

Mediating Intelligence through Observation, Dependency and Agency in Making Construals of Malaria

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Abstract. Achieving co-adaptation in building an Intelligent Tutoring System (ITS) involves integrating machine and human perspectives on ‘knowledge’ and ‘intelligence’. We address this integration by using Empirical Modelling (EM) principles to make *construals*: interactive environments in which human agents acting as model-builders can explore the observation, dependency and agency that underpins their understanding of the subject domain. This approach is well-suited to domains such as medicine where reasoning draws both on scientific knowledge and evolving human experience and judgement. We illustrate this by developing construals of malaria using a web-based variant of the principal EM tool that enables many agents to participate in the process of adaptation.

1 Introduction

In supporting co-adaptation in an Intelligent Tutoring System (ITS), the conceptual framework surrounding ‘knowledge’ and ‘intelligence’ has a critical role. The well-known problems of adapting software to meet new requirements suggest that something richer than the conventional conceptual framework for computing applications is appropriate. Where a traditional computing system is conceived as a ‘program’ that reflects a paradigm of ‘computational thinking’, Empirical Modelling (EM) [1] proposes a broader perspective on computing based on the more primitive notion of ‘construal’. A *construal* is an interactive environment in which a human interpreter can experience metaphorical counterparts of the different states and transitions between states they encounter in a phenomenon they wish to understand.

In this paper, we briefly discuss the use of construals to support learning activities in which adaptation to new information or agent behaviours is essential, with specific reference to medicine. A conventional ITS can give excellent support for medical education where learning terminology, factual information and standard protocols is concerned. But clinicians and researchers can also benefit from complementary learning resources that help to develop informal and tacit knowledge that may guide their judgement. A construal fulfils this role by inviting engagement from learners with different goals, expertise, and experience. Rather than supplying definitive answers, this activity stimulates questions, and forces the learner to reflect upon their knowledge and experience. This is vital in medical education, where educators must learn to cope with emerging science, evolving practice, and ever-changing contexts.

2 Construals of malaria

A potential application to medical education has been illustrated by developing online construals of human malaria infection [2]. More details of the principles behind this development, the construction process, and the relationship between construals and traditional computer models are given in the full version of this poster paper [1].

Observables of many different kinds are associated with understanding malaria. These can be classified according to the role of the modeller (e.g. clinician, medical researcher, malaria patient), the nature of their observation, and the other agents relevant to the modelling context (e.g. Plasmodium parasites and associated hosts). Two principal construals for malaria infection have been developed: one specific for *P. Vivax* and the other made generic. In making these construals, the modeller potentially has the current status of many relevant observables in mind. These range from the patient's current temperature or likely haemoglobin to the current activity in the blood and the biochemical interactions that are as-of-now occurring. Though it is plausible that observables of all these kinds inform the modeller's mental model, the modeller cannot actually apprehend them all in one and the same state.

The *constructed* nature of the modeller's perception of state highlights the fundamental character of a construal, and its potential educational role. The correspondence between the modeller's experience of the construal and its referent is always necessarily incomplete and in some aspects uncertain. This uncertainty is a positive rather than an undesirable feature in the learning context. The modeller can maintain the construal through carrying out exploratory interactions and rehearsing interpretations. This activity provokes questions, and may lead them to qualify their mental model in different ways, whether consolidating, refining, or softening the perceived connection between the virtual and real world. Of their nature, construals also echo the learning activity underlying the actual historical development of understanding about malaria.

3 Conclusion

EM construals for medical education are still at an early stage of development. They lack the computational ingenuity of techniques to support adaptation in conventional ITSs, but have rich promise for adaptation and co-adaptation from the *human* perspective. Suitably developed, EM tools may be a useful collaborative vehicle for helping the many participants in the learning context to communicate, critique, refine and share their mental models. They will also promote that blending of virtual and real experience, of technical problem-solving with creative problematisation, and of scientific and human perspectives that is vital to fields such as medicine.

References

1. Beynon, M. and Beynon, W.: Construals as a Complement to Intelligent Tutoring Systems in Medical Education, Computer Science RR #449, University of Warwick (2012).
2. <http://go.warwick.ac.uk/em/publications/papers/119> (14/3/12)