Towards Customizable Individualized Dialogue Systems

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Background:
Spoken language dialogue systems are one of the few extant examples of an intelligent artifact that can interact with humans. As such, they provide a platform for exploring fundamental cognitive science questions about the nature of human language processing and interaction. Recently, research in this area has moved towards using empirical natural scientific methods that rely on the generation of theoretically motivated hypotheses, derived from cognitive and computer science, which are then tested via experiments on real-time systems with real users. One of the most consistent findings from research on the modeling of human cognition is individual differences in cognitive processing and style, which is as yet unaddressed by these systems. It is our aim to address that here.

Research Problem:
Current dialogue techniques are difficult to customize to new domains and to individual users, who may have quite different needs and preferences (e.g. expert vs. novice users, the elderly, business people vs. teenagers). In previous work, we've developed novel techniques for automatically training dialogue system modules for new application domains. These techniques suggest a new approach to building dialogue systems [Young02], which should allow systems to be automatically customized to individual users. However this promise of individualized systems has yet to be tested.

To date, we've conducted experiments using three different classes of algorithms: (1) user-tailored content selection in generation using multi-attribute decision theory [Carenini and Moore 2001, Walker etal 2004]; (2) reinforcement learning for optimising dialogue management [Walker 2000, Singh etal, 2002, Scheffler and Young 2002]; (3) boosting for spoken language generation [Walker etal 2002]. User-tailored content selection provides a mechanism for customization based on soliciting feedback from the user as to properties of the user's decision-making in that domain. One of the strengths of reinforcement learning and boosting is that the optimization process is driven by an objective function (performance metric) which can be independently specified. Objective functions previously applied include task completion, informational coherence and user satisfaction. However, in order to model individual differences, new objective functions based on neurophysiological information should be developed, to determine for example the cognitive load experienced by a user when processing system-provided information, or an individual's interest in what the system is saying.

To reach the goal of truly personalized systems, a number of open research questions need to be answered. The proposed research would first define new neurophysiological objective functions and then embody them in an end-to-end trainable dialogue system used as a testbed for methods for individualizing dialogue systems. This testbed could then be used to evaluate the effectiveness of these new measures, to explore alternative methods for soliciting feedback from users, training regimes focused on individual training samples, and the use of these techniques to adapt the system on-line and over time, as user needs and preferences change.

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