Training the Cognitive and Stylistic Aspects of Surgery Through Simulation

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Purpose
The education of a surgeon-in-training involves the acquisition of the sensorimotor skills necessary for performing surgical tasks as well as the refinement of the cognitive processes involved in performing a full procedure. While a number of existing surgical simulators have been developed to train specific skills, there is also substantial benefit to providing trainees with increased experience through simulation in dealing with the wide range of potential scenarios that can arise in the course of performing a full procedure. Ideally, such a simulator should allow the trainee to interact with the virtual environment in a free-form manner, while evaluating his/her performance according to criteria devised and tuned by the instructing surgeon. It should also provide the user with feedback detailing the trainee's weaknesses and how they can be improved.

Materials and Methods
We are developing a framework for a full-procedure surgical simulator that incorporates an ability to detect discrete events, and that uses these events to track the logical flow of the procedure as performed by the trainee. In addition, we are developing a scripting language that allows an experienced surgeon to precisely specify the logical flow of a procedure without the need for programming. At a basic level, the trainee's performance can be critiqued according to whether he/she achieved a specific objective while avoiding "injurous" actions. However, a more thorough simulator should also be able to assess the trainee's adherence to stylistic guidelines specified by the instructing surgeon. Nevertheless, such criteria are significantly more difficult to specify and to quantify.

Results and Conclusions
We are extending our framework to enable training of stylistic techniques. The utility of the framework has been studied through its application to a mastoidectomy [1]. One of the primary components of good technique in a mastoidectomy is exercising appropriate caution when drilling near vulnerable structures. Caution is exercised both by operating more slowly, and by removing only bone in the field of view.

References
[1] Sewell C, Morris D, Blevins N, Barbagli F, Salisbury K: An Event-Driven Framework for the Simulation of Complex Surgical Procedures. Proceedings of MICCAI 2004, II-337.