NOTES TOWARD A MODEL FOR THE STRUCTURE OF KNOWLEDGE SYSTEMS

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This paper reviews two formulations of some structural aspects of knowledge systems. These two structural specifications of knowledge systems, by Judith Willer and by Norwood Russell Hanson, are then combined to suggest a model for relating several "ideal type" knowledge systems. Some tentative descriptions of these knowledge systems are given.

The paper concludes by suggesting that scientific systems involve a particular combination of two of the systems and that sociology of knowledge and cognitive psychology have clear roles in the theoretical development of such a model.

We make 'sense' out of the phenomenal world in a number of ways. These ways of ordering, structuring, and relating the world are here referred to as understandings. What is taken as truth, correctness, or valid and worthwhile knowledge varies across different forms of understandings.

A single individual can simultaneously hold different understandings of the same subject matter. A physical scientist may have an abstract, theoretical understanding of the physical universe and at the same time operate within the physical world using a practical empirical form of understanding. What is a valid explanation of what "makes" his car go is different within each form of understanding. The theoretical form consists of various laws of mechanics, gases, and electrical activity. The event "car moving" disappears within the scope and generality of the explanation. The individual possessing this form of understanding could hardly use it to convey to another person the "reason" his car did not start on a particular occasion. Such a reason could however, be conveyed through the use of a shared practical form of empirical understanding. He might simply say that the battery cable was broken, and thus convey the "reason."

Understandings take objective form in knowledge systems. Knowledge systems have been characterized in many ways. Some examples of the tags which have been used are: deductive, inductive, religious, scientific, mystical, practical-empirical, analytic, experimental, naturalistic, abstract, and theoretical. Judith Willer (1971) suggests that the structure of all such knowledge systems can be characterized in terms of three basic types of thought connection.

The term "thought connection" refers to the structural character or form of relation the understanding makes among the ideas with which it deals. The three types of connections are empirical, rational, and abstractive. They are illustrated in Table 1.

Empirical thought connections are those that operate only at the empirical level; rational thought connections operate only at the theoretical level; and abstractive thought makes connections between the theoretic and observational levels.

Table 1. Basic Types of Thought Connection (Willer, 1971:20).

Connective Level	Types of thought connection
Theoretic	Rational: a ⟶ b Abstractive: b ↑ or a ↓
Observational	Empirical: A ⟶ B A, B

These three types of thought connections are further combined to produce four types of knowledge systems. The four are magical, mystical, religious, and scientific. They are illustrated in Table 2.

Table 2. Combinations of Types of Thought Connection in Four Types of Knowledge Systems (Willer, 1971:25).

Connective Levels:	Knowledge System: Magical	Mystical	Religious	Scientific
Theoretic		b ↑	a ⟶ b	a ⟷ b
Observational	A ⟶ B	A ⟶ B	B	A ⟷ B

All of the knowledge systems utilize empirical thinking in some manner or another. Magical systems exist ". . . only if [empirical] . . . thinking alone forms the basis for gaining knowledge about connections in the world" (Willer, 1971:26).

A mystical knowledge system adds to empirical thought a conception of an ideal rather than empirical end. This conception of an ideal end and its connection with empirical events forms an abstractive link, and when this sort of structure emerges a mystical knowledge system is formed.

When rational connections are made at the theoretic level and are in turn used to place ethical interpretations on the empirical world, a religious knowledge system exists. The connections among concepts are tight and necessary and do not give way to empirical "evidence," rather they afford a "way" to interpret and understand empirical events.

A scientific knowledge system involves all three types of thought connections: empirical, rational, and abstractive. Scientific systems both interpret empirical events through rational connections at the theoretical level and allow for those

connections to be corrected if they are not isomorphic to empirical events.

Hanson (1971) in a short essay on philosophy of science, set himself the task of outlining "a balanced 'middle of the channel' resolution . . ." to the ". . . conceptual terrain of standard issues . . ." (1971:1-2) which makes up philosophy of science. I would like to suggest that he does more than this however. Implicit in his discussion is a model of knowledge systems which, if combined with Judith Willer's model, forms a still more general model from which a theory of knowledge might be built.

