A Reappraisal of the Concept of Science in Psychology: The Implications of Research Results of Cognitive Psychology

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< Abstract >

The traditional concept of science in psychology is the foundationalistic one that psychology had adopted from the physical science. This traditional theory of science which is called Received View is based on Cartesian ontology and epistemology. This theory of science is riddled with many problems. One of the main problems of this theory is that its epistemology is too simple and without empirical grounds.

The theory assumes that human as the knower exists independent of the objects it experiences and cognizes, that human reason is rational, that human cognition is a true mirror of the nature, that scientific data can be obtained independent of the theory the scientist has in mind, and that explicit meanings of the linguistic concepts can be given independent of social contexts.

Research in cognitive psychology has cast serious doubts on the above assumptions. The basic tenets of cognitive psychology are that human mind is an active information processor whose basic principle is the 'effort after meaning.' Mind is not the direct and true reflector of the objects in the environment. The objects are only some partial cues or indices to what sorts of mental contents should be constructed out of it. The remaining parts are supplied by the knowledge in the mind and the social context.

The results of empirical research of cognitive psychology on perception, attention, memory, language, and thinking also support these tenets. The empirical research results cast serious doubts on the epistemology of the traditional concept of science in psychology. It seems that the logical rationality of human reason and of science are questionable.

This paper discusses in what ways the research results of cognitive psychology cast doubt on the traditional concept of science in psychology, what unanalyzed presuppositions underlie the traditional concept of science, and how we should launch a cognitive psychology of science – a new concept of science in psychology.

<Introduction>

The traditional concept of science or theory of science in psychology has been the one that psychology had adopted from the physical science. This concept of science as frequently called as the 'Received View', 'foundationalism' or 'positivistic view' has been the backbone of psychology in its early days while psychology tried to establish itself as an independent respectable science.

This view of science assumes that objects exist independent of human subjects as the cognizers, that human reason is rational, that human cognition is a true mirror of the nature, that scientific data can be obtained independent of the theory a scientist or the society of scientists have in mind, and that explicit meanings of linguistic concepts can be given within an individual, independent of social contexts. This theory of science has many problems. One of the main problems of this theory is that its epistemology, Cartesian epistemology, is too simple and does not truly reflect the cognition of the real human being. The epistemology was formulated without proper empirical evidences.

This concept of science, however, has been adopted erroneously by psychology and has outlived its use. This concept of science had already been criticized by the philosophers of science even before psychology adopted the concept, has been criticized thereafter, and finally discarded by most of the philosophers of science. In philosophy of science several new theories of science have been proposed and they have underwent several revisions. Yet most of psychologists are still clinging to the old version of the concept of science and are not easily yielding to the necessity and inevitability of discarding this old concept. They say that the criticisms against the traditional concept are groundless and metaphysical, ie. abstract and non-empirical. Psychologists are not lending their ears to the current theories and discussions in philosophy of science.

This autistic behavior and belief of the psychologists are now put in a great quandary. They now have to recant their belief in the traditional concept of science and construct a new one. This time the driving force toward a revision of the concept of science is not coming from the philosophers. Nor it is of an abstract argument. It is coming from science. And what is more it is coming from their own: from psychology. In addition to this, the argument is unfolding in an increasing force with the weight of compelling empirical evidences. This compelling argument asks psychologist to discard their outmoded and non-empirically-based concept of science and adopt a new concept of science based on the evidences of empirical psychology.

Then, what are the empirical evidences that compel psychologists to revise their concept of science? What area(s) of psychology is(are) the provider(s) of the

empirical evidences?

Cognitive psychology is the area that provides various evidences that show how the traditional concept of science has been wrong and what form a new version of the concept of science should take.

This paper discusses in what ways the empirical research results of cognitive psychology cast doubts on the traditional concept of science in psychology, what unanalyzed presuppositions underlie the traditional concept of science, and how we should launch a new concept of science in psychology – a cognitive theory of science.

