Available online at www.sciencedirect.com
SCIENCE DIRECT
The Foot 15 (2005) 190–197
The Foot
www.elsevierhealth.com/journals/foot

Attitudes to expert systems: A card sort study

Michael Curran *, Gordon Rugg, Susan Corr

The University of Northampton, Boughton Green Road, Northampton NN2 7AL, UK

Abstract

Background: It is sometimes difficult to make a diagnosis in podiatry and expert systems may help to improve the situation. Card Sorts Methodology may be a useful technique to explore attitudes towards the use of expert systems within a domain. Although card sorts have been widely used for decades, they have tended to be viewed as an informal technique for initial exploration. More recent work in knowledge acquisition and in requirements acquisition has changed the situation by developing more powerful, formalized versions of card sorts.
Objectives: The aim of this study was to investigate podiatrists' perceptions of expert systems in relation to their perceptions of other diagnostic aids.
Method: Two groups of seven participants composed of Podiatry lecturers and Nursing lecturers were asked to sort cards containing various diagnostic aids.
Results: Expert systems are viewed as very different in kind from the other diagnostic aids.

Keywords: Expert systems; Attitudes; Card sorts; Personal Construct Theory; Podiatry

1. Introduction

It is often difficult to make a diagnosis in podiatry and it has been suggested that using expert systems may help with this process [1]. This article examines issues relating to podiatrists' attitudes towards the use of expert systems in podiatry.

A striking feature of Kelly's Personal Construct Theory (PCT) [2] is the relationship between the theory and a single technique, namely repertory grid technique. Although there have been numerous refinements to the technique, and some development of complementary techniques such as laddering [3], PCT is still closely linked with repertory grid technique. This paper examines issues affecting choice of technique, and describes the use of card sorts within a PCT framework.

The repertory grid has been a central feature of PCT from the start. The earliest versions used binary values, indicated with symbols such as a tick and a cross; later versions extended the measurement types for cell values to include ranking and rating, with a range of options such as allowing tied values for ranking, and the use of "don't know" or "not applicable" cell values. Statistical packages have been available for analysis of repertory grids for decades, and there is a well-established and sophisticated literature on this topic, ranging from standard introductory texts such as those by [4] to highly specialized articles. The standard repertory grid can also be used in various ways, such as exchange grids, where two or more individuals complete a grid from another person's viewpoint [5].

Something, which has received less attention, however, is the knowledge representation and measurement theory issues involved in use of repertory grids. Repertory grids, as is apparent from the discussion above, are well suited to representing knowledge which is binary or scalar. Unfortunately, not all knowledge is of this sort; knowledge may also be nominal, i.e. consisting of discrete categories which are semantically related but do not form any sort of scale. An example in the domain of types of automobile is "place of manufacture", where the possible values might include "USA", "UK", "Japan", etc. Although these categories are clearly related to each other, there is no simple way to represent this in standard repertory grids. It is possible to represent each place of manufacture as a separate construct, and then represent each element using binary values—for instance, the construct "made in the USA?" could have the values "yes" and "no"—but this involves treating each place of manufacture

* Corresponding author. Tel.: +44 1604 892771; fax: +44 1604 892771.
E-mail address: Mike.Curran@Northampton.ac.uk (M. Curran).

0958-2592/$ – see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foot.2005.07.001

separately, thus losing the semantic relationship between the categories, and is also very cumbersome.

This would not be a problem if nominal values were a rare exception, but the evidence so far suggests that nominal values are widespread: of three studies which specifically included analysis of the frequency of nominal values in real world domains, all three found high incidences of nominal values. The domains involved ranged from identification of minerals in geology [6] to Web page design for sugar beet farmers [7] and Web page design for private schools [8]. This is consistent with earlier work by York [9] and strongly suggests that a domain should be investigated before an elicitation technique is chosen, to ensure that the technique used is capable of handling the knowledge types involved. This is a topic in its own right, beyond the scope of the present paper; detailed frameworks for choice of technique are presented by Maiden and Rugg [10], Rugg et al. [11], and Rugg and McGeorge [12].

A convenient way of handling nominal categories is to use card sorts. Card sorts have been widely used for decades on an informal basis, usually for initial exploration, but have until recently received little formal attention. With increasing attention to elicitation techniques in the fields of knowledge acquisition and requirements acquisition, card sorts have received more detailed attention as a technique in their own right [13].

There are numerous varieties of card sort, including the version used in Q methodology by Stephenson [14]. Although the latter is an interesting topic in its own right, it is outside the scope of the present paper, which focuses on a particular variety of card sort highly compatible with PCT. This variety involves the participant sorting a pack of cards repeatedly, using different criteria of their own choice each time a sort is performed. The similarities to eliciting different constructs with each line of the repertory grid are clear, and many of the issues involved in analysis of the resulting data are very similar to those involved in analysis of repertory grid data, both conceptually and procedurally.

This version of card sorting has been widely used in knowledge acquisition according to Firlej and Helens [15], and is described in some detail by Rugg and McGeorge [16]. The present paper describes the method using a worked example from the domain of medical diagnosis in podiatry, and locates the method in relation to other techniques from PCT, particularly repertory grids and laddering. The aim of this study was to investigate podiatrists' perceptions of expert systems in relation to their perceptions of other diagnostic aids.

2. Method

2.1. Participants

Work by Gerrard [17] suggests that there may be a gender difference when using card sorts, in that females may sort cards in a different manner to males, with males using more dichotomous sorts (i.e. sorts into two groups, as opposed to more than two). Work by Carswell [18] also suggests this. The gender balance of the participant groups was therefore controlled. There were two groups of participants, each with seven participants, composed of Podiatry lecturers and Nursing lecturers from the Staff of University College Northampton. There were five male lecturers and two female lecturers in each group chosen, as they are leaders in their domains.

2.2. Apparatus

The first step in card sorts, as with repertory grids, is to choose the elements. These are usually termed "entities" in knowledge acquisition and requirements acquisition, for historical reasons. The issues involved in choice of entities are much the same as in choosing entities for repertory grids (even semantic spread, etc.), but with one significant difference. Card sorts may be performed using either names of entities, or pictures of entities, or the entities themselves (card sorts, picture sorts or item sorts, respectively). The latter two approaches are particularly useful for cross-cultural work, since the pictures and items are independent of the investigator's language, unlike names of entities; picture sorts are also well suited to topics such as investigating perceptions of Web pages [19] where the entities are themselves images. Usually the number of entities is similar to that of elements in a repertory grid (about 8–25), mainly for practical reasons. Each entity is given a sequential number for ease of recording, as demonstrated below.

For this case study, the entities chosen were seven hospital investigations and laboratory tests as featured in a standard Podiatry textbook [20]. Another card, namely "Expert System" was added to this set, since the purpose of the study was to investigate podiatrists' perceptions of expert systems in relation to their perceptions of other diagnostic aids. Each card therefore bore the name of a diagnostic aid, as follows:

(1) Histology
(2) Biochemistry
(3) Blood analysis
(4) Microbiology
(5) Urinalysis
(6) Radiology
(7) Expert system
(8) Ultrasound

3. Procedure

Participants were given a briefing sheet and a set of instructions. Once the participants had read these and indicated that they were ready to proceed, they were given the cards and asked to sort them into groups of their own choice, using only one criterion of their own choice at a time for the sorting. In addition, the participants were asked to state the viewpoint