of 29 previously published sentences taken from Kintsch (1998). These sentences were processed through *AutoProp* to derive the tool's propositional representations.

The types of contrasts (i.e., output differences) between the tool and the Kintsch model were categorized *a priori* as follows:

Type 1: Superficial, easily correctable differences.
Type 2: Easily correctable contrasts
Type 3: Systematic contrasts caused by parser limitations
Type 4: Systematic, but correctable contrasts
Type 5: Difficult to correct systematic contrasts

Based on these criteria, we analyzed contrasts between the propositional tool and the hand-coded Kintsch textbase.

Analysis and Discussion

While all of the *AutoProp* propositions recorded Type 1 contrasts, the results of the analysis suggested that major differences between the Kintsch and *AutoProp* generated propositions were minimal. Our results offered only one propositional contrast caused by parser limitations (Type 3), and eleven further *correctable* Type 4 contrasts. There were no Type 2 or Type 5 contrasts. Thus, *AutoProp* was highly successful. The success of these initial results, however, must be tempered by the fact that our corpus of propositions stem from sentences no longer than two clauses. Subsequent *AutoProp* algorithms must address far more complex multi-clausal sentence constructions.

In addition to generating textbase propositions, future *AutoProp* research will also develop modules for comparing these propositions to recall and self explanation propositions. Thus, *AutoProp* stands to contribute to the field by substantially reducing preparation time and substantially increasing the accuracy and reliability of scores generated from recall data.

This research initiates a response to a growing need for an automated propositionalization tool. The current version of *AutoProp* is the first step toward building a tool capable of converting a wide range of sentence types into propositional units, as well as comparing and scoring textbase propositions from recall and self-explanation examples.

Acknowledgments

This research was supported by the Institute for Education Sciences (IES R3056020018-02).

References

Charniak, E. (2000). A maximum-entropy-inspired parser. *Proceedings of the North-American Chapter of Association for Computational Linguistics*, Seattle, WA, United States.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review, 2,* 163-182.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition.* Cambridge, United Kingdom: Cambridge University Press.

McNamara, D.S., Levinstein, I.B. & Boonthum, C. (2004). iSTART: Interactive strategy trainer for active reading and thinking. *Behavioral Research Methods, Instruments, and Computers, 36*, 222-233.