Psyke & Logos, 1986, *7*, 000-000

VERBAL REPORTS IN PSYCHOLOGICAL INVESTIGATIONS: A LOGICAL AND PSYCHOLOGICAL ANALYSIS

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Since the era of Wundtian introspectionism the status and usefulness of verbal reports from subjects in psychological investigations have been a recurring topic of heated debate and controversy in the international psychological literature. In order to untangle and clearify some of the uncertainties and confusions in this debate, an analysis is attempted of some of the logical *and* psychological *conditions for research involving verbal reports. In the course of this analysis we argue first that any psychological investigation logically presupposes, that communication takes place in a shared language in which both the investigator and the subject know correct statements and descriptions and their correct uses. It is argued, more over, that different areas of psychological research differ distinctively with regard to the opportunities of observation and description - for the investigator and the subject - and, consequently, in the amount of control exercised over events and variables by the investigator and the subject. Examples are given of different psychological conditions and problems encountered in different areas of research and their implications for the development of different research methodes and programmes.*

Introduction

»How did you solve that problem?« »What did you think when your boss sacked you?« »What do you feel about discrimination against minorities?« »What is the colour of that shirt?« . . .

These questions are a few examples of ordinary every day questions which every one of us finds it perfectly reasonable to ask - and to which we expect that correct and reliable answers can be made. We ask many such questions every day. In fact, questions - and answers to such questions - are one of the most important sources of information between language users. This is precisely how knowledge is taught and passed between language users about the world we live in, our fellow citizens, our individual differences and similarities, our social relations, institutions, and corporations, etc. If we want to know what other people think, what they feel, what they know, which is clearly of vital importance for maintaining societies and for each of us to cope with the complexities of our daily lives and existence, we feel it perfectly natural to ask questions about it and to talk about it.

We are, however, realistic in the sense that we very well know that answers to such questions are not *infallible,* or that adequate and satisfactory answers are not always readily at hand. Sometimes we will have to go through various procedures of questions and answers, probing and priming in several ways, in order to narrow down the range of possible correct or understandable answers. But on the whole we know how to cope with the fallibility or uncertainties in exchanging verbal information about our actions, or knowledge. Moreover, we are usually well aware when we have difficulties in coping.

What seems to be not only natural but also necessary in our every day encounters, however, is, it seems, not so regarded in psychology. The controversy about the use and status of verbal reports from subjects in psychological investigations on human activities, be they problem solving, perception, motivation, thinking, or emotions, is as old as academic psychology itself. Apart from the »golden age« of verbal reports during the years of the foundation of psychology as a science, highly influenced as it was by the theories and research method (i.e. introspection) developed by Wilhelm Wundt and his followers, the use of verbal reports as data in psychological investigations has been - and still is - a highly sensitive issue to many psychological researchers. Following the devastating and justified critique of the *doctrines* of what has been termed »introspectionism«, not only the very special introspective techniques of the Wundtian tradition, but verbal accounts as such from subjects about their mental activities and, for that matter, their behaviour in general, were considered with deep scepticism, if not totally abandoned, by the majority of the psychological community. (For a review of the discussions and arguments, which led to the defeat of the Wundtian tradition, see e.g. Boring 1953).

Stated very briefly, the doctrine of introspectionism is that . . . »the descriptions of consciousness reveal complexes that are constituted of patterns of sensory elements« (Boring 1953). The nature and quality of these sensory elements, called sensations, and the structures by which they are associated, were the issues of psychological investigation, according to the introspectionists, and the only way to get access to them was by introspection, i.e. by looking »inward« into the working mind and its content of »immediate experiences«. But even though Wundt contended that these immediate experiences were »true in themselves«, as opposed to the facts of physical sciences, which are *mediated* and derived by inference from direct experience, it turned out that data about sensations were not at all that accessible. Subjects had to go through extensive training in order to become reliable observers capable of delivering scientific data. (According to Boring, no observers who had performed less than 10.000 »introspectively controlled reactions« were suitable to provide data for published research from Wundt's laboratory).

The revolt against introspectionism was staged by what were to become

two leading schools of psychology in the inter-war period, i.e. Behaviorism in the United States and Gestal Psychology in Europe. Their criticisms were aimed at the introspectionist doctrine of consciousness - though for different reasons - as well as the techniques of introspection. The data acquired by these techniques proved highly unreliable. There was very little inter-subject agreement about the correct descriptions of the various sensations, especially for subjects taking part in experiments conducted by different experimenters.

The Behaviourists replaced introspectionism with their own peculiar interpretation of positivism, according to which rocks, lifeless atoms and language using humans were to be studied alike: only what could be observed and measured in *naturalistic* ways could count as data for scientific investigations in psychology. As in the natural sciences, the only legitimate objectives for psychological investigation were to uncover lawful relations between the observable *stimulus* and the observable *response* determined or elicted by the stimulus. To the Behaviourists it was totally unacceptable for psychology, regarded as a science, to employ or deal with observations which could not be controlled, i.e. observations to which only one person, namely the subject, had access.

Although reference to consciousness or to »mental events« between stimulus and response was abandoned, it was soon realized that the Behaviourist doctrine had to be modified, since only a very limited range of human behaviour could be observed or described as determined *only* by external conditions. Thus, it seemed inevitable to accept a notion of hypothetical »inner states« or processes, at the very least to formulate intervening variables between the stimulus and response. However, this did not imply regression to the psychological concept of consciousness adopted by the introspectionists, let alone a return to their methods of acquiring knowledge about such »internal« goings on, such as the use of verbal reports from subjects. The hypothetical constructs or intervening variable were to be considered as legitimate psychological inferences from the *experimenter's* direct observation of whatever responses from the subject were made to carefully controlled stimuli.

The influence of Behaviorist doctrines spread far beyond the confessed adherents of Behaviourism, as we shall see in an example shortly, with the unfortunate effect that a lot of topics of psychological importance were no longer considered legitimate issues of scientific research. During the era of Behaviourist dominance there was a drastic decline in the use of verbal reports from subjects in psychological investigations. Or, if they were used, they only figured as data to the extent that they could be conceived of as *observable operations* - referring (for the experimenter) to whatever construct of hypothetical goings on between stimulus and response he was considering. In all other respects, verbal reports were considered irrelevant - and to most researchers unreliable and worthless as well.

Although Gestalt Psychology made extensive use of verbal reports and »phenomenological observations« about »direct experiences« from subjects, they were not taken as *infallible* data of consciousness. Indeed, the focus of attention for Gestalt Psychology was not consciousness considered as a »reservoire« of experiences, comparable to the Introspectionist notion of consciousness, but rather the structuring »forces« *behind* the »observed phenomena«, which could be *inferred* from these phenomena (cf. the Gestalt laws of organisation, the concept of praegnanz etc.). In this respect the processes of consciousness were considered as psychological *constructs* inferred from observations, that is, observations made by the experimenter of the »phenomena« being described by subjects, occuring as a consequence of various manipulations of the stimulus material presented.

In one important respect, one could say that Beahaviourism and Gestalt Psychology (as well as most other »branches« of psychology in general) met on a common »positivist« ground, namely a general conception of what were the objectives of psychological investigation and how to attain these objectives: The *experimenter* is the observer, as opposed to the subject as in introspectionism; who observes the behaviour, actions, descriptions etc. of the subject with regard to their implications for the, inferred, *constructs* or the psychological processes being studied; these may, incidently, be »consciousness« og »organizing principles of consciousness« or »intervening variables« or »conditioned responses«.