Hanson viewed the understanding of events as placing them in a framework of other ". . . 'unsurprisabilia' known to obtain" (1971:32) or placing anomalies ". . . within an intelligible framework of ideas . . ." (1971:48). Magical, mystical, religious, and scientific knowledge systems all provide an intelligible framework of "unsurprisabilia" (i.e., standard, consensual knowledge) within which encountered events can be placed and interpreted.

Hanson further suggests that statements can be placed in a logical space circumscribed by syntactic, semantic, and epistemological dimensions.

Syntax is characterized by Hanson as involving the "sign-design" of statements, that is, the logical character which results from the ". . . symbol structure of an assertion" (Hanson, 1971:49-50). The two logical extremes of this dimension are synthetic statements and analytic statements. A statement ". . . is synthetic if and only if its negation . . . entails no inconsistencies (i.e., nothing of the form Q and not-Q)" (Hanson, 1971:50). 'Synthetic' can best be viewed in the context of this paper as referring to statements the truth of which is logically open. When the negation of a statement entails an inconsistency, then it is the "opposite" of synthetic and is called analytic. 'Analytic' refers to statements the truth of which is "contained" within the form of the statement itself. According to Hanson (1971:51) "Claims like 'All fathers are parents', 'Bicycles have two wheels', and 'All equiangular triangles are equilateral' are (re: their sign-design) the opposite of synthetic." The negation of such statements entails an inconsistency, and such statements are true by virtue of their linguistic construction.

The semantic dimension has at one pole statements that are invulnerable and vulnerable statements at the other pole.

> Invulnerable claims (whatever the genesis of that invulnerability) are often designated as 'necessary' or 'necessarily true'. Vulnerable claims, on the other hand, are said to be 'contingent', e.g., on the way the world is, or on the rules of the game, or on the conditions of inquiry within a given context. (Hanson, 1971:50)

The epistemological dimension characterizes the status of statements with regard to experience. Statements can at one extreme be *a priori* and at the other *a posteriori*. Those which are *a priori* are subject to analysis through reflection, they need make no direct reference to experience to justify their claims.

A posteriori claims are justified through direct reference to experience. *A priori* and *a posteriori* do not exhaust the meaning of this dimension. The dimension does not simply refer to "prior and post" analysis but includes something like the degree to which statements directly *depend* on experience for their justification.

These three dimensions are shown as polar opposites in Figure 1.

Figure 1. Logical Space for the Status of Statements.

A priori	Epistemological	A posteriori
Vulnerable	Semantic	Invulnerable
Analytic	Syntactic	Synthetic

Taking the end points of these dimensions three at a time yields eight separate combinations. These eight combinations are listed in Table 3 as ideal types.

Table 3. Ideal Type Knowledge Systems.

	Epistemological	Semantic	Syntactic
I.	A priori	Vulnerable	Analytic
II.	A priori	Vulnerable	Synthetic
III.	A priori	Invulnerable	Analytic
IV.	A priori	Invulnerable	Synthetic
V.	A posteriori	Vulnerable	Analytic
VI.	A posteriori	Vulnerable	Synthetic
VII.	A posteriori	Invulnerable	Analytic
VIII.	A posteriori	Invulnerable	Synthetic

Hanson points out that, on the one hand, empirical statements are a posteriori, vulnerable (or contingent), and synthetic; while on the other hand, tautologies are a priori, invulnerable (or necessary), and analytic (Hanson, 1971:52). In terms of Table 3 empirical statements are Type VI and tautologies are Type III.

Judith Willer's characterization of magical knowledge implies two of the characteristics which Hanson ascribes to empirical statements. She notes that the elements of magical thought systems are empirical categories which are connected by trial and error using "rules of thumb" at the observational level. Thus one can say that statement forms of magical knowledge systems are empirical, and that they are vulnerable and contingent (since they are based on rules of thumb) rather than necessary. Such statement forms are also a posteriori in the sense that they are directly dependent on experience for their justification. Thus if one event fails to result in another event which was, according to rule of thumb, "supposed" to follow, the rule of thumb will be subject to challenge, that is, its claim to be valid knowledge is vulnerable. In the face of such a challenge ". . . it may be thought that the intent was no longer present, the causal connection was broken, or the first event lost its efficacy - its power to produce the second. . ." (Willer, 1971:26). The statements of magical systems can also be characterized in terms of the syntactic dimension. Such statements are analytic or logically closed rather than synthetic and open.

