

Expertise van huisartsen : praktijkervaring, kennis en diagnostische hypothesevorming

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SUMMARY

The central proposition put forward in this thesis is that experienced doctors produce better diagnostic hypotheses than doctors with less experience, because they make more extensive use of contextual information about patients available to them. In this thesis we define contextual information as the additional information available to a doctor at the time when the patient expresses his complaint. This knowledge helps the medical practitioner restrict the number of possible diagnostic alternatives, given the complaint or the symptoms presented by the patient, to the number of probable ones. This may concern information which does not form an essential or sufficient condition for the development of a particular illness in a patient. It is therefore not essential for an underlying causal pathophysiological relationship to exist between the information which is already available about a patient and the present complaint or present clinical picture (although this may be the case, or at least such a causal relationship could be suspected). It is for this reason that we have referred to this kind of information as 'contextual information' in this thesis; it does not concern information which necessarily has a direct relationship with the clinical picture in question, but that is recognized by the experienced doctor in its context.

The theoretical basis for the study is provided by the idea that in diagnosing diseases, doctors have so-called illness scripts (Feltovich & Barrows, 1984) at their disposal, i.e. cognitive structures in which their knowledge of certain diseases is organized. According to Feltovich and Barrows, these scripts consist of three elements: "enabling conditions," which we refer to here as contextual information; a "fault," the dysfunction of the organism and the pathophysiological mechanisms which result in this dysfunction; and "consequences," the results of the dysfunction as expressed in complaints and symptoms. Knowledge of the context and knowledge of the complaints and symptoms should together result in the identification of the dysfunction in the diagnostic situation.

In our opinion, knowledge of the context in which illness can arise is vitally important to the diagnosis, particularly for General Practitioners (GP's). Furthermore, in this thesis we assume that in the development of illness scripts, practical experience with diseases in all its forms is an important element. The more experience a doctor has with a particular illness, the more detailed his or her illness script will be for that disease and the more detailed in contextual information. In order to study these propositions, we carried out a number of experiments, summarized below.

In Chapter 2 an experiment is described in which 18 experienced GPs and 17 medical near or recent graduates of medical school were shown 32 sets of three slides. The

first slide showed a photo of a patient, whose age and sex could be divined. The second slide showed the so-called "green card" which provides patient file information, such as place of residence, type of work, lifestyle, medication, previous illnesses and operations etc. The third slide comprised a brief description of a complaint or symptom, for example: "I became unwell on a number of occasions, my heart began to thump. And during the past few days I vomited a couple of times." The first two slides therefore provided contextual information about the patient. The slides were shown for a set amount of time. The task of the test subjects was, given this apparently very brief information about a patient, to formulate an initial diagnostic hypothesis. The correctness or incorrectness of this initial diagnostic hypothesis could be determined because the 32 patient descriptions were based on "real" patients, the nature of whose illness had been established with certainty. The results showed that experienced GPs, i.e. doctors with an average of 10 years experience, performed considerably better than the group of medical recent and near MD's. Using the information available, the experienced GPs made a correct diagnosis in almost 40% of the cases, while this was the case in 27% of the cases for the inexperienced doctors. The test subjects were later asked what information they remembered about the patients shown. It appeared that experienced doctors remembered on average 25% more information from the slides, indicating that they had processed this information more intensively in a cognitive way. The difference can be totally explained by the fact that experienced doctors remembered more relevant information pertaining to the illness; irrelevant information was not remembered better. From these findings, we concluded that the better diagnostic performance of experienced doctors can be explained by the fact that these doctors make more intensive use of contextual information in interpreting the complaint or symptom. Not only this is proved by the fact that relevant contextual information was remembered better; it is also supported by the fact that the amount of relevant information remembered correlated 0,63** with the correctness or incorrectness of the diagnosis (while irrelevant information remembered did not appear to be correlated with performance). These results suggest that expertise mainly seems to be a function of an abundant set of contextual knowledge related to the knowledge of symptoms and complaints associated with a particular illness. In discussions concerning this first experiment, it was noted that there may still be alternative explanations for the result. Given the set-up of the experiment, the possibility may not be excluded that the experienced doctors performed better, not because they made more intensive use of the contextual information, but, for example, because they have more detailed lists of possible diagnoses for a given complaint. It is possible that doctors develop a personal epidemiology which tells them which illness is most probable, given the nature of the complaint of symptom. Finding a causal relationship between the use of contextual information and diagnostic performance requires actual experimental manipulation of that contextual information.