Whether or not it was for fear of being stigmatized as raving introspectionists or for putting back the clock of psychological research, (cf. Evans, 1976), the issue of verbal reports, and especially the questions about their reliability and methods whereby they could be improved, was avoided in psychological debate for almost 40 years. Although most researchers, if pressed, would admit that from time to time they consulted their subjects, if in doubt on the interpretation of their observations, it was not openly talked about.

The revival and extensive use of verbal reports during the last two decades came fromt outside mainstream psychology, namely from scientist interesed in the computer simulations of human mental processes, (notably Herbert A. Simon). It was soon realized that, in order to develop their simulations, knowledge of how humans actually solve problems, make decisions etc. would be an advantage. And the most obvious way of acquiring such knowledge seemed to them to be simply to ask people about it: that is, to ask them what went on in their »minds« when they were solving problems or making decisions.

As a consequence of the endeavours of computer scientists, combined, it must be added, with other important influences such as information »theory« (Shannon & Weaver, 1949, Attneave, 1959), and the theory of signal detection (Tanner and Swets, 1954) the study of cognitive or mental processes once again won general approval and respectability. The subsequent

expansion of cognitive psychology has been explosive - and no psychologist today, knowing where research money is allocated, would seriously question the existence of, or relevance of, studying cognitive processes. The term cognitive processes is used here in the very broad sense adopted by most researchers and writers of textbooks in the field (for example Eysenck 1984), i.e. it covers most varieties of human behaviour implying mental activities of one kind or another - from emotions, attention, perception, memory, imagery, knowledge, language to problem solving, and decision making.

However, what is still not agreed upon within psychology is *how* we may acquire knowledge about cognitive processes, and in particular whether reports from subjects about their cognitive processes may be used as data. Discussions, arguments and investigations on the usefulness or reliability of verbal reports have, once again, become an issue of heated debate in leading international journals - notably after the 1977 appearance in Psychological Review of the paper by Nisbett and Wilson »Telling more than we can know: Verbal reports on mental processes«. In their review of examples from various fields of psychological research the authors claim to have proved that subjects are not able to report reliably about their activities, emotions, perceptions, opinions, decisions, problem solving etc., because, according to Nisbett and Wilson, they simply have no access to their own »higher mental processes«.

Although severe critisms of Nisbett and Wilson's methods have been voiced, their conclusions and beliefs are still widespread among psychological researchers, and equally so, it seems, confusion and uncertainty as to *what* are the objectives of psychological investigation *and* the status of verbal reports relative to these objectives. In this connection it is ironic that one of the psychological researchers who has probably spent most time in analyzing verbal reports, i.e. verbal protocols of control room operators working in industrial plants, almost succeeds in pulling the rug from under her own research in a theoretical statement about the status of verbal reports, (»Verbal reports as evidence of the process operator's knowledge«, Bainbridge, 1979). Thus, she states that as mental behaviour cannot be studied directly, there is no way of correlating »what someone thinks and what he says he thinks«. She further reflects that verbal behaviour may be the result of special »mental behaviour« associated with generating verbal reports and that we must, therefore, have two theories, one for the cognitive task, i.e. thinking, and another for the generation of verbal reports about this thinking.

What is available to the experimenter, however, is only the observable behaviour and thus, according to Bainbridge, only nonverbal behaviour can be used to test the investigator's theory of mental behaviour. She argues, furthermore, that . . . »If verbal behaviour is the result of another type of mental behaviour with different determinants, then when verbal behaviour does not fit a theory of mental behaviour one does not have to reject this theory. As the main test for the scientific value of data is that they can be used to re-

ject theories, does this argument imply that verbal data are use less? Many psychologists feel strongly that this is the case«.

We believe that Bainbridge is right about what many psychologists feel very strongly. But we also think that these feelings are ill-founded, and that the arguments and conclusions described above are untenable. Moreover, it seems to us that the meager results of attempts to employ verbal reports by subjects in psychological investigations reveal, more than anything else, a rather impressive awkwardness in the approach to verbal reports, and especially reveal that proper methods of acquiring reliable, or more reliable, verbal reports are still to be developed. In this respect psychology, it seems to us, is still in it's infancy almost certainly due to the unfortunate historical circumstances as we have outlined them.

Thus, before drawing any *general* conclusions about the reliability or otherwise of verbal reports, by an argument which, necessarily, can only have the status of speculation, we think it would be worthwhile to start with a more careful analysis of a few basic questions. We have in mind questions such as: *Who,* in a given psychological investigation, has access to *what* processes, information etc.; *what* is actually being *described and observed,* as opposed to *inferred,* by the experimenter and subject; *what* conditions govern *control* and conduct of the investigation by the investigator and, as will later be argued, by the subject; and *what* may, consequently, be considered as *data* of psychological investigation. This amounts to an analysis of what are the *objectives* of psychological investigation, and what concepts are basic to these objectives.

The main part of this paper is devoted to an attempt at such an analysis, or rather, to giving examples of one of the forms such an analysis could take. We have divided the analysis into two main areas:

1. An analysis of what could meaningfully or sensibly be said to be the *objectives* of psychological investigation in different areas of research and, *inseparably* related to this question, what constitute the *logical conditions* for communication and verbal reporting between investigator and subject to achieve these objectives.

2. An analysis of the *psychological* conditions for communication and reporting, conditions which have to do, e.g. with the limitations or otherwise of our ability to report verbally about our knowledge, thoughts, actions etc.; to do so sufficiently adequately, satisfactorily, precisely, or reliably; and how we may, or may not, cope with this task. Such conditions will be issues for psychological investigation, either directly, as in research on verbal report *per se,* or indirectly, as in research on psychological functions other than communication or speech, such as memory, attention, or perception, where the conditions for verbal reporting, or rather the »quality« of the verbal reports, may be an important source of information.

The issue of the first analysis is then the logical basis, or conditions for psychological investigation. These conditions can only be analyzed and argued conceptually; they are not and cannot be issues of psychological research. They constitute the conceptual framework, or theoretical preconditions on which psychological research, among others the preconditions for research on the psychological aspects of verbal reports, are based.

We believe that part of the confusion and uncertainty about the status of communication and verbal reports in psychological investigation may be due to either neglect of or an unfortunate mixing of problems of the two quite different types of conditions set out above. We hope, that the present analysis, by distinguishing logical and psychological conditions, will provide a clarification of some of these problems. To that end, in the course of our analysis, we give examples from previous research of how problems concerning the psychological conditions for communication and reporting may have given rise to premature conclusions about the logical or conceptual conditions for psychological investigations and in consequence, about the status of verbal reports in such investigations.

In the final section we summarize some of the problems encountered in the use of verbal reports and point to some of the methodological improvements necessary if the usefulness and reliability of verbal reports in psychological investigations are to be enhanced.

Analysis of ojectives and conditions for describing, observing and reporting in different areas of psychological research

The general conditions for establishing an experiment or investigation in psychology. We shall begin our analysis with an outline of what we have called the logical conditions for psychological investigations.

