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KNOWLEDGE-BASED SYSTEMS FOR ASSESSMENT

The task of assessing a person's need for a communication aid is
complex, and many skills are required to reach a satisfactory
conclusion. It is suggested that the task of collating the advice from a
large number of professional and other sources could be significantly
facilitated by deploying knowledge-based techniques.

COOPERATIVE DECISIONS.

Panton(1) discusses the question of techniques for assessing people's requirements for communication aids. She emphasises the wide variety of skills and areas of expertise which should be brought to bear on the decision : ergonomicists, speech therapists, occupational therapists, rehabilitation engineers, audiologists, psychologists, teachers, family, friends, and others all have their part to contribute in finding the best solution for an individual. Moffat and Jolleff(2) and Brown(3) present similar cases, adding other professionals to the list. Handleman and Harris(4) present an analogous case for the "developmentally disabled", a group including people with both physical and mental handicaps. The general case for "collaborative consultation" is made by Gibson(5).

Doubtless these writers put forward the ideal case, and it would be gratifying to believe that every decision was made with the care and complete presentation of evidence from all possible relevant sources which they recommend. It is no reflection on the people concerned in the decisions to suggest that this may not always be what happens. The sheer expense of collecting and combining judgments from such a large number of contributors is inevitably considerable; and the difficulty of incorporating all views into a balanced conclusion would be formidable. Some of the difficulties which can impede satisfactory communication between the contributors have been reviewed(6). In such circumstances, any assistance which can be offered in reaching a conclusion would be well worth while. Indeed, Brown(3) makes explicit mention of the need for compromise : "... it is important to ensure that the compromise solution is achieved out of a balanced and complete appraisal of the person's condition". He also remarks on the need for *continuing* assessment to ensure that the aid provided continues to serve its purposes as its owner's facility in using it waxes or wanes.

EXPERT SYSTEMS ?

One way to handle such complex knowledge-based tasks is through an expert system. An expert system, even if it does little to contribute directly to the final assessment, is particularly valuable in its ability to check details : to make sure that all questions which should be asked have been asked, to identify and report any seeming anomalies in the available information, to combine together impartially the views of many contributors. Expert systems also have the potential to "learn" items of knowledge from expert advisers, and to apply them where relevant to the facts of the current case. They can also be valuable in their unemotional presentation of cases of conflict which must be resolved : for example, if an inconsistency has been detected, an expert system can continue to request that it be resolved somehow, and no amount of bluster or intimidation will prevail against it. One could imagine this feature being of value in countering the well-meant, but misguided, enthusiasm of many technical experts in their eagerness to provide the most recent, elaborate, and expensive imaginable aid, because it's the best possibility (which may be true) and therefore the only possibility (which may not).

AN ALTERNATIVE APPROACH ?

A rather less ambitious approach can be seen, in embryo, in work reported by Creak and Davies(7). They regard the arguments which must be worked through in arriving at an agreed position as likely to be too complex or subtle to be settled by an expert system, so concentrate on organising the arguments put forward by the participants in the debate, and attempt to ensure that each argument step is checked and available for rechecking, and that any overt inconsistencies are identified and exposed. They have not implemented their proposed method, but are cautiously optimistic, on the basis of simulated experiments, that it could be a useful aid to discussions between two or more parties.

SOME CASES.

Moffat and Jolleff(2) remark on the continuing need for reviewing the way the computer is used in the classroom. The problems here are different, and another set of experts must be consulted to find the best way of using the available resources to help each individual pupil. Le Patourel(8) focuses attention on the needs of those with progressive illnesses; again, regular assessment is vital if these needs are to be met as the person's condition changes. Yet again, it seems that there are opportunities to exploit the capabilities of an expert system.

Dipner and Gattis(9) propose (but do not appear to have implemented) an expert system designed to make available information on the sorts of rehabilitation aid which are available to provide assistance for various forms of disability. Their system would take into account not only the nature of the disability and the characteristics of the devices available, but also what they call the "life purpose" - the sort of activity for which the aid is required. An important factor in choosing an aid, or a set of aids, is the environment in which the person for whom they are intended proposes to use them. A computer to be used at home mainly for playing games is not necessarily well suited for carrying between home and school, and being used for schoolwork, but too often such considerations are left out of account. An expert system can prompt for details of both the person who will use the system and the reason behind the need for the system, and guide the selection process accordingly.

