Generating Adequate Instructions: Knowing When to Stop

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Adequate instructions are essential to the correct performance of actions. An instruction is adequate if its action(s) and objects are identified sufficiently and unambiguously, given the instruction's context. For instance, the instruction *Turn the knob* would be inadequate if, in the context, more than one knob or one way of turning a knob were salient. However, even if the knob and the manner of turning were uniquely identifiable, the instruction could still be inadequate since it does not tell the reader when to stop turning the knob. What is missing here is the *termination information* for the action, or when the performance of the action is to end. Conveying such information in automated text generation is the focus of my research. I consider how to incorporate termination information into an action representation and how to generate adequate instructions from instances of the action representation, including how to choose appropriate expressions for conveying action termination.

To study termination information and how it is expressed in instructions, I have completed a preliminary corpus analysis of 3000 simple step-by-step instructions taken from several sources: *The Reader's Digest New Complete Do-It-Yourself Manual* (1991), a collection of *technical orders* (military instructions) for the maintenance of F-16 aircraft, and a small set of instructions for a mitre saw assembly line. I have coded the instructions for types of main verb phrases and types of additional phrases or subordinate clauses used with them. Rough analysis shows that nearly ninety percent of the termination condition clauses, such as *until* clauses, as well as nearly half of the clauses expressing purpose, co-occur with main verb phrases which do not themselves provide termination information. (Such verb phrases appear in about a quarter of the instructions.) This analysis has been the basis for my work on the representation of termination information and initial work on generating expressions of termination information.

One of the problems I face is that an action's termination often follows from other features of the action, either individually or together. An action's participants, path, purpose, and relationships with other actions can all provide termination information. Using knowledge about features of actions and their interconnections, as gleaned from the corpus analysis, I have begun to specify what an action representation needs to look like in order to generate adequate instructions. Given an action representation which contains all of the necessary slots for action information, including the plan which an action is part of, generating adequate instructions is then a matter of knowing how to express the information in the action representation and how to recognize when an instruction does not yet convey when to stop.

Since termination information appears throughout the representation of an action, realizing it involves different parts of an action's description. For example, possible ways to express termination for *Turn the knob* include: *...90 degrees*, *...to the* OPEN *position*, *...to open the door*, *...until the door opens*. As such information is primarily expressed intra-sententially, albeit over multiple clauses, I have begun to use a generation system called SPUD (Stone & Doran 1997; Stone & Webber 1998) which plans sentences by forming descriptions of events, states, and objects. By matching the semantic and pragmatic information of its Lexicalized Tree-Adjoining Grammar entries against information it is told to convey, SPUD chooses those lexical items which serve its communicative goals best in describing an action. Encoding semantic and pragmatic information and associating it with realizations of termination information allows SPUD to generate appropriate action descriptions based on action information. SPUD's ability to check the semantic and pragmatic information provided by an instruction to see whether it contains termination information ensures the generation of adequate instructions.

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References

Stone, M., and Doran, C. 1997. Sentence planning as description using tree-adjoining grammar. In *Proceedings of ACL/EACL'97*, 198–205.

Stone, M., and Webber, B. 1998. Textual economy through close coupling of syntax and semantics. International Workshop of Natural Language Generation.