To start with what may seem uncontroversial, a psychological experimenter must, in order to *establish* an experimental situation at all, rely on the fact that he and the subject can communicate in a shared language and that within this language they can both correctly describe and identify each other and the situation in which they find themselves, the room in which the experiment takes place, the experimental set-up etc. The experimenter must assume that the subject is able to understand his discription of the experimental situation or the part of it which the subject is supposed to relate to or act on, that is the task.

This amounts to a first, very general condition for any psychological experiment or investigation, namely that the experimenter must assume that the subject is a user of the language used in the experiment or research situation and that, consequently, he knows correct descriptions or assertions in this language and knows how to use them correctly. In particular, the experimenter or investigator has to presuppose that the verbal reports and descrip-

tions given by the subject may be reliable, truthful, and correct. These conditions are so general that it may be said to apply to all successful communication, and constitute the logical basis of establishing psychological research in which verbal communication takes place.

Analysis of an example: the conditions of an experiment in perception psychology. What is the status or nature of the communication or verbal reports during, or after the experiment? In order to answer this question we shall first analyse an experimental situation within traditional psychology of perception, the analysis taking the form of a discussion of a series of questions of obvious importance to our problem, such as:

- What are the conditions for establishing communication, about the experiment, between experimenter and subject

- What are the subject's and experimenter's access to, and conditions for describing, the experimental situation or task

- What are the subject's verbal reports about

- To what extent and in what sense do we, logically, have to presuppose the reliability and correctness of the subject's reports of the experimental situation and task

Later a similar analysis will be carried out within another area of psychological research, i.e. problem solving. This analysis will, when compared with the analysis of the conditions for experiments in perception psychology reveal significant differences between the experimental conditions *per se* as well as for the verbal reports and communication between subject and researcher respectively in different areas of research.

The conditions for establishing communication between experimenter and subject about the experiment. In perception experiments it will often be the case that the experimenter has arranged a so-called stimulus-situation within which there will be some parameters or variables which the experimenter is able to vary in a systematic way. The aim of such experiments will often be to find out how or whether these variations make any difference or give rise to systematic variations in the subject's descriptions of what he perceives.

If the experiment is successful the result of the experiment, or series of such experiments, may often be formulated as laws of the form: if A is presented to the subject, he will perceive B, where A is a description of the object or situation which the subject is to observe, and B is a description of what the subject observes or perceives.

For such a law to have any scientific credibility, the experimenter must, of course, be able correctly and unambiguosly to describe and identify A and B -A being the salient features of the experimental situation (the independent variable), and B being the subject's description of the experimental situation, or rather that part of it to which the subject has access, as it appears to the subject (the depent variable).

In order to ensure that the subject's description may be thus identified, and therefore, may be correctly described as the dependent variable related to the experimental situation, it will usually be necessary for the experimenter, by giving instructions to the subject, to draw his attention to what can be considered as relevant answers in the experimental situation under consideration. Communication between experimenter and subject, however, requires and presupposes a substantial degree of agreement. They must have identified each other, the chairs, holes in a screen, figures, objects etc. which form the equipment of the experiment in a public world of objects. In short, they must agree on the *correct* description of the experimental situation. Otherwise the experimenter would not be able to ask the subject to sit in *that* chair, look with the right eye through *that* little hole in *that* screen, and say which of two objects appear to be further from him, i.e. to *report* what he sees through the hole.

The differences in access to and conditions of describing the experimental situation for the experimenter and subject respectively. A general defining, condition of perception experiments is a significant difference between the opportunities for *observing* and *decribing* the experimental situation open to the experimenter and to the subject. While the experimenter will have almost unlimited access to the experimental set-up (the »stimulus-situation«), that is, he can make whatever observations and measurements he pleases and describe the situation in whatever language, formalisms etc., which he finds necessary in order to give a precise description of variations of the variables or parameters he wants to investigate, the subject's opportunities for observing and describing the situation will be limited. They will be limited compared with the experimenter's opportunities but also limited compared with normal every-day opportunities of observation. (The subject is not allowed e.g. to look behind the screen, use a ruler, to use both eyes, to ask a friend etc. etc.) His opportunities of description will, moreover, be limited in the sense that he will have no alternative other than to describe what he perceives in ordinary daily language. A typical example is the experimental investigation of perceptual illusions.

Differences in access to the experimental or research situation and different conditions of describing such situations or tasks also exist between subject and researcher in other research areas although, as will be argued later, the »privileges« of observation and description between researcher and subject may be quite differently distributed.

These differences in the opportunities of observing and describing are crucial in almost all experiments in perception psychology. If this was not the case the description of the subject and the experimenter would not be different - and the result of the experiment would already be given by logic, and therefore devoid of empirical content.

Thus an experiment in perception psychology will result in two different descriptions of the same thing, i.e. the experimental situation, as it may be described under two different conditions of observation and, probably with different means of description available, conceptual systems, formalisms, and so forth.

Now, the position has been held among perception theorists that what subjects are describing or reporting about is not the experimental situation, that is the »stimulus-situation« to which the subject has access, but rather »representations«, or »internal mental models«, or »hypotheses«, about the stimulus-situation (cf e.g. Gregory, 1974) which reside in and only characterise the subject's »mental processes« or »functions«.

One of the reasons why such a view has seemed plausible is that since the experiment results in two different, and often conflicting, descriptions they cannot both be correct descriptions of the situation, i.e. the experimental set-up. Again, since the experimenter's description seems a better candidate for an »objective« description of the situation, the subject's description must be a description of something else, i.e. of something which belongs to the non-observable mental realm of the subject.

Such a view is not tenable and will prevent any sensible account of the experiment, as we try to explain in the following section.

What are the subject's verbal reports about? As mentioned earlier it is vital in any scientific experiment that the experimenter is able unambiguously to identify the independent as well as the dependent variables of the experiment. But what if the dependent variable is some mental activity of the subject variously called »internal mental models« or »representations«? How can the experimenter possibly identify that which the subject describes, that is, the subject's representation? As far as we can see, there is no possibility of the experimenter and the subject together identifying this »something« described as something *other than,* or something *different from,* the object which the subject is looking at and the experimenter has placed in front of him, because they lack an independent procedure for determining in advance whether they are talking about the subject's *representation* of the object or about the *object* itself.

Not even the subject would be able to know what he is talking about. For one cannot point to the representation, take it in one's hand and show it to someone. Nor can it be unambiguously identified related to some tangible object. Furthermore identification would presuppose, *either* that to any given object there corresponds one and only one representation - which is fal-

se - *or* that it is possible to describe *what,* we see, i.e. the representation, without describing it as *that,* which we see, i.e. the object, which would be an absurd requirement.

In an experiment in perception psychology, then, that of which the subject's descriptions or reports are descriptions and reports, *cannot* be anything *other than* that which the experimenter has placed in front of him and asked him to describe. If it *were* anything else, the experiment would have failed, as we have argued above. We must therefore conclude that in a psychological law of the form »if a subject is in a situation A, he will perceive B, we have to presuppose that A and B are different descriptions of the *same* thing, namely, the experimental situation as it can be identified and described under two different sets of observational conditions.

