**PEDRO: Assessing Presentation Decodability on the Basis of Empirically Validated Models**

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**Abstract.** This chapter describes a psychological experiment performed in the framework of a user modeling component that makes use of Bayesian networks to anticipate the decodability of presentations planned by a multimedia presentation system. The goal of this empirical study was to test the validity of the assumptions contained in a decodability model postulated for the problem of reference resolution. This paper briefly introduces the user modeling component and describes the experiment.

1 Introduction

In order to determine whether a presentation will be effective and efficient for a particular user, a multimedia presentation system needs to consider several factors. These include: 1) the type of information, 2) the type of media available, 3) the goal of the presentation, and 4) the characteristics of the individual user.

Many research groups in the field have focussed on the use and coordination of multiple media. For *media allocation*, they generally take into account the factors type of information, available media, and – although to a lesser extent – the user’s task.

Also, several projects have started to integrate user modeling techniques to adapt presentation contents to the individual user, thus trying to ensure that a presentation is effective in the sense that it lies within the user’s understanding capabilities. However, this type of adaptation only concerns the contents of the presentation. Therefore, one could regard this not to be really characteristic of automatic multimedia presentation but rather of automatic presentation in general (e.g. also of purely textual presentations).

However, also at the surface level of generation, the user’s familiarity with the particular code used is important. Graphics, for instance, can be regarded as a language itself with each element having a specific meaning. Here, the effectiveness and efficiency of a presentation depend not only on the type of information and the user’s task, but also on the individual’s knowledge with regard to the specific graphical language used. So far, adaptation to the *individual* user has

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been more or less neglected (see van Mulken, 1997; 1998). Neglecting the characteristics of the individual user may render invalid the system’s estimate of what would constitute an effective and efficient presentation for a given communicative goal.

This paper therefore advocates an approach implemented in the system PEDRO\(^1\) that explicitly takes into account the specific characteristics of the user while estimating whether a planned (textual or graphical) presentation will be effective and efficient for a particular individual. PEDRO was built with an orientation toward the hypermedia system PPP (see e.g. André et al., 1996; André and Rist, 1996; Wahlster et al., 1993).

PEDRO exploits Bayesian networks to make predictions about the decodability of a presentation and to interpret evidence received from user input. The Bayesian networks represent the variables and their interrelations that play a role in decoding presentations. Some of the models – that is, the specific variables and their relationships – were investigated empirically in psychological experiments.

In the following, it is first pointed out how the systems PPP and PEDRO can interact with each other so as to raise effectiveness and efficiency. Then, an empirical study that examined the validity of one of the models is described.

2 Approach

As it is impossible to anticipate every possible decoding problem beforehand, the strategy adopted in this work is that of an anticipation feedback loop (AFL) (Jameson and Wahlster, 1982). In the present work, AFL means that the presentation system plans a presentation as usual, but that before outputting this presentation, it is evaluated with regard to decodability for the intended user. Not until the planned presentation is rated as decodable is the presentation actually output.

Using an AFL in this manner, the decodability of a presentation can be taken into account on-line. Thus, also decodability problems that are hard to anticipate – and that are therefore hard to specify design rules for – can be considered. The problem then comes down to predicting how likely a user is to decode a presentation as intended. This in turn comes down to a prediction of whether the user will draw particular inferences required by the presentation. For this reason, the system needs to have a representation of what causes a particular inference to be more or less easy to draw.

PEDRO represents its decodability knowledge using Bayesian networks (BNs). BNs are directed acyclic graphs whose nodes represent chance variables. The edges in the networks represent the (causal) relationships between the variables. The nature of the relationships between the variables are represented in conditional probability tables. In such a table, for each combination of values (e.g., true or false) of a child and parent variable, a conditional probability is stored.

\(^1\) PEDRO stands for PrEsentation Decodability pRedictOr.