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The Feasibility of General -Use Expert Systems: A Philosophy of Language Perspective

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Historically, expert systems (ESs) were designed to be systems for experts. Once an appropriate domain was identified, an expert's problem-solving expertise was captured, and his knowledge and problem-solving rules were represented and then validated. An easy-to-use interface then allowed the expert or another expert to use the ES as a colleague or second opinion for the problem-solving task at hand. Expert systems enable experts to perform problem-solving activities more quickly and consistently. Initially, ESs were intended to be used by other domain experts or by someone who was training to be a domain expert. In either of these cases, both the "represented expert" and the ESs' users share similar concepts, training, and experience with domain matters.

Recently, it has been suggested that ESs can be used to leverage an organization's expertise (Hammer and Champy, 1993). Once an ES is developed, the "expert-bounded" expertise can be accessed by anyone in the organization at any time for any reason. Whereas conventional computer-based tools automate well-defined, structured, relatively low-level and routine problem-solving tasks, ESs attempt to capture and model problem-solving tasks performed by highly-skilled people. More complex technical knowledge is required to perform these tasks. When the context in which ESs are used becomes less restrictive, we must question whether the assumptions that are valid for ESs' initial purpose still hold true in a more generalized environment. We must investigate the ramifications that broadening the type of user and purpose might have on the usability of the tool and subsequent outcomes.

Imagine two human experts engaged in a problem-solving dialogue in their domain. They share similar training, problem-solving methodologies, conceptual framework and experience in the domain area. They are able to perceive and question their counterpart's assumptions or methodology and provide alternative views at any time during the session. When one or the other expert notices a breakdown in communication, she can address it when it occurs. Together they can pinpoint what went wrong, negotiate a remedy for the dysfunction and continue problem-solving. An essential part of this exchange is altered when we replace one of the experts with a non-expert. Here, the problem-solving session changes its character and focus; the expert must contend with the non-expert's paucity of terms and concepts with which to convey his ideas. The expert must translate imprecise observations and information into problem formulations that can be solved. Due to a lack of domain knowledge, the non-expert is precluded from questioning assumptions, presenting alternative perspectives, and understanding the interrelationships of apparently isolated phenomena. Further, the responsibility for identifying difficulties with the problem-solving process lies with the expert. When the human expert is subsequently replaced by a computer-based representation of her expertise, the fluidity and fault-tolerance of the preceding example are gravely hindered. The non-expert will still encounter problems articulating his perceptions and questions, yet the computer-based system is incapable of responding with the robust spontaneity of a human expert; it can only present what has been represented in its interface. This can be problematic at best if the interface was designed to be used by another domain expert. The non-expert may not know how to clarify his groping questions, and be incapable of using such ESs due to this confusion. Also, the non-expert may unknowingly provide erroneous input which will distort the problem-solving process and result. Having little exposure to the problem-solving process, the non-expert may be unaware of any irregularities.

Despite the inclusion of an artificial entity, the problems that occur with ESs and non-expert users are reminiscent of the difficulties that can arise between two people engaging in discourse. In this paper, a philosophy of language perspective is used to identify the root causes of problems inherent when non-experts use ESs and to suggest possible remedies. Saussure, the later works of Wittgenstein, Hanson, and Searle investigate the impacts that shared practice and context have on the ability of individuals to

communicate. Grice emphasizes the importance of the audience's recognition of the speakers intention in conveying an idea. These theories suggest that context and audience must be considered for meaning to be conveyed through language. A brief summary of some ideas from the philosophy of language is presented to orient the reader.

The French linguist Saussure (1959 reprint of 1910) postulates a relationship between the abstract structure of a language, "langue," and the language's embodiment in particular statements, "parole." Langue is discovered by learning how the syntax and semantics of a language are used. In turn, statements "mean" something because they are understood in relation to langue. Analogously, expertise is built up by years of particular experiences in the domain area that are abstracted into systematized knowledge. Thus, the expert's language represents a "sub-langue" that is not available to those who are outside of the expert's language community.