Reliability or correctness of the subject's description. But what about the *correctness* of the subject's description? As already argued, inasmuch as the required, presupposed, common description and identification of the experimental situation agreed by the experimenter and the subject prior to the experiment is concerned, there can by logical necessity, be no difference in correctness. The descriptions given by the subject and the experimenter have to be identical.

But the aim of a lot of experiments in perception is concerned with perception in extreme situations, that is, situations where »normal« perception breaks down. This is the case in experiments where attempts have been made to investigate whether certain information, »cues« or »patterns« are salient for our ordinary daily correct perception of, say, distance or the size of objects. In experiments such information or »cues« are left out of the »stimulus-material« and, as some of these experiments have shown, the subject's ability correctly to describe e.g. the distance between two objects or their size may be very uncertain or even completely incorrect.

Does this mean that the subject is now in a situation where he is no longer able to give correct descriptions? Not it what we mean is that the subject no longer knows correct descriptions and their correct application or use. If the subject of the experiment is given the task of deciding which of two lines is longer, as in the Müller-Lyer studies, the experimenter must *still* be able to count upon the subject's knowledge of the correct application of »description of lines«, and »description of length«, i.e. that the subject has the concepts of line and length. The experimenter must presuppose that the subject knows the consequences of describing the two lines as of »unequal length«, consequences which could be descriptions or statements such as: »If I measure the distance with a ruler, the values will turn out to be different«.

If the experimenter could not count upon such knowledge on the part of the subject, no psychological experiment would be possible - and psychological laws of the form: »If the subject is placed in such and such a stimulus situation, with these and these conditions for observation, he will describe the

situation in this way«, would be meaningless.

It might still be objected that there is no sense in saying that the decription of the subject is correct, because »the two lines *are in reality* of equal length and not unequal, as the subject says«. Such objections have, of course, no bearing on the point argued that any psychological experiment rests upon the assumption that the subject is able to produce correct descriptions and apply them correctly. The descriptions of the subject are advanced within the limits of certain defined and restricted conditions of observation and opportunities for deciding whether the consequences, to which he has committed himself, turn out to hold true. But we have to maintain that also under these conditions the subject advances *correct* descriptions about what he perceives, even if it turns out that, given access to further opportunities of observation, such as those to which the experimenter has access, the subject no longer abides by the original description of the stimulus situation. If we do not, carrying out the experiment would make no sense.

Objectives of research in perception. Let us summarize some of the points so far made about the objectives and status of verbal reports in research in perception.

What the subject is observing and describing is the experimental situation, identified by himself and the experimenter in a shared world of material objects and things, and with respect to the sometimes special, conditions of observation and description available to the subject. It can be nothing else. Moreover, the subject's descriptions of what he perceives is correct in the sense, that he knows correct descriptions and how they are correctly used.

In practice, that is also what any researcher in perception usually assumes and takes for granted when carrying out his experiments. The problems only arise when in the theoretical interpretations or conceptions of the experiments one departs from these assumptions and asserts, that what the subject - really - is describing are e.g. but »representations« or »hypotheses« or »percepts« of the experimental situation or »internal mental models« (Gregory, 1974). (For an extensive analysis of the epistemological problems of the »representational position« see e.g. Praetorius, 1978, 1981, 1982. For a critique of Gregory's »hypotheses testing theory of perception«, see e.g. Anscombe, 1974).

Such a view will, of course, give impetus to the critiques of »mentalism« and give rise to the questions entailed in such criticism about the status and control of the subject's verbal reports as well as of the reliability of these verbal reports.

Fortunately, however, we do very well in disregarding these problematic theoretical interpretations or concepts of the perception psychologists. As long as they actually do the right thing in their research work, there will be no problems of control of observation, or questions about the status of the subjects verbal reports as *data* of the investigation.

This also applies to the Gestalt Psychologists who more than any others have stressed the necessity of a sharp distinction between the »phenomenologically experienced reality« (of the subject) and the »physical reality« (of the experimenter). Although they took their subjects reports as *evidence* of the existence of organizing »forces« operating *behind* our perception, they never claimed that their subjects actually described or observed these organizing forces or other obscure »mental events« in their minds. The truth of the accusations of »subjectivism« and »idealism« in their *theoretical* statements and position notwithstanding, their research work was essential *descriptive,* - and they did what most perception psychologists have done ever since - and what we believe is the only thing we *can* do in perception psychology: They systematically varied the stimulus material in order to establish the extent to which these variations, modifications and manipulations lead to changes in the subjects descriptions of this stimulus material. In doing so, perception psychology has accumulated considerable amounts of knowledge with important practical implications about how we perceive the material reality, under what circumstances we perceive it in certain ways, and under what circumstances we e.g. perceive reality *verdically* and under what circumstances we do not.

Reliability or correctness of descriptions of non-material objects and states vs. material ones

In the analysis so far we have only been discussing verbal reports or descriptions of objects and things, including people, in external material reality. But how to deal with our descriptions of so-called »non-observable« states, such as our thought, emotions, feelings, pains, tastes etc. The first point is that these »non-observables« are more accurately said to be non-observable *to people other than* the subject or, to put it more positively, only *immediately* available to the subject. Do such descriptions have the same logical status, e.g. the same logical claim to correctness as do descriptions of observable things such as objects and persons? Surely they must have. Just as we know correct descriptions of objects and know their correct uses, we know correct descriptions and how to correctly use descriptions concerning our feelings or thoughts. We know what it implies to describe our feelings as happiness, or as pain, just as we know what it implies to describe other »mental goings-on« as trying to solve a certain problem, or finding different solutions.

There is, however, one significant difference between descriptions of material objects and states and descriptions of so-called »non-observable states«. The difference lies in the types of procedures possible for *testing* whether the consequences or implications of our descriptions hold true. If I am discussing with somebody whether or not this line is longer than that line, we will be able to settle our discussion by measuring the lines with a ruler. We

will both be able to *observe* the result of the test, granted the same observational conditions. This is not the case when we say that a knock on the head by a hammer is painful or that something tastes sweet or sour. What we *can* do is to discuss what the implications of such descriptions are, at whatever length we like, and in the course of discussion we may arrive at better and better agreement about what the consequences may by. But to test the proposition itself, the observer will clearly not be able to *observe* in the sense of e.g. feel the pain of the person hit by the hammer, i.e. to observe the *result* of a test, although he may well be able quite correctly to decide from his behaviour that he is in pain.

However, as in our descriptions of objects in material reality, we know and may offer correct descriptions of so-called »non-observable states«, such as feelings, thoughts, reasoning, pain, taste. Like descriptions of objects such descriptions are *in principle* communicable and we are therefore able to establish intersubjective agreement about the correct implications and correct uses of such descriptions. Otherwise, we would never know whether we were making sense to each other when discussing e.g. feelings, thoughts, pains, taste etc., and we would be unable to make such things as feelings, taste etc. the subject of every day conversation, still less the subject of an inquiry into individual differences and disagreements in such matters.