Such an experiment is described in Chapter 3. In this second experiment, 16 experienced doctors and 16 inexperienced doctors were presented with 18 cases under two conditions. Eight experienced doctors and 8 inexperienced doctors were given the 18 cases with context, i.e. for each case they were shown the portrait, the green card and the complaint. The other 8 experienced and 8 inexperienced doctors were

only shown the complaint. If experienced doctors make more intensive use of context, it should be expected that the omission of the context would have more effect on the performance of this group than on the performance of inexperienced doctors. The results supported this hypothesis. When the context in the form of the portrait and the green card was present, the experienced doctors formulated a correct diagnosis in no less than 54% of the cases. Where there was no context, this applied in only 31% of the cases on average. In addition the results showed that inexperienced doctors profit far less from the availability of context information: 26% as opposed to 19% correct diagnoses. The diagnostic performance of experts is therefore reduced by 23% when there is no context, while the performance of the inexperienced is reduced by a mere 7%. It can therefore be concluded that the latter group does not utilize the information actually available to the maximum extent. A statistically significant interaction effect between expertise level and manipulation of the context supports this conclusion. As this experiment also reflected the same difference in performance as was found in the first experiment between experienced and inexperienced doctors, we concluded that the increasing use of contextual information is related to experience. Doctors learn to use contextual information as a result of their experiences with patients.

This proposition is aptly illustrated by a study described in Chapter 4. In this study diagnostic performance in the task used in the experiments discussed above was related to the number of years during which a doctor had been active in practice. There appeared to be a positive relationship between both variables. The Pearson product moment correlation coefficient was equal to 0.69. This means that no less than 47% of the variance in performance between the participating doctors could be explained by the amount of experience they had, expressed in years in practice. Interestingly, a hypothesized linear relationship between both variables did not produce a lower correlation than a second order relationship which, based on intuition and on stories circulating among doctors, was more or less expected. This means that diagnostic expertise concerning the generation of diagnostic hypotheses increases linearly even after 30 years in practice.

Chapter 5 reports on experiment IV. Experiment II put us on the trail of the relative effect of context versus the complaint on diagnosis. After all, the results of that experiment showed that, already in response of the complaint alone, experienced doctors produce even better performances than unexperienced doctors. It was even the case that the experts in the experiment scored higher on the basis of the complaint alone than the "beginners" on the basis of complaint plus context (although the latter was not statistically significant). This leads us to question of the relative importance of both kinds of information in the formulation of a diagnosis. Is it the case that the diagnosis (or a number of diagnoses) is first generated by the complaint, and then its plausibility evaluated on the basis of context information? Or is it rather the other way round? Does context information perhaps suggest a number of possibilities which are then weeded out as the complaint information becomes available? In the latter case, context should have a broad "stage-setting" function instead of acting as a source of information against which concrete hypotheses can be tested. The plausibility of both views were tested in the following experiment. Experts and newly quali-

fied doctors were confronted with 18 patient problems in the form of the familiar three slides. These slides were organized in two ways. Half of the test subjects were presented firstly with the complaint and then the context slides; the other half saw them in the order context-complaint. In addition to measuring diagnostic accuracy, the time used to produce them was also measured and subjects were later asked what they could remember about the different cases. It was expected that if the complaint generated the diagnosis, while context mainly acted as a test pool, participating subjects under the condition complaint-context would perform better, i.e. they would require less time to study the case and would score significantly better as regards how much information relevant to the diagnosis they remembered. If, on the other hand, diagnoses were mainly generated by context information, then the information under the context-complaint condition would be processed more quickly and more information would have to be remembered under this condition (both relevant and irrelevant as regards the final diagnosis). Furthermore we hypothesized that if knowledge accessibility is the main factor, diagnostic accuracy will be better in the complaint-context order, provided scripts are exclusively triggered by the complaint. In contrast, when scripts are solely triggered by contextual information diagnostic accuracy will be better in the other presentation order. If knowledge availability is the most important factor that determines diagnostic performance, no effect of presentation order is expected.