From Saussure we see that problems can arise because a non-expert may not understand the langue embedded in the ES. Additionally, a flexible ES may still be incapable of successfully determining and accommodating a user's domain understanding. A possible remedy is to provide non-expert users with tutorials designed to assist them in constructing the necessary sub-langue for using the tool.

Wittgenstein (1953) retreated from his earlier position (1972 reprint of 1922) of an ideally constructed logical language and began to view a word's meaning in terms of its use. Instead of a word having an intrinsic meaning, Wittgenstein states that the way in which a word is used and its context determine its meaning. He offers the concept of "language games" that contain fundamental rules and conditions that allow the possibility of interpersonal communication.

It is not clear to what extent we can teach ESs to play Wittgensteinian language games with the same facility of human experts, although we can anticipate advances in this ability as artificial intelligence technology improves. However, it is not clear whether both ESs and human non-experts need to play their language game at the level of a human expert. It may be sufficient, depending on the context, for the level of play of the non-expert to be raised to play at the level possible by the ES. Interactive media might provide an appropriate context in which users could learn a required language game.

Hanson (1969) differentiates theory-laden and phenomenal words: phenomenal words are descriptive, whereas theory-laden words ascribe causality (and thus have theoretical implications). The more theoretical a word is, the less one can understand it and use it independently of the system it "inhabits." Theory-laden words function as a shorthand for complete propositions whose meaning is clear from their context.

In Hanson, the difficulties previously described with Saussure and Wittgenstein become more convoluted given the multiplicities of theoretical and experiential meaning ascribed to theory-laden words by the various levels of user. Lacking a theoretical groundwork, it is difficult to bring non-experts up to an expert level of understanding of theory-laden words, primarily due to the complexities of identifying and articulating the theories pertaining to these words. This suggests that remedies are difficult to achieve, however we might contain the problem by minimizing the use of theory-laden words presented in the ES dialogue.

Searle (1992) states two necessary conditions for two parties to have a conversation: that they share a communicational purpose, which creates a joint activity; and that they share the same "Background." Semantic content alone is insufficient to understand the meaning of words; the Background is what one must know in order to understand a statement. The Background consists of non-intentional and pre-intentional capacities and phenomena that allow us to think, communicate, and perceive. Searle (1995) distinguishes between the "Deep Background" that contains the general just-because-we-are-human set of capacities and "Local Practice" that contains the idiosyncratic capacities we develop through our choices and experiences. The more one knows in an area, the less semantic content is needed to convey her ideas; the Local Practice completes her semantic utterance. Searle (1992, 1995) also postulates a web of knowledge, belief, opinion, skills, and ways of dealing with the world that he terms the "Network." The

Network is composed of intentional states whose interconnections support and further their meaning. The Network is the "representable scaffolding" that creates the possibility for the non-representable Background. Searle points out the insufficiency of a statement, itself, to convey its meaning and posits the necessity of a shared Background for successful communication.

Through electronic media we acquire vicarious low-level understandings of complex theoretical concepts, which exist in our Background. However, non-experts understand these concepts according to their non-expert Background. Searle argues that expertise is a product of long-term experience in a domain area. However, there is a difference between an actual expert Background and a Background that enables one to converse with an expert. The challenge is to either change the non-expert's Background to competently interpret expertise or to design an interface capable of assessing domain knowledge level and presenting appropriate dialogue.

Grice (1987 reprint of 1957) shifts consideration from a statement's semantics and syntax to the statement's intended audience: a statement's meaning is dependent on the audience's response to the speaker's intention. A speaker's statement means something only when his intention is recognized by his audience. Thus, the speaker must have his audience in mind while formulating and articulating his intention.

ESs with a single mapping of meaning to experience level will fail in a Grician sense for some class of user. For each type of user, the expert must specifically articulate his expertise for the experience level of such a user. This suggests the need for multiple ESs, each with appropriate expert-provided expert-to-audience mappings.

Each of these philosophers challenges us to look beyond the actual statement for its meaning. That ESs require their users to convey problem characteristics rather than to possess tool-based skills suggests that widening the range of users would be easy to accomplish. However, the philosophy of language perspectives presented above suggest that the viability of the problem-solving process may be inhibited when a human non-expert consults a computer-based expert.

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