Problems related to the psychological conditions for investigations in psychology

What has so far been said about descriptions of loosely called »non-observable states« are the *necessary* conditions to talk correctly, or at all, about such things as our feelings, thoughts, problem solving strategies or to report how they appear to us. But they are certainly not *sufficient* conditions. There are numerous situations in which we are not able to give adequate, exhaustive or even correct descriptions of our mental states, any more than we are always able to provide similarly satisfactory descriptions of many things in material reality. If asked what we thought about yesterday morning during breakfast, we may not be able to give correct answers, or to report on it at all, because we have forgotten. But we subsequently may if a turn in conversation or a glimpse of a cornflakes advertisement triggers our memory. If somebody asks a 12 year old child to account for the grammatical rules he is abiding by when talking, he may have no verbalizable knowledge about his language, though he may be able to decide whether a grammatical rule suggested to him by a linguist is correct or not. The subject may be unable to tell how many times the experimenter struck a bell while busily trying to solve a problem, simply because he was not attending to the strokes, or did not have the capacity to attend to them and at the same time solve the problem. If suitably instructed beforehand by the experimenter however, he might accurately report the number. Likewise it might simply be impossible to

describe to any satisfactory extent feelings of being in love with another person. Nevertheless a poet might be able to produce such descriptions.

The examples sketched above are examples of satisfying or failing to satisfy *psychological conditions,* as opposed to the logical conditions, for reporting correctly and reliably about so-called »non-observable states«. Likewise, many experiments in traditional perception psychology may be seen as examples or lack of the sufficient *psychological* conditions for being able to describe material objects and states in a »veridical« way. Such psychological conditions, and many more examples could be given, of our being able correctly and reliably to describe observable as well as so-called »non-observable« states of affairs have been the topic of investigation in a broad range of psychological areas, for example perception, attention, memory, psycholinguistics. Indeed, such investigations constitutes, par excellence, the empirical basis for any development of fundamental theories in psychology. The point is, however, that in all such studies it is simply taken for granted that people are indeed able to memorize, attend, perceive and to *communicate* about their memory, attention and perception in a correct and reliable way. This is simply the logical precondition for investigating the sufficient psychological conditions for subjects being able to attend, memorize, perceive veridically or correctly. In this respect the conditions for research in these areas of psychology are the same as the conditions analyzed above for the traditional experiment in perception.

The topic of investigations such as these is *not* the reliability, accuracy or correctness of the subject's verbal report. On the contrary, the verbal reports, whatever degree of reliability or accuracy they reach, are taken as measures or indicators. They are the *data* of these investigations by which we determine the conditions under which the psychological functions of memory, attention, or perception work.

In these areas of psychology verbal reports from the subject and verbal communication between researcher and subject has been an extremely powerful not to say an essential source of information for research.

Methods and assumptions of some recent evaluations of verbal reports

The question of the reliability of verbal reports has typically been raised by researchers within areas of psychology which differ in significant ways from the traditional psychological research considered above. The main difference is that part of what the subject describes, or is asked to describe, in such investigations is not directly observable to the investigator.

By not directly observable to the investigator, we refer to what, with too little discussion or attempts at further precision, has been varyingly labelled »mental processes«, »mental behaviour«, »internal mental models«, and sometimes »non-observable behaviour«.

It is the reliability of the subject's *report* of such »mental phenomena«, which is in question.

The main issues in such studies, put very generally, has been *ARE* the subject's verbal reports about the conditions which, supposedly, influence their actions, attitudes, judgements, or feelings, reliable?« og »*HOW* reliable are they? (Nisbett and Wilson, 1977). Alternatively, to what extent does the subjects' capability to report the stategies or models employed in solving a problem correspond to their problem solving performance? (Berry and Broadbent, 1984).

If we accept the premises and implications of such questions, some minimal requirements must be met. The subject should enjoy conditions of observation and descriptions which at least make it possible to *remember* or *attend* to that which he is asked to report about. The questions asked of the subject should, moreover, be precise and understandable. Indeed the questions must be thorough and elaborate if the investigator is to be sure whether any of the relevant information available to the subject has been reported or not.

If these requirements are not met, the research will, first of all, probably say more about conditions for e.g. memorizing and attending, conditions which may have nothing to do with the conditions for what may *in principle* be reliably reportable. The research will say more about psychological conditions *other* than those which have to do with the verbal reportability of the matters in question.

Secondly, to establish an investigation which would settle the question of the reliability of verbal report, the investigator must have access to information about that which the subject reports verbally, that is access to information *independently* of the subject's verbal report itself. If the investigator cannot cite such independently accessed information, he has no criteria or standards from which to judge or decide on the reliability of the subject's verbal report. The need for such criteria or standards are the more obvious in cases where the reliability of the subject's verbal reports are said to be evaluated in relation to other observable data about the subject.

But strictly speaking, the investigator does not have access to such independent information. What he *has* access to is whatever is observable of the subject's overt activity, that is, access to what will be just as observable to the investigator as to anyone else, including the subject. From these observations the investigator may, of course, make *inferences* about the »mental processes« of the subject - but the *status* of descriptions of the subject's activity which includes such inferences from observable behaviour does not of course amount to that of *data*. The conclusion, then is, that the investigator in research of this kind does not really have the objective criteria required to make conclusive judgements about the reliability of the subject's verbal reports.

This conclusion may seem fatal enough to end the debate about research

raising questions about reliability of verbal reports, that is in the way *these questions have been formulated.* We must nevertheless point to one more condition for such research. Before advancing any general conclusion, of the »yes/no« kind, about the reliability of verbal reports in psychological research, the investigator ought to be able to show beyond doubt that the subject's verbal reports would not have been reliable or more reliable given *better* conditions, questions, probing etc. than those to which the subjects were in the event exposed.

Banale and self-evident as these few requirements and conditions for the subject may seem, none of them have been met in studies which advocate the non-reliability of verbal reports, as documented in the extensive and critical review of the field by Ericsson and Simon (1980). Had the confounding variables of the investigations not been so numerous, or had the questions asked of the subjects not been so inprecise or even senseless, as Ericsson and Simon point out, the investigations carried out would, at best, have contributed to more precise understanding of those conditions under which verbal reports may *not* be reliable. At best, for it must be admitted that these studies may still have left untouched the conditions uniquely required for reliable verbal reports.

It is, moreover, suprising that none of the studies seriously discuss whether or not the investigator had access to information about the subject's cognitive processes, higher mental processes, etc., or rather discuss whether his extrapolations and interpretations about such processes were reliable, or *any more* reliable than the subject's reports, even granted that the subjects had a fair chance of reporting them. The studies do not deal with or reflect on that question, or discuss what a fair chance might be.

But most astonishing, it seems to us, is how quickly and uncritically the issue of the reliability of verbal reports has turned into »yes/no« questions, as if any *general* conclusion on this issue, drawn even from experiments employing the soundest of methodological design, would ever make sense.

However, the sweeping, general and mostly negative conclusions drawn from rather few ill-founded, although surprisingly influential studies, if taken only a little further lead to logical absurdities. Suppose an investigator asked the subject to give retrospective descriptions of the equipment in the experimental room, to which the subject may not have attended, or could no longer remember. The subject's failure to do so reliably, would surely not lead to general conslusion as to the reliability of verbal reports about physical objects in external material reality. But, we would be bound to draw such conclusions if we used the same line of argument as has been used in studies on the reliability of verbal reports about cognitive processes and the like.

It might not be quite so obvious, perhaps, that such general conclusions, or even *doubts,* by psychologists as to the general reliability of verbal reports of subjects, would also be self-defeating, since they would be debarred from

carrying out almost any study in psychology.