< Research Results of Cognitive Psychology and its Implications on Traditional Concept of science >

Research in cognitive psychology on various aspects of human cognition has cast serious doubts on the basic assumptions of traditional concept of science. The results of empirical research of cognitive psychology on perception, attention, memory, language, thinking, and social cognition suggest that the traditional concept of science, especially its epistemology, should be reformulated into one that is compatible with the real human cognition of the acting scientists. Let us look at the key implications of research findings in various areas of cognitive psychology.

The research on perception has shown that human perception is a construction: knowledge, motivations and other cognitive factors affect the contents of perception. Perception is not a simple one-shot process that reflects the nature as truly as a mirror does. Even a simple perception is a complex of multi-stage information processes, where the percepts are determined by the complex averaging or abstracting mathematical processes. Simple pattern recognition is also affected by language or categorical knowledge. Higher level perception is muddled with the effects of contextual knowledge. All these research results show that the so-called simple data of sensory experience are hard to come by and not the one-to-one mapped mirror images of the nature as previously assumed. This casts a serious doubt on the traditional positivistic epistemology which had assumed some pure theory-free sensory data.

Research on attention points the same thing. Empirical research on attention shows that our attention is of limited capacity, carried out by processing some selected parts of the total arrays of input stimuli only, and many are left out. This indicates that mind can not be a true mirror of the nature.

Research results on memory are the one where the traditional epistemology and concept of science are hardest put to survive the criticism. Empirical research on memory has shown that the view of memory implicit in the traditional epistemology

and concept of science was simplistic. The wax-like, photocopy-like, or mirror-like view of memory in the traditional concept was not a realistic view. Empirical research in Bartlettian and other tradition has revealed that memory is a construction and a complex of multi-stage processes and multi-structure representation where a mirror-like or wax-like mapping of the external stimuli is an exception but not a common usual phenomenon. Memory includes the processes of computation, abstraction, deletion, reconstruction, transformation, inference and interpretation. Sensory input is not stored in its original modality. The working memory and Long Term Memory usually changes the modal codes of the sensory inputs into verbal or propositional; a deeper or more elaborative processing is usually involved and this entails a memory trace of different durability or retrievability(thus not a truthful copy of the input stimuli) depending on the depths of processing; stored representations are the interpreted results by adding personal knowledge to and transforming the input information; even a simple recognition of an object is a multistage computation; even the nature of the imagery which the traditional epistemology considered as a true copy of the sensory inputs is questioned. Imagery has been found as an abstract representation and cognitively penetrable. Imagery as a representation that maps the reality in a one-to-one way is no longer viable. All these research results on memory indicate that the traditional assumptions of mind as a mirror of the nature and of the possibility of obtaining pure sensory data are no longer tenable.

Research on concept and categorization also shows that traditional view on concepts and language meaning was not based on empirical evidences. Traditional theory of science viewed that knowledge consists of organized concepts and propositions, where categories of concepts have distinct boundaries and the meaning of each concept is given by the defining semantic primitives or defining propositions independent of social contexts. Research in cognitive psychology has shown that categories have no clear-cut boundaries, categories are not fixed things stored but generated based on some prototypes or exemplars when it is needed, the meaning of a concept is not given by some defining semantic attributes or propositions but by some Gestalt of its relation with other concepts and knowledge, and it is dependent on social agreement and contexts. These indicate that traditional view of concept categories and language meaning was simplistic and nonrealistic.

Research on language comprehension is another area where the limits of the traditional epistemology show clearly. Traditional theory of science held a view that the comprehension of language is a matter of simply combining the meanings of individual concepts. The meaning of each concept is viewed as fixed, independent of language user and social contexts. Thus any knowledge couched in linguistic or propositional forms is considered as having an intersubjectively explicit meaning. Research results in cognitive psychology, on the other hand, revealed that language

comprehension is also a construction; language comprehension is an interpreting and inferencing process which uses the language input as a cue, program or index to what knowledge should be activated from Long Term Memory and what type of processing should be carried out. Language input itself has no meaning. The comprehended meaning and the resulting representation is a result of some complex multistage processes of applying one's knowledge to the language inputs. Comprehending is always a matter of going beyond the given information. The research results indicate that the traditional assumptions of the existence of intersubjectively objective and invariant meaning of language independent of social contexts are groundless.

While the research results in the above mentioned areas raised doubts on some assumptions (mind as a mirror of nature, and the existence of pure sensory data and objective meanings of linguistic propositions and concepts) of the traditional concept of science, research on thinking has shown that the other assumptions of the traditional view(rationality of reason, algorithmic nature of logical reasoning, and automaticity and rationality of justification inference) are laden with problems.

Research results on problem solving have shown have shown that human problem solving processes rely more on heuristics than algorithms, and on subjective mental models than the explicit problem statements.

Deductive reasoning research has revealed that human logical reasoning is riddled with nonrational characteristics; confirmation bias occurs consistently, the conclusion inference in syllogistic reasoning depends heavily on some factors other than the contents or ;logical forms of propositions, different mental models entail different reasoning results for the same syllogistic propositions, and situation dependent heuristics or schemata are applied instead of situation independent algorithms. These results indicate that human reasoning(including scientific reasoning) is not so logical, rule-following, automatic, and rational as the traditional view has espoused. It is rather heuristic, error-prone and pragmatic-principle following.

Research on judgment and deciding also has shown that our inductive reasoning and decision making are not like what the traditional view has assumed. As Kahneman, Slovic, & Tversky(1982) have shown, human judgment and decision making are dependent on various heuristics to a great extent. People are insensitive to the prior probability or base-rate, sample size, and statistical regression. They make judgment or decision relying heavily on some heuristics; such as availability or representativeness. Context or knowledge effects such as frame effect or anchoring effect show up clearly. All these results show our judgment and decision making are riddled with many non-logical, non-rational, non-algorithmic, and situation- or knowledge-dependent heuristics. We are not simply applying the logical rules to the given reasoning or deciding problems. These results counters the basic assumptions

of the traditional view – the rationality of reason and automaticity and algorithmic nature of deductive or inductive reasoning.

< A Recapitulation>

The above cursory look at the research results in cognitive psychology and its implications clearly shows that the basic tenets and assumptions of the traditional theory of science in psychology is laden with problems. The objects human cognizes no longer exist independent of the cognizer and his knowledge and biases. The tenet that human cognition is a true mirror of the nature is a myth. Pure sensory data no longer exist. So-called objective scientific data are riddled with all sorts of bias, subjective knowledge and inferred meanings, and other contextual effects. The exact meanings of linguistic concepts are difficult to come by and meanings are dependent on the comprehender and social contexts. Human reason is not so logical or rational as traditionally thought. Human logical reasoning is not an algorithmic process of simply applying logical rules to the given propositions. Human reason follows some pragmatic principle instead of logically rational principle. The traditional concept of science, especially its epistemology, has lost its base and no longer tenable. When we look further at the foundations of the traditional theory of science, we could find many more presuppositions and assumptions unanalyzed or unvindicated(see TABLE 1).

< A possible direction for a Reformulation >

Once we have realized that the traditional concept of science must be reformulated, then how should we go about it? An extensive discussion of this issue is beyond the range of this short paper. I would rather propose briefly a possible direction.

We should first reformulate the traditional Cartesian, rational, and modernistic epistemology, and it will entail a reformulation of other basic assumptions of the traditional theory of science.

