A Linguistic Model that Infers User States and Traits

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Abstract. This paper introduces the Personality and Emotion Parser (PEP), a model for evaluating the linguistic input of users’ that reflect underlying personality traits and emotional states. PEP is currently being incorporated into AutoTutor, a web-enabled computer tutor that helps students learn by having a natural language conversation with them.

1 Introduction

Building intelligent systems with greater social intelligence is worthwhile given that intelligent systems are becoming increasingly more important in our everyday experiences. We are particularly interested in exploring whether learning systems that possess social intelligence contribute to greater student learning outcomes than systems that lack social intelligence. It seems likely that systems that can adapt to users’ emotional states and personality traits will lead to more positive user perceptions and possibly greater learning gains. For example, an intelligent tutoring system that can detect when learners are frustrated, angry, or confused can adjust its teaching and communicative style accordingly. Similarly, a system that can sense when learners are pleased will know what and when certain actions and responses are desirable [10].

The fields of psycholinguistics, computational linguistics, and human communications have yielded a trove of analytical techniques that can be used to detect users’ emotional states and personality traits, and ultimately, improve the social intelligence of intelligent systems. The purpose of this paper is to introduce a model for detecting the states and traits of users that will inform the development of future intelligent, pedagogical systems that incorporate features of social intelligence.
2 AutoTutor and the PEP Model

AutoTutor is a fully automated, web-enabled tutor developed by Graesser and colleagues at the University of Memphis [5]. The AutoTutor system has been developed for two topics, computer literacy and conceptual physics. AutoTutor poses questions or problems that require approximately a paragraph of information to answer. Although an ideal answer is approximately 3-7 sentences in length, the initial answers to questions are typically only 1 word to 2 sentences in length. AutoTutor engages the learner in a conversation that assists the learner in the evolution of an improved answer. The dialogue between AutoTutor and the learner for one problem typically lasts 30-100 turns. Given that the learner is required to submit a considerable amount of information over multiple turns, student contributions are an ideal source for linguistic analyses of personality and emotion.

Our goal is to equip AutoTutor with facilities that not only serve learners’ pedagogical needs, but also adapt to their emotional states and personality traits. The remainder of this paper will describe the Personality and Emotion Parser (PEP) Model, a model for evaluating the linguistic input of users’ that reflects underlying personality traits and emotional states (see Figure 2).

The PEP Model includes modules that assess users’ personalities prior to the learning session and their emotional states during learning. Personality is comprised of traits that are considered to remain relatively stable over time; therefore, personality profiles for AutoTutor users can be established prior to the actual learning session and should not require frequent updating. User personality profiles will contain data generated by three computational linguistic tools: Linguistic Inquiry Word Count (LIWC, see [8], Coh-Metrix [4], and the Medical Research Council (MRC) Psycho-linguistic database [11]. The emotional states of users, however, are much more precarious and will require constant monitoring by AutoTutor. The users’ emotional profile will be updated after each user contribution and will help determine the nature of AutoTutor’s next dialogue move or pedagogical strategy. The content of each user turn will be analyzed by LIWC, Latent Semantic Analysis (LSA, see [2, 6]), and a motivation analysis module [1].
LIWC. The Linguistic Inquiry Word Count program categorizes words into 74 linguistic or psychologically relevant categories [8]. LIWC has been used in numerous studies to reveal reliable linguistic fingerprints for psychological phenomena such as personality [3, 8], emotion [3, 8], deception [7], and bereavement [9]. Past studies of personality using the LIWC program reveal that Extraverts (compared to Introverts) are more positive, informal, confident, assertive, and stylistic in their language use, whereas Introverts use more negations, first-person pronouns, are more tentative and timid. LIWC will be used to help create the personality profile of the user prior to the learning session and to update the emotion profile of the user during the learning session.

CoMetrix. Coh-Metrix is an automated cohesion metric tool that computes the coherence of texts on over 250 psycholinguistic measures [4]. Unlike LIWC, Coh-Metrix has never been used to identify writers’ motivation, emotion, or personality traits from text samples. Given that Coh-Metrix contains considerably more measures, additional insights about the relations between language use, personality, and emotion may emerge. Coh-Metrix is not included in the emotion assessment portion of the model for two reasons; it requires relatively large text samples (at least 500 words) and it takes roughly ten seconds to generate output. Obviously, all of the emotion assessment modules must compute data rapidly so that the conversation between AutoTutor and the student is not disrupted.

MRC Database. The MRC Database contains 150,837 words and provides information about 26 different linguistic properties. In related research, Gill and Oberlander found that certain linguistics properties derived from the MRC Database (i.e., Brown Verbal Frequency and Concreteness) are related to the personality traits of Extraversion and Neuroticism [3]. Our PEP Model will use the MRC Database in much the same way to determine user personality traits prior to the onset of the actual learning session.

Latent Semantic Analysis. LSA is a high-dimensional, statistical technique that, among other things, measures the conceptual similarity of any two pieces of text, such as a word, sentence, paragraph, or lengthier document [2]. We use LSA in AutoTutor to assess the quality of student contributions by comparing student input to sets of predetermined expectations and misconceptions. The LSA comparison measures are collected over the course of the conversation in order to induce student knowledge about particular topics at different grain sizes [6]. The PEP model will continue to use LSA in this capacity. It seems likely that users’ emotions and motivational states are likely to fluctuate as the quality of their input varies over the course of the tutoring session.

Motivation Analysis. The PEP model also includes a feature that detects user motivation. This feature was inspired by the motivation diagnosis research conducted by de Vicente and Pain [1]. They derived 85 inference rules from think-aloud protocols of observers watching students interact with MOODS, an ITS that helps students learn Japanese numbers and includes a motivation self-report facility. The input categories (or conditions) for the rules are based on student performance, student self-reported motivational states and traits, and the nature of the teaching. The output categories (or inferred motivational states) are based on motivational states that are frequently discussed in the motivation and learning literature (e.g., confidence, cogni-
ative interest, effort, satisfaction). The PEP model has a motivation analysis module that will utilize a subset of the inference rules in which the input categories can be computed by current AutoTutor modules.

4 Conclusions

We have presented a model for assessing learners’ personality traits and emotional states during tutoring sessions with AutoTutor. Unlike other models and techniques being proposed by affective computing researchers, our model relies solely on learners’ linguistic input that occurs in a normal tutoring dialogue. That is, the PEP model does not require learners to disrupt the flow of the tutoring session by stopping to report explicitly their emotional or motivational states. In addition, our approach to inferring users’ states and traits allows users to interact with AutoTutor on a normal PC from virtually anywhere. Specifically, users do not need special equipment to interact with AutoTutor nor are they bound to laboratory settings where expensive equipment and haptic devices typically reside.

References