Thus as argued earlier, it will be necessarily, if only implicitly, to communicate about and to refer to both observable and so call non-observable conditions in determining the experimental situation with the subject, the problem which the subject is going to solve, and what will be relevant answers to the investigator's questions.

In a problem solving experiment, for example, the investigator, in his instruction to the subject about the task and about relevant categories of actions and answers, will have to presume, that the subject knows what he is talking about, that the solving of problems involves the production of actions or responses which are the result among others, of thought processes. The investigator must, consequently, presume that thought processes are something about which it makes good sense to say, that language users - and not only language users who happen to be psychological investigators - can talk about correctly.

If, after having carried out the experiment, the investigator nevertheless feels tempted to conclude, as a *general* fact, that thought processes are the sort of things which subjects cannot talk about or describe in reliable verbal terms, he would thereby disavow the presupposition for designing, establishing and carrying out the experiment, in the first place. The reader will probably be able to produce a list of similar examples. The whole argument then leads us to doubt whether *any body* could be said to be able to describe thought processes in a reliable way, or whether we will ever be able to know *what* we are talking about when we talk about such things.

Analysis of objectives and of conditiond for describing, observing, and reporting in investigations of cognition

In the paper mentioned earlier in this article, Bainbridge, (1979), states that mental behaviour of operators cannot be studied directly; it can only be inferred, i.e. it has the status of a psychological construct, or as she puts it, a »theory«. Moreover, as verbal behaviour of subjects cannot be taken as *data* about their mental behaviour, only non-verbal behaviour can be used to test the investigator's constructs or theories about mental behaviour.

According to Bainbridge, then, we must disregard *as data* all sources of information other than non-verbal manifestly observable activities. The only basis on which an investigator may draw inferences and develop theories about the mental behaviour of the subject, can be non-verbal observable behaviour, i.e. the same data as is used in any test of the investigator's inferred construct or theory about the subject's mental behaviour.

This is surely a misleading way of describing how the investigator develops and tests theories about the subject's mental behaviour. As pointed out at the end of the previous section in investigations on cognition, we do not

disregard all other sources of information than that which is non-verbal and manifestly observable, neither in establishing with the subject the common definition and description of the situation and task, nor in interpreting the subject's observable behaviour.

Moreover, we do not assume that it is possible to distinguish sharply between what Bainbridge and many others call »mental behaviour« and »observable behaviour«. If such a sharp distinction were possible, it would not then be possible to make the inferences about »mental behaviour« from »observable behaviour«, which form the substance of cognitive psychology.

These points are justified in the following analysis of the conditions for carrying out investigations in cognitive psychology. This is along the same lines as the analysis of the conditions for experiments in perception and takes problem solving as an example.

What is described in a problem solving experiment by the subject and investigator.

The moment the experimenter has identified and described any observable behaviour of the subject as being *problem solving behaviour,* he has inevitably stated a lot more about that behaviour than may be observable in strictly physical or material terms. He is implying in his description that the subject's behaviour is *action,* not mere »movements« and, consequently *intentional,* i.e. that the subject intends to reach a solution, preferably to the problem which he has been asked to solve. The investigator is therefore implying that some mental or cognitive or just thought processes, are involved in or even govern the subject's action. That much is logically and conceptually part of the definition and determination of an action as being a problem solving action, and part of what we mean when we describe human action as being problem solving. It follows that we cannot talk about or describe something as being problem solving activity without implying or referring to mental or cognitive activity of the subject solving a problem.

But equally important one cannot, conversely, talk about these mental processes without referring to what these processes are about, that is, without referring to the problem solving task, the components or features of which it consists, and to a range of activities involved in performing the task. This applies *both* to the experimenter *and* to the subject. Cognitive or mental processes, which we can talk about in any sensible or well defined way will always be about something taking place in a cartain context. If that does not sound immediately convincing, we ask the reader to think of an example to which it does not apply. Thus, if a subject is asked to account for how he solved the problem, i.e. what lines of thought (eventually) led him to adopt a certain strategy or series of actions, he will not be able to talk about these mental processes *apart from* or as something different from the task in question, the courses of action open to him and the context in which the task is carried out. He cannot talk about his thought processes apart from or without referring to that which is observable to himself as well as the experimen-

ter.

In short, the dichotomy or opposition of observable behaviour and mental behaviour in problem solving does not make sense.

This does not mean, however, that we cannot talk about cognitive processes or thought processes as being *different* from the subject's overt activities. Just as we can talk about ordinary verbal descriptions of objects and things as being different from the objects and things themselves, we can talk about the cognitive processes carried out in e.g. a problem solving task as being different from the overt activities carried out in solving the problem. But just as we cannot talk about a description, what it means or implies, independently of or without referring to that which the description is about, we cannot, for the same reason, talk about the cognitive processes carried out in solving a problem independently of or without referring to the overt activities or features of the problem solving task.

Because of this interdependency, what we usually call cognitive or mental processes in e.g. problem solving behaviour, must necessarily be firmly grounded in what is observable. Consequently, when we talk of the investigator's description of the subject's observable problem solving behaviour, we are referring to the *totality* of what is immediately observable, plus the implications of the description being a description of *problem solving behaviour,* i.e. implications by way of inferences the investigator may have made, or knowledge he may have acquired, about the cognitive processes involved.

What *may* be *compared* or *opposed,* is the investigator's description, thus defined, and the subject's own account of his problem solving behaviour.

All too often there will be differences or inconsistencies between the experimenter's and the subject's account of the subject's problem solving behaviour. Some of the reasons have already been mentioned, e.g. the less than ideal conditions of observation with which the subjects were provided. But besides reasons, which can only be characterised as obvious methodological flaws on the part of the investigator, there are *psychological* problems for the subject communicating about his problem solving behaviour. We return to these in a later section.

The subject's and investigator's access to and conditions for describing the experimental situation and the problem solving of the subject. There is an important distinction which *must* be made between experimenter and subject in their conditions of observation and description.The cognitive or thought processes, their nature and sequence, which eventually lead to the subject's solving the problem, can only be *immediately* accessible or observable, if at all, to the subject. This, again in marked contrast to perception research, leaves the investigator as the one who has problems of observation and access to information.

The difference in access to information for the investigator and subject in problem solving has significant implications for the conditions of specifying

and controlling the experimental situation. This difference is illustrated when we compare these conditions with specifying and controlling experiments in perception.

In a traditional perception experiment the experimenter has not only unlimited access when observing and describing the objective conditions of the experimental situation, but also of controlling that situation, and thereby controlling and restricting the subject's opportunities for observation and description. Everything is, literally, out there; the response possibilities are fairly restricted, and relevant answers to the investigator's questions are usually extremely well-defined. The investigator does not have to speculate much about whether he and the subject mean the same thing when they describe two lines as being equally long. He has to presuppose that. He is not interested in how the subject conceives the situation, or interested in the intentional depths, breadths, or widths of the subject's concepts, as only a very limited range will be relevant; neither is he interested in the subject's past »perception-history«. It will probably make no significant differences, as long as the subject is endowed with normal senses. Above all the experimenter is not interested in the subject's expertise in observing and describing, since normal every day perceiving and communication will probably be sufficient.