The empirical statements to which Willer refers and the empirical statements to which Hanson refers differ only with respect to the syntactic dimension. Hanson characterizes empirical statements as synthetic (open), contingent and a posteriori; Willer's discussion implies that empirical statements are analytic (closed), contingent, and a posteriori. This difference is due to the fact that Hanson limits his discussion to empirical statements that are part of scientific

knowledge systems while Willer's discussion includes empirical statements of magical knowledge systems. Such systems utilize only empirical thinking to gain knowledge of the world. According to her, scientific thought systems combine rational and empirical thought, the combination being in the form of an integration of rational (open, synthetic) and empirical thought through abstraction (1971:31). This sort of connection to a rational system is what Hanson seems to have in mind when he characterized empirical statements as synthetic (e.g., they are more than matters of definition). Hanson and Willer's discussions of empirical statements agree when the empirical statements are part of a scientific knowledge system. The character of empirical statements is then dependent on the knowledge system of which they are a part.

The three dimensions of this logical space are independent of one another and should be viewed as "continuous" and not simply dichotomies. Independence simply means that the "position" of a statement of any one dimension does not automatically determine its "position" on the other two. The nature of such a relationship can perhaps be seen more readily in Figure 2. The dimensions are arranged in a manner intended to picture a cube-like "space." The syntactic dimension is drawn as a horizontal axis, the epistemological dimension as a vertical axis and the semantic dimension as an axis running from the "front" of the cube to the "back." In Figure 2 one should picture the intersection of the three dimensions as being "on" the page with the vulnerable or contingent pole of the epistemological dimension projecting forward from the page and the invulnerable or necessary pole receding "into" the page.

The purpose of this graphic representation is to point out that although the three dimensions are viewed as independent of one another, knowledge systems characterized in terms of them are not viewed as independent of one another. The arrangement of the dimensions in Figure 2 constitutes a mechanism for relating different types of knowledge systems in a theoretical model.

The eight combinations of Table 3 should be seen as theoretical ideal types. These ideal types in turn can be located at the extreme "corners" of the cube. The following discussion takes up each ideal type and suggests a specific form of knowledge system which approaches that type.