However, no differences were discovered in the diagnostic performance of both expert groups, although again they produced significantly better diagnoses than the novices. This means therefore that the content of illness script knowledge is apparently more important than the way in which that knowledge is activated. The time necessary to generate a diagnosis was significantly shorter in the condition where the complaint is presented before the contextual information. This suggests that diagnosis is indeed mainly generated by the complaint. However, technical shortcomings in the set-up of the experiment might have been the reason for this, partly because the results relating to the recall of the information which was relevant to the diagnosis do not support the above finding. The recall results rather provide arguments in favour of activation by contextual information. All in all, neither of the rival explanations could be excluded with this experiment. It is, however, clear that both the complaint and the contextual information activate relevant illness scripts. However, it is not clear which of the two sources of information do this most explicitly. The complaint seems to have more specific effects here than contextual information. In relation to their less experienced colleagues, however, experienced GPs seemed to be intensively involved with forming a hypothesis even before the complaint was presented, without this diminishing their diagnostic superiority. In this process they mainly use information relating to the patient's medical history and use of medication. From the differences in speed and depth of the processing of relevant information in the condition where the contextual information was given prior to the complaint, we conclude that experienced GPs have a knowledge base containing many pre-existent illness scripts (probably several per diagnosis). They therefore seem more capable of activating correct illness scripts, purely on the basis of specific information in context, such as use of medication or previous medical history.

Finally in Chapter 6 an attempt is made to study more directly the illness scripts which are assumed to lay the foundations for the superior diagnostic performance of experienced doctors. We used a narrative methodology for this. Doctors with various levels of expertise were presented 18 sets consisting of a complaint and a diagnosis and asked to describe a typical patient with this complaint and this diagnosis. The resulting protocols were analyzed according to the numbers of references to enabling conditions, faults and consequences. The data showed that the descriptions of the experts contained more contextual information (enabling conditions) and fewer references to the fault and to complaints and symptoms. These findings suggest that experienced doctors do have larger knowledge relating to the context of a disease than newly qualified doctors, even though the difference was smaller than expected, meaning that it cannot completely explain the great effects of context on diagnostic performance previously found. It may be that both experienced and inexperienced doctors have this knowledge, but that this knowledge only becomes functional, i.e. is only used, when under the influence of experience. A second finding was that the majority of the descriptions produced could be easily classified in the categories of the model of Feltovich and Barrows (1984). Even more interesting was the discovery that doctors also produced information relating to the treatment of the various complaints, although this had not been requested of them. This suggests that knowledge of diagnosis and treatment are part of the same script and are therefore activated simultaneously.

The research described in this thesis makes various contributions to further support the idea of illness script. In fact the studies discussed in this thesis mark the first attempts to empirically show the psychological reality of these cognitive structures. Although the concept of illness scripts, which form the basis on which doctors operate in routine cases, is almost commonplace in the community of researchers active in this field, this was not the case when this research was started, now seven years ago. The dominant view at that time was that experienced doctors had a more extensive fund of knowledge than people with less expertise in a field, and this fact allowed experienced doctors to make a correct diagnosis by means of careful, "deep" reasoning. Pattern recognition, now generally seen as the main characteristic of real expertise, was then considered a risky business which doctors should avoid. An initial contribution provided by the research described in this thesis to the development of the theory is therefore the idea that the knowledge on which doctors operate in routine cases, has a script structure and that knowledge which is organized in these scripts is rather clinical than causal biomedical.