In problem solving experiments, on the other hand, the conditions are almost completely the reverse. Apart from the description of the task presented to the subject, and various measurements of the subject's overt performance, which may be limited to the solution of the problem itself, the experimenter's control of the experimental situation is negligible, e.g. his *control* of the subject's opportunities for action, be they mental or overt. But even more important, the investigator's specification of the experimental situation of which these opportunities for action are part, must necessarily depend on and be determined by how the *subject* conceives of and observes the experimental situation and task in question.

In short, most of what in a traditional experiment in perception would either be in the control of the investigator, or of no consequence, are precisely what the investigator in a problem solving experiment is after; they are the *major dependent variables* in the investigation.

If it made sense to arrange psychological investigations on a continuum according to the investigator's control of variables in the experimental situation, traditional perception experiments being at one extreme and problem solving investigations somewhere in the middle, then obvious candidates for the other extreme would be research in applied psychology on »knowledge capture« of the »expertise« of experts. In studies of the knowledge and performance of, e.g. operators working in complex industrial plants, the conditions of the investigations, and the aim of the psychological investigator, are exactly described as determining *what* are the conditions of observation, and describing the tasks and issues under investigation, that is, the operator's

knowledge or conception of the system he is operating and, implicit in this knowledge, the operator's opportunities for action and control when operating the system. In short, the aim of such investigations will be to determine the frame of reference for obsevation and description as it exists in the operator's *representation* of the system.

In the next section we discuss some of the psychological difficulties encountered by the subject in describing his knowledge and performance, but before doing that it is appropriate to say a few words about what can be meant by terms like the »mental models« or »representations« of experts - or, for that matter, of subjects in problem solving experiments in general.

These terms or concepts, which for all practical purposes are synonymous, have established, rather unfortunate connotations in research on expert knowledge, at least in our opinion. Often a distinction or dichotomy, parallel to the one being made in the studies referred to on cognitive processes between so called »mental behaviour« and »observable behaviour«, emerges again in the usages of terms like »mental representation« of the expert, as opposed to the »observable behaviour« described by the investigator.

As was the case in problem solving research, because these mental representations may be regarded as »internal« to the expert subject, they are then construed as non-observable, or even inaccessible, see for example the monograph by Morris and Rouse: »On looking into the black box: Prospects and limits in the search for mental models« (1985). On the same lines, the problem of the investigation is said to be that of determining these non-observable mental entities and, consequently, the problem of whether or not the subject's verbal reports may be considered reliable reports, about these entities, or about his performance in general. Indeed, one can even see the problem being formulated in terms of a *trichotomy* or opposition between the presumed independent entities or states of: »observable or overt behaviour«; the »mental model«; and »verbal report«, (Bainbridge 1979, Leplat and Hoc 1981, Morris and Rouse 1985).

But as we have already shown the interdependency between these concepts and the corresponding descriptions are inescapable and therefore such dichotomies or trichotomies do not make sense. If this point is not accepted, it must be admitted that opposistion of this kind are simply not useful.

Alternatively, we would argue that what is meant by concepts like »mental model« or »representation« is the expert's actual, or potential, conception and knowledge of the system, the processes and the functioning of the system, and his opportunities for action upon the system. That is what tasks may or must be performed during certain states of the system, what measures can be taken to re-establish the system to its normal state of functioning. It is the expert's capability to observe, describe and act upon the system in question, and consequently, his facility to predict future states of the system.

The expert's representation of the system is not of course static. It will change as a result of experience and training, and it may change or differ with changes in states of the system. Neither is the expert's representation purely internal or private, though it may be *personal,* in the sense that it will depend, among other things on the individual history of experience and training of the expert. That part of the expert's representation which is only immediately observable by himself will, nevertheless be firmly rooted in his observable behaviour, and will *in principle* be amenable to public description and communication and, therefore, accessible to the investigator.

Psychological conditions and problems of observation and reporting in cognitive research

In our arguments above we believe we have logic as well as common sense on our side. But common sense will also have it, that our observations and descriptions are not always infallible and that adequate or exhaustive descriptions are not always easily obtained. This may apply to whatever we describe, be it material reality or our mental states. Logic has nothing or very little to contribute to these problems.

Problems and difficulties of observing and describing our mental states, and methods by which they may be studied, as well as pitfalls to be avoided when studying them, have been thoroughly covered and discussed in the early psychological literature, from the end of the previous century and to the beginning of this one, notably by James (Principles of Psychology, 1890), Dewey (How we think, 1910), Clarparede (a genese de l'hypothese, 1934), Høffding (Den menneskelige tanke, 1910). An adequate review of this literature would be a lengthy article in itself. However, in pointing out a few of the problems and experiences which we have encountered in our own studies, we are well aware that others have been here before.

It is well known that although we may be perfectly well aware of what we are doing or thinking, we may not always be aware of how we do what we do, or why we think or do as we do. As has been pointed out repeatedly in the psychological literature since William James, awareness of how we think will typically occur spontaneously only in situations when our otherwise smooth and well formed actions do not lead to the results or desired goals. Or such awareness occurs when several procedures may be used in performing a task, but where it is not immediately obvious or transparent which would be preferable. In such cases we are forced to *reflect* on how we think or act, or as Flavell, (1976) puts it, to engage in »metacognition«.

Normally, however, we tend to concentrate on the outcome of our thinking, reflexions, problem solving etc. rather than how we arrived at our results or conclusions. We often communicate quite effortlessly with others, e.g. persons with whom we collaborate, about solutions to problems and the

products of our thinking, and whether or not they are logically consistent with the premisses or purposes. But we are hardly ever expected systematically to observe or to give elaborated verbal accounts of how we got from the problem to the solution or the intermediate steps in the process of our thinking.

It therefore seems a massive assumption that subjects in psychological investigations brought in from the street, so to speak, should be able to report verbally about the way they think or solve problems, without difficulties, or without any help or tutoring in how to do so correctly and reliably. Thus, a subject requested to give sophisticated descriptions about his performance which, on any estimate must entail considerable effort and skill, may, if not warned at the outset, feel rather baffled and ill-prepared, to say the least.

But, subjects taking part in psychological investigations usually believe or expect that the investigator is a sensible person asking sensible questions, which they believe they should be able to answer. The danger of mistakes resides in the fact that, although the investigator's questions are not intelligible, or do not seem relevant to the subject, the subject will, nevertheless, try to meet the investigator's requirement and come up with *replies which may not be answers to the investigator's questions.*

An example of this pitfall was encountered by the first author in an investigation of fault diagnosis performance by operators on a simple simulation of a nuclear power plant. (Hollnagel et al. 1984).

To test knowledge of principles and correct strategies for fault diagnosing, the subjects were asked to fill in a questionnaire at the end of the training period and after a series of diagnostic tasks. Surprisingly, there was a notable discrepancy in the subjects' knowledge of correct diagnostic measures, as it could be described from their rather successful performance on the simulator, compared with their not so impressive replies to the questionnaire. It might seem obvious that the subjects did not know, or that they were not aware of, what they were doing. But an informal post-experimental interview seemed to indicate that a much more defensible explanation would be that the subjects, who experienced performance of the diagnostic task itself as quite dissimilar to what was required by the questionnaire, had been presented with *two distinct problem solving tasks,* and that the »questionnaire task« was only to a limited extent a test of performance in the fault diagnosis task.