Type I: A priori - Vulnerable - Analytic

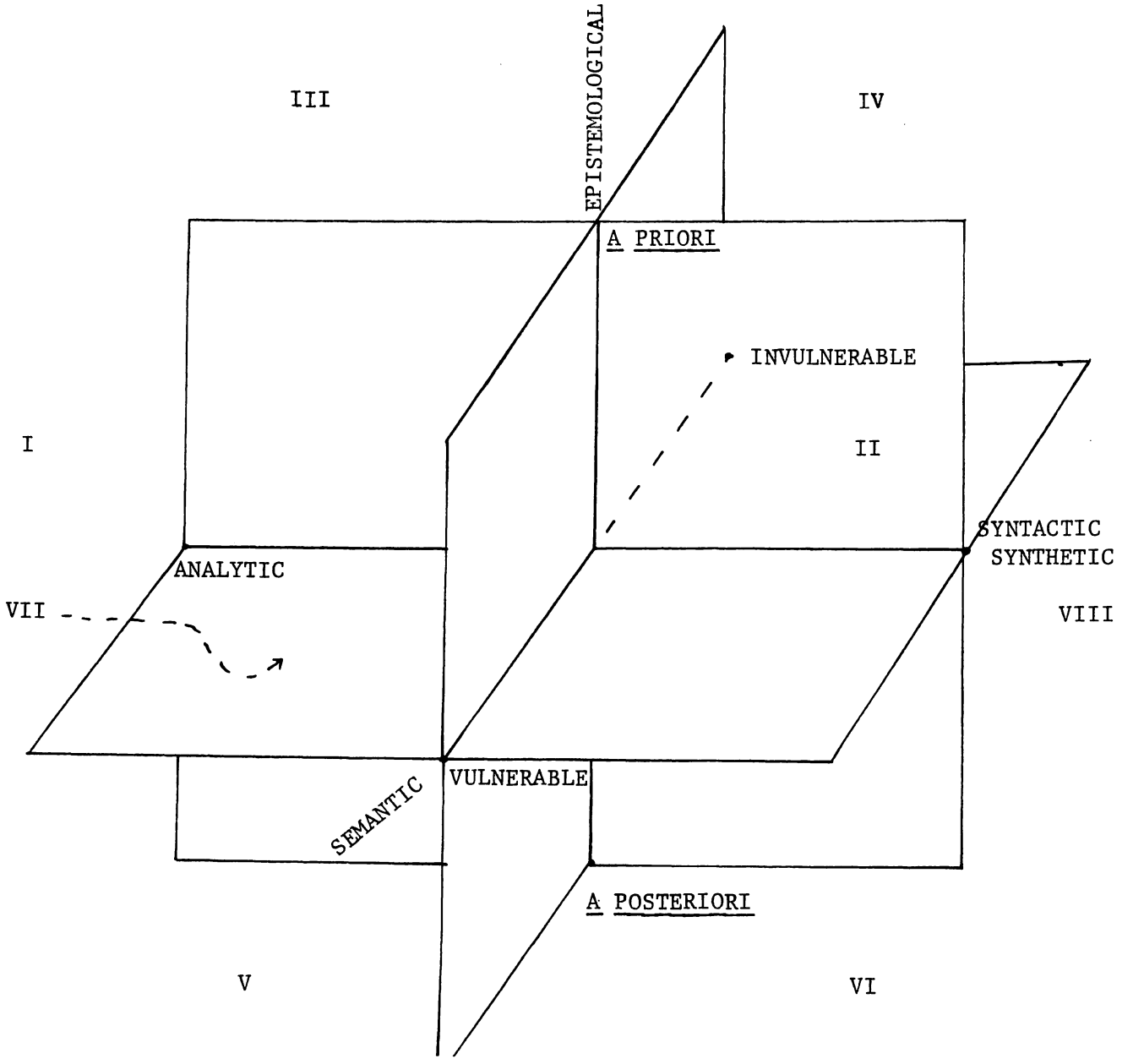
Mystical knowledge systems approach this extreme. Such systems have as their "object" a "state" which is independent of the empirical world (i.e., a priori). The knowledge is vulnerable (not in the face of empirical events but in the face of the rules' "ability" to reach and maintain the mystical state); and the statements have analytical interpretations. Mystical ideals or states gain their meaning at the abstract level. There are empirical steps for reaching such a state but the steps do not give the state its meaning - the meaning is gained at the abstract level.

Type II: A priori - Vulnerable - Synthetic

Metaphysical systems seem to be an ideal type which is synthetic, a priori, and vulnerable. I will not elaborate on this point in the present paper since I have done little actual investigation of such knowledge systems. However, on the surface, metaphysical systems seem to be concerned with a priori truths which are not "mere" definition or "simply" tautological statements. The concern seems to be with the absoluteness and certainty of the knowledge. Although ostensibly

seeking absoluteness and certainty, metaphysical systems are placed at the vulnerable extreme of the semantic dimension. This hinges more on the methods metaphysicians use to investigate the system than on the actual statement form itself. The dialectic might be used as such a method. The individual statements of a dialectical set of statements are of a necessary or invulnerable logical form. Thesis, anti-thesis, and synthesis are all of invulnerable form individually; however, taken as a unit the three statements constitute a contingent or vulnerable set. The vulnerability is found in the thesis - anti-thesis combination. The dialectical synthesis in turn forms a new synthetic statement (a new thesis) from the two original statements. The juxtaposition of two analytical statements could not lead to a synthesis (e.g., all bicycles have two wheels versus no bicycles have two wheels), therefore it seems that metaphysical statements which take a dialectical form can be characterized as synthetic. Whether this is true of all metaphysical methods I will not attempt to say without further investigation. I do think that all metaphysical systems seek a priori truths however.

Figure 2. A Logical Space for Knowledge Systems.