In the traditional theory of science and epistemology, science was viewed as an abstract structure, specified in abstract linguistic terms. Science was not discussed as one of concrete human activities. Science was dissociated entirely from any activities of the scientist as a human being. The role of scientists as real cognizing persons was not considered in formulating the traditional concept of science. The traditional view merely presented a prescription on how scientific knowledge can be obtained and accumulated following the explicated objective logical rules, and on how a theory is justified based on some empirical data via inductive inference. It did not

considered the real cognitive aspects of an acting scientist. It failed to consider a scientist is just an ordinary cognizing person who has many cognitive limitations(as shown in the previous section) in information processing, is biased with some motivational, emotional and other prior-knowledge, and whose knowledge and thought are influenced by social, historical and cultural contexts. Thus the resulting view of science is postulating a science done by some imagined abstract thinking(logical) machine but not by a concrete living cognizing human being. This view fails on its own terms since it violates its own prescriptions that a theory of something should be based on some firm empirical evidences. The traditional concept of science and its prescriptions were formulated without any serious and systematic considerations of or validations by empirical evidences. This is a paradox inherent in the traditional concept of science.

In the newly formulated concept of science, the scientist as a real living and cognizing human being should be placed at the center. In other words, human cognition should be placed at the core and base of the concept of science. Before we explicate the logical rules and systems of science, we should study the nature of scientist as a human being and his cognition, namely the nature of his information processing processes and structures;- his processing limitations, biases and fallibility; the extents social and other contexts or prior knowledge determine the represented meanings of comprehended and remembered contents of linguistic inputs; heuristic and non-logical nature of his reasoning, judging and deciding processes. Only after we have considered these and incorporated the research findings and its implications into our conception of the scientist as a human cognizer, then we can develope some logical or formal system of our new theory of science. This is a call for a cognitive psychology of science: a new cognitive theory of science as discussed by Corlett(1991), Giere(1988), Goldman(1986), Hooker(1987), and Kornblith(1986).

Theory of science is no longer a exclusive possession of philosophers. Cognitive psychologist should play an active and key role in developing and formulating a new concept of science: A concept whose epistemology is based firmly on the real living and cognizing human scientists, but not on a mechanistic abstract thinking machine that simply follows the logical rules prescribed by the philosophers.

When we look closely at the nature of cognitive activities of a scientists, we could find that his scientific activities are a kind of discursive practice, that his cognition takes place in the medium of discourse(Harre, 1994), and that he is following the 'petit recit', instead of 'grand recit', as J.F. Lyotard pointed out. This realization would lead us into another step of possible reformulation of the old modernistic concept of science. I believe cognitive psychology and social psychology will play a critical role in that direction.

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Appendix:

<TABLE 1. Presuppositions and Assumptions underlying the Scientific Activities >

I. Presuppositions and Assumptions on Human cognition

Cognition in general	Possibilities of overcoming some basic aspects of cognition
innate ability to organize; general ability of information processing; drive for knowledge acquisition; intolerance to the gaps in knowledge;	cognition as construction; interpretation situation-, context-dependent inferential non-logical rationality (pragmatic rational principle) difficulty in defining meanings of linguistic concepts; indeterminacy of category boundaries; intrusion of beliefs, motivation;
incomplete but workable correspondence between human representations and the reality in the nature	capacity limitations of Working Memory; incompleteness of search in LTM; variability inherent in retrieved and reconstructed information from LTM;

II. Presuppositions on Scientists and Human Being in General

rationality of human reason;
commonality in designated meanings of linguistic concepts among scientists and other human beings;
existence of common belief systems among scientists and in societies;
similarity of general knowledge structure among scientists and other human beings
possibility of successful communication among scientists;
similarity of the principles of reasoning, judging, and deciding among scientists;
trustworthiness of human memory
trustworthiness of human sensation and perception processes

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III. Presuppositions and Assumptions on Basic Theories

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validity of formal logic and formal language
validity of measurement theories
validity of statistical inference theories;
validity of decision theories
validity of theories of errors
validity of theories of probability
validity of selecting and relying on a specific probability theory
validity of theories of meaning and concept classification

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