We gather, that our case is not unique, (Berry and Broadbent, 1984). It demonstrates, among other things the importance of providing the subject with appropriate media or mean of expression, adequate for eliciting the information, that the investigator is searching. It also demonstrates the danger of premature conclusions about the reliability of the subject's verbal reports, if he replies in ways which are inconsistent with his performance. The danger of mistaken interpretations resides in the fact that the question does not represent the task, that is, for the subject, it does not refer to the task as seen

by the subject. Similarily, if there are discrepancies between the investigator's *interpretation* of the subject's performance and the subject's descriptions of his deliberations and procedures followed in performing the task, this may very well be due to the fact, that one and the same problem may be determined and solved in several ways. A solution may be reached by using *different* cues and algorithms, both different and *other* than those the investigator had in mind, when he constructed or analysed the problem or task. It goes without saying, that if subjects are only prompted with questions based on the investigator's conception of the task and his interpretation of the subjects performance, the investigator almost certainly risks getting unreliable replies, i.e. *replies* which are not *answers* to his questions.

Problems in reporting verbally about cognitive activities are gaining growing recognition in recent psychological literature, although methods by which these problems can be identified and tackled still remain to be developed. Thus, the distinction between e.g. *reportable knowledge* about a task and *performance* of that task is increasingly being made in psychology, in the perceptional, memorial, conceptual and other domains (Berry and Broadbent, 1984). This distinction has ancestors in Ryle's (1949) distinction between knowing how and knowing that, as well as in Polanyi's (1958) distinction between explicit knowledge and tacit knowledge. Similar distinctions can be found in applied psychological investigations of »knowledge capture« from experts. (Ducan and Praetorius, 1986). Elsewhere, Winograd's 1974 distinction between declarative knowledge and procedural knowledge has been extensively used. What these different distinctions within our knowledge denote is, among others, that only some of the knowledge we possess about out performance of a task may be immediately accessible in verbal form. Parts of performance may be characterized and describable by the subject as following rather explicit rules, whereas knowledge of other parts of performance may not be so readily expressible. The latter kind of implicit knowledge is evident in the considerable amount of »common sense« knowledge, not easily specifiable, which often in complex ways forms the basis of human performance. It is the knowledge implied in highly skilled or automatized performance, be it skills required of most of us in coping with normal every day activities, or the skills of experts. However, we have no a priori reasons to believe that it cannot be made accessible and available in verbal form but that it *will* demand the development of special techniques, perhaps also of special linguistic terms and concepts by both the subject and investigator, (Duncan and Praetorius, 1986).

Whether our efforts are devoted to the capture of knowledge of experts, or to the more humble exercises of determining and describing the cognitive processes of subjects performing comparatively simple tasks in laboratory experiments, a better alternative to the questionable practice of inferring such knowledge from observable behaviour may well be to *enable* the subjects to become reliable observers and describers of their performance.

One way of achieving this would be to provide the subject with extensive pre-experimental training in observing and describing. Such training could, for example, be carried out on material different form that which is used in the experiment proper, but which is familiar to the subject, or simple and well defined, in the sense that what will be observed and how it can be correctly described will be uncontroversial and easily agreed. During pretraining, the subject should be familiarized with distinctions between what is the result of *observation* as opposed to *inference,* attain competence in distinguishing between relevant and irrelevant observations and descriptions, between relevant and irrelevant questions, and between answerable and unanswerable questions.

The intention of this training is, obviously enough, to increase the subject's awarenesss of how he performs and what it implies to observe and describe it as reliably and thoroughly as possible. But it is, also, the intention to create the best possible *common ground* for communication between investigator and subject, to enable the subject to be what we believe he ought to be, namely, a well trained co-observer of the investigation.

This procedure, coupled with other techniques of inquiry, may considerably enhance the investigators access to information from the subject. The first author and Svend Erik Olsen (Olsen, 1985) had promising results from e.g. analyzing video tapes with subjects, trained in the way described above, of commenting on their performance in fault diagnostic tasks, similar to the ones related earlier. It is beyond doubt that many potential misunderstandings and false interpretations of the subjects performance was avoided during this analysis. Stated positively, we got information from the subjects which would not otherwise have been accessible to us.

Similarily, a recent study of Berry and Broadbent (1984) seems to prove the efficiency of verbal instructions which are carefully managed so as to direct attention and to render critical features of task performance salient.

The second author has successfully employed a technique of »withholding information« about plant state in simulated faults of industrial processes. In this case operators see a simulated instrumental panel, but without readings on the instruments. To make a diagnosis information must be sought, and is withheld until requested, about the state of various parts of the plant. This method proved profitable in eliciting verbal reports from the operators about knowledge and heuristics which would otherwise have been difficult to put into words. The effectiveness of the knowledge and heuristics thus obtained is subsequently tested in training programmes where novices have to diagnose novel failures. (Duncan and Shepherd, 1975, Shepherd et al. 1977, Marshall et al. 1981).

Summary of psychological conditions and problems. Nothing may be easier than to »prove« that the subjects' reports are unreliable, and that subjects

»do not know, what they think or how they think«. Nissbetts and Wilson's review demonstrates how this is done. We have argued that verbal reports from subjcts may be a powerful source of information in the area of cognitive research - as powerful as in any other area of psychology. But the development of special methodes and techniques in eliciting these information will be needed. The alternative to inferring »cognitive processes« from »observable behaviour« is to *enable* the subject, who may have direct access to information, which the investigator is searching, to be a reliable observer and describer. That is, by providing him with opportunities of understanding *what* the investigator wants him to observe, as well as optimal conditions for observing that, and by providing the subject with optimal linquistic conditions of describing it as correctly and reliably as possible.

The matter of interest will, consequently, not be whether or not the subject's verbal reports are reliable, but *how* reliable it can *become,* granted that we employ all our methodological skills and ingenuity. Ideally, the aim and responsibility of the investigator must be to minimize the differences between his own and the subject's account of the subject's cognitive processes and behaviour.

Conclusion

The intention of this paper has been to stamp out the myth, apparently still widespred in psychological theorizing, that verbal reports from subjects in psychological investigations are not or cannot be reliable, accurate of truthful; that subjects are not able to communicate reliably about what they think, feel, or how they solve problems, i.e. about their mental states, higher mental processes and the like.

Such assumptions, we have argued, are self-defeating, and would, in the final analysis, render research in cognitive psychology - as well as in any other field of psychology - self-contraditory and senseless.

We have argued, moreover, that in some areas of psychological research there may be significant *psychological problems* for the subject in observing and in verbally conveying information to the investigator of what is observed; but we have also argued, why such psychological problems should not be mistaken as *in principle* problematic.

Implied in the myth is the assumption, that only what is manifestly or objectively observable to the investigator may count as data in psychological investigations. In some areas of research, notably in research on cognitive processes, the subject is the only one who may have direct access to the information, which the investigator is searching. We have argued, however, that this does *not* mean that it is not observable - and we see that as no reason for assuming a »black box theory« of the human mind and its mental states, representations or cognitive processes, or for invoking unknown, or in prin-

ciple unknowable entities for such states or processes. Humans are language users who, given appropriate conditions, may observe and describe their thinking, feelings, problem solving etc. both accurately and reliably - probably as accurately and reliably as any psychological investigator.

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