Type III: A priori - Invulnerable - Analytic

Theology as the theoretical aspect of religions illustrates this type of knowledge system. In its ideal type the statements are invulnerable, a priori, and analytic in form. The meaning of the statements may be illustrated by ethical stances in relation to empirical events, but the reason (meaning) for the stance gained from the symbolic structure and not from the empirical event. Empirical events are relevant to the meaning of the statements as illustrations of good and evil in the world. The empirical events are neither ways to "reach" an abstracted state nor are they used self-consciously to "check" the connections among concepts of the symbolic system.[1]

Type IV: A priori - Invulnerable - Synthetic

Fully formal theory (e.g., "pure" mathematics) is located at position IV. Such a knowledge system would have sets of statements of synthetic, invulnerable, a priori form. The justification of the statements of formal theory like those of mystical, religious, and metaphysical systems, gain their meaning from the abstract symbolic structure. This abstract structure does not, however, constitute an ideal state, a means of ethical interpretation, or an attempt at a state of absolute knowledge. These sorts of issues simply do not arise in regard to formal theory. I will return to this point later in regard to scientific systems.

Type V: A posteriori - Vulnerable - Analytic

Magical knowledge systems, as characterized by Judith Willer, are the ideal typical illustration for this "area" of the cube. The elements of such systems are related through empirical connections. The statements which specify the relations place empirical signs into symbolic systems. The signs carry little meaning in addition to what they indicate empirically. Regardless of whether the individual signs are called by terms such as cause, indicator, or predictor, they are strongly tied to empirical conditions for justification of their meaning. This might illustrate what I mean by saying that the epistemological dimension refers to the degree to which statements are dependent on experience for justification. The way in which empirical categories are linked to each other may be symbolic (e.g., mathematical, symbolic logic, magical formulas) yet not abstract. Abstraction involves developing symbolic systems which are not directly dependent on empirical circumstances for their meaning and justification.

Type VI: A posteriori - Vulnerable - Synthetic

Type VI consists of sets of synthetic, a posteriori, and contingent statements. Purely naturalistic description seems to fit as an ideal type of this sort of knowledge system. Willems (1969:46-47) in a discussion of naturalistic research in psychology, suggests that what a researcher does can be characterized in terms of two dimensions. The two dimensions are 1) the degree to which antecedent conditions are manipulated, and 2) the degree to which units are imposed upon the phenomena studied. Naturalistic research is characterized by Willems as being low on both of these dimensions. The "degree of imposition of units" dimension utilized by Willems coincides with the contingent-necessary (semantic) dimension of the present model and his "degree of manipulation of antecedent conditions" coincides with the a priori - a posteriori (epistemological dimension). Naturalistic research minimizes the degree to which results are "forced into" or "interpreted in terms of" an invulnerable conceptual scheme (i.e., one made up of a set of necessary statements), or in Willems' terms, the degree to which units

(from whatever sort of conceptual scheme) are imposed on the research. Naturalistic research also minimizes the degree to which the conditions under which the phenomena are studied are manipulated a priori (i.e., empirical conditions are accepted as they are found and statements receive their justification from accuracy of the description.) This coincides with the epistemological dimension.

The third dimension of the model is not explicitly reflected in Willems' presentation. Willems is, however, writing in the context of a methodology for the science of psychology and would, presumably, agree that the statements forming naturalistic knowledge of phenomena would, in their ideal form, be logically open and synthetic rather than logically closed and analytic.

Type VII: A posteriori - Invulnerable - Analytic

Ideological thought systems can be characterized as analytic, invulnerable, and a posteriori. Ideology defines empirical events (i.e., it is a posteriori) in a logically closed manner (i.e., it is analytic), and these events are related to one another in a logically necessary form (i.e., the set of statements are invulnerable). Therefore, it illustrates the ideal type for position VII.

Type VIII: A posteriori - Invulnerable - Synthetic

Paradigms, or formal statements of the sum of past knowledge for some subject area approach the ideal extreme for type VIII. The paradigms which Kuhn (1962) discusses would be an example of the type of knowledge systems found here. The statements are of an a posteriori, synthetic, and necessary form. Kuhn points out that the theories of a science are learned through sets of standard examples and illustrations which demonstrate the concepts, laws, and applications of those theories. These latter ". . . intellectual tools are from the start encountered in a historically and pedagogically prior unit that displays them with and through their applications" (Kuhn, 1962:46). The prior unit is the set of standard examples and illustrations. This being the case, the concepts, laws, and applications are, within paradigms, logically subsequent (a posteriori) to the problems which they explain.

Since these paradigms are transmitted through and learned from exposure to classroom, laboratory, and textbