COMPASS III: Teaching L2 grammar graphically on a tablet computer

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We demonstrate a prototype of the tablet-based L2 *grammar teaching system* COMPASS III. COMPASS stands for COMbinatorial and Paraphrastic Assembly of Sentence Structure; for a description of the underlying computational-linguistic software, see [1]. COMPASS invites the student to construct sentences by composing syntactic trees out of lexically anchored "treelets" via the graphical drag&drop user interface provided by tablet and touchscreen. After each move (i.e. each attempt to combine two treelets, or to reorder a branch), the system's natural-language generator computes all possible grammatically well-formed sentences entailed by the attempted tree. COMPASS provides positive feedback if the student-composed tree belongs to the well-formed set, and negative feedback otherwise. In the latter case, COMPASS may propose alternatives based on a comparison between the student-composed tree and its own well-formed trees (informative feedback on demand). As system feedback may explicitly refer to grammar rules, the learner needs to have elementary syntactic knowledge. COMPASS III targets L2 learners of German with high-school level understanding of word classes and grammatical functions. The user interface allows the student to select words and to move (parts of) trees around through finger or stylus gestures. No typing is required. COMPASS III focuses on word order and case morphology—difficult topics in L2 German.

The grammar formalism underlying COMPASS is *Performance Grammar* [2], which assumes separate rules for the hierarchical *structures* of a sentence and the *linear order* of its constituents. This split allows the student to break sentence construction exercises into relatively small parts. For instance, the learner can select a word and inflect it according to the intended grammatical function without having to worry about the linear position of the constituent in the sentence under construction. At any time during this "scaffolded" sentence construction process, the tree built so far remains visible on the screen, ready to be expanded by attaching additional words/treelets; any earlier decision can be undone and corrected.

Fig. 1 shows a student action which is rejected by the generator due to incompatibility of accusative case of the Direct Object (DOBJ) and dative case of the personal pronoun *ihm* 'him'. The red circles denote NPs; the arrow indicates that the student attempts to attach (unify, merge) the NP dominating *ihm* with the NP that fulfills the function of Direct Object. The example presupposes that the student has already successfully constructed the hierarchical structure for *Anja baut* 'Anja builds'. COMPASS does not allow the attempted attachment, though, and the two red circles do not fuse. In response to a request, the system may suggest *ihn* as the pronouns with correct accusative case. The purple shapes serve as receptacles for linearly ordered constituents. The

student can drag circles into these squares (which, in response, may expand to rectangles) and place them there in any order.
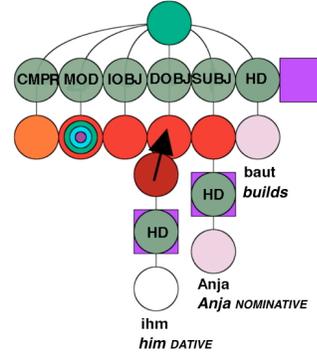

Figure 1. *Failed attempt to combine two treelets, due to missing morphological case agreement. Circles without text stand for syntactic categories (clauses, phrases, word classes).*

Fig. 2 depicts the system's reaction to the incorrect linear order of Direct and Indirect Object in *Anja baut eine Rakete ihm* 'Anja builds a rocket for him'. The student has moved four grammatical function nodes into the purple rectangle associated with the Head Verb. Although the order of DOBJ and IOBJ is wrong, COMPASS does not reject it outright but indicates an error by changing the color to yellow; this allows the student to continue with the hierarchical structure, and to return to the linear order at a later time. Due to space limitations, we cannot describe here how COMPASS "teaches" even complicated linear order rules.
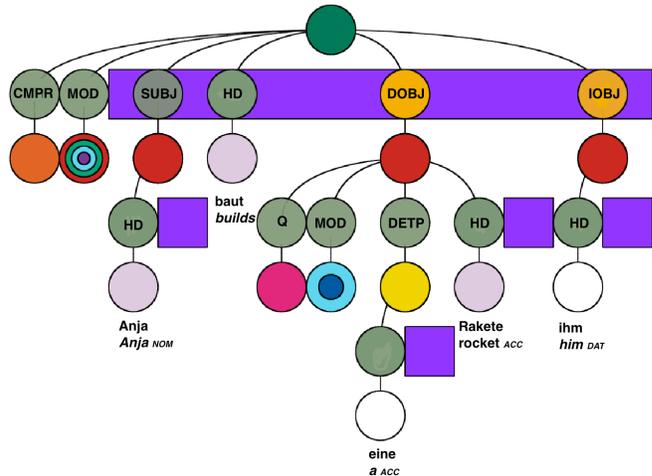

Figure 2. *Incorrect linear error in 'Anja baut eine Rakete ihm'.*
Index Terms: e-learning, grammar teaching, German as L2

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[2] Kempen, G. and Harbusch, K. "Performance Grammar: A declarative definition", in M. Theune, Nijholt, A. and Hondorp, H. [Eds], *Computational Linguistics in the Netherlands 2001*, Amsterdam: Rodopi, 2002.