A second contribution of our research is that it has focused attention on the great significance of the context in which an illness develops for its diagnosis. As has been shown in the study presented here, contextual cues belong to the schemes which experts use to understand their world. The research is related to the recent cognitive-psychological stream called "situated cognition." This approach calls attention to the fact that human cognition is strongly linked to situations in which that cognition is functional. One of the consequences of this concept is that

knowledge and skills should be learned as far as possible in that situation in which such knowledge and skills must be applied.

A third contribution is that illness scripts can be satisfactorily described with Feltovich and Barrows' division into enabling conditions, fault and consequences. The study discussed in Chapter 6 showed that patient descriptions generated by doctors can be easily classified in these categories. Furthermore, this research has provided a new empirical and experimental method for studying the knowledge structures of doctors. Experimental manipulation of variables regarded as being of theoretical importance makes it possible to understand in greater detail what expertise is and how it develops. It was the Maastricht group which first introduced such manipulations in research into medical expertise. In addition the narrative method used in Chapter 6 is very suitable to elicit illness script knowledge directly.

With the results of experimental scientific research described in this thesis, we feel that a number of other important features of medical practitioner's diagnostics have also been highlighted. In no other discipline in health care can a doctor be confronted with such a great diversity of illnesses. We think that in order to be able to provide diagnoses for a wide range of different illnesses the mechanisms and particular changes in medical knowledge described in this thesis develop.

This thesis may provide a contribution to the improvement of diagnostic guidelines for the medical practitioner as contained in the standards policy of the Dutch General Practitioners Society (Nederlands Huisarts Genootschap). The application of standards by GPs in daily practice is sparse for many reasons, some of which are not always clear. One of the reasons could be that they do not parallel the "natural" thinking process of GPs. Most standards first give guidelines how to analyse the complaint and second describe risk factors or causal factors available in the context of the complaint. In 64% of the standards there is a reference to contextual factors with diagnostic implications. This creates the impression that there is a discrepancy between the structure and content of most of the standards as provided by policy organizations and the actual knowledge structure of the GPs as shown in this thesis. Acceptation and implementation of guidelines therefore suffer unnecessarily. If standards contained more explicit references to contextual factors preferable at the beginning of the standard, this would bring the guidelines for diagnostic more into line with the actual way of thinking.

Another area in which the results of this thesis may have implications is that of automation in medical practice, such as the existing Medical Practitioners' Information Systems [Huisarts Informatie Systemen: HIS] or yet to be developed expert programs for medical practitioners' diagnostics. The fact that GPs make intensive use of contextual information during the initial phase of the diagnostic process should be used for improving existing HIS programs. Ideally the GP should, during input of present complaints, have direct access to (relevant) data from problem list, list of risk factors, medication list, previous correspondence, or the file of another member of the same family. The existing HIS programs, however, have an architect-

ture that does not allow this flexibility. This means that every screen page (the problem list or medication list or previous correspondence) contains mainly incomplete information about the patient. Any contextual information present in the problem list, risk profile list, medication list or the file of another member of the same family can only be seen by calling up this information using special codes. Improvements could be made here. It would be useful for a GP if the input screen from the patients record directly showed contextual factors such as: active problems from the problem list, important details from previous history, active medication, a number of risk factors or "life events" which affect a whole family. With regard to medication information, good use can be made of the possibilities which can be offered by a computer, for example the presentation of the active medication, monitored by a support system to detect patient compliance or drug interaction.

The results described in this thesis can also be useful in the development of expert programs to support medical practitioners' diagnostic process. Up until now only expert programs have been developed to support specialist diagnostics. Contextual information which is so important in the very first phase of medical practitioners' diagnostics is only briefly included in such programs or is only referred to at the end of an analysis process. If the diagnostic process of the GP is to be simulated on computers, at the very start of the analysis process, the number of possible hypotheses will have to be limited with the help of contextual data. In this respect the possibilities of a neural network can offer the most suitable architecture.