An expert system designed to choose communication devices for children with cerebral palsy is described(10). It has been constructed and tested, and works. A simple expert system which can select a communication device given information about the person who will use the device has also been reported(18).

SOME POSSIBILITIES.

After assessment, then what ? That must depend on specific details of each case, but one common requirement, particularly with children, is education. The assessment process gives much important information of use in planning a curriculum, which for best effect must be specifically designed to fit each case. Once again, expert knowledge is required(11), and must be kept up to date.

It is interesting that some of the teaching techniques for elementary skills as recorded by Handleman and Harris(12) seem to be very simple and mechanical, and well adapted to implementation by computer means. The most difficult part of that task would be to identify the learner's response, especially seeing that a developmentally disabled child may not give the sort of response you would expect from a fully able-bodied person : perhaps artificial intelligence techniques would be useful.

Yet another possible niche for an expert system is suggested by Easton's comments(13) on the need to train those who help disabled people in looking after their equipment. As this becomes more technical in nature, it is less likely that parents, relations, or friends will have the technical skills needed to cope with any breakdown in the equipment(14). Expert systems have been widely applied in diagnosing machine faults, just as they have with people's faults, and many comparatively simple problems could well be amenable to treatment by comparatively unskilled people with the help of expertise encapsulated in an expert system. This becomes particularly important as health policy moves away from institutional care (which, whatever its faults, made it possible to provide technical help close to a large number of people who might need it) to community care (where no such provision is possible, and someone with a faulty wheelchair might have to wait a long time for service).

WHICH WAY ?

Chew and Creak(15) have argued that the trend in expert systems is towards greater complexity, with systems handling a multiplicity of knowledge bases, knowledge sources, and other things. An expert system to cope with this assessment task would certainly be of this sort.

It might be too hard to manage by the expert systems techniques. An expert system is a problem solver; it is designed to collect and deploy knowledge about some field of application, and to use that knowledge to guide its solution of a problem presented to it. In the decision-making tasks which we propose to address, though, the knowledge is available; the task is to coordinate it as it is proffered from different sources, to identify interactions, and to make sure that the final solution takes into account all

the factors involved. If there is a problem, then it is more in the area of diplomacy than therapy, and an expert system would have to operate at that level if it were to be successful. That being so, a debate moderator could be a more practicable aim, at least in the first instance.

Of particular interest would be the possibility of a *long-term* system, which would carry through from initial assessment for the duration of the person's use of communication aids. It would be involved in reviewing the person's changing physical abilities; and also in keeping track of the person's needs, such as the evolving educational needs mentioned above. Add to this the potential for taking into account new technological developments, and it is seen that the system would have a very important role to play in improving the quality of the person's life. An important part of constructing such a system is *knowledge acquisition*, the collection and encoding of expertise in the field concerned. In the field of patient assessment, once again we must cope with a multiplicity of experts, which makes the problems of knowledge acquisition more acute. Methods for handling these problems have recently been investigated[16][17].

Finally, it is interesting to observe a parallel from another field. Surprisingly similar remarks can be made in what at first sight might seem to be a completely different context : the legal system. Berman and Hafner[19] record the opinion "there is far too much law for those who can afford it and far too little for those who cannot", which sets the tone of their discussion; and the title of their paper - "The potential of artificial intelligence to help solve the crisis in our legal system" - shows the trend of their thoughts. This quotation from their paper draws the parallel :

> *In the ideal case, legal decisions are made after lengthy study and debate, recorded in published justifications, and later scrutinized in depth by other legal experts. In contrast to this ideal, most day-to-day legal decisions are made by municipal and state court judges, police officers, prosecuting attorneys, insurance claims adjusters, welfare administrators, social workers, and lawyers advising their clients on whether to settle or litigate. These decisions must often be made under severe pressures of limited time, money, and information. Expert systems can provide decision makers with tools to better understand, evaluate, and disseminate their decisions. At the same time, it is important to reiterate that expert systems should not and cannot replace human judgment in the legal decision making process.*

Only a few words and titles need be changed to fit that quotation to the rehabilitation environment. The authors recommend two sorts of expert system which they believe could help to alleviate the consequences of this unsatisfactory state of affairs. They distinguish between *predictive* expert systems, which would take into account previous case histories in order to predict the results of taking some legal step; and *normative* systems, which look backwards rather than forwards, compare the circumstances of a case under study with other cases on record, and identify those of particular relevance to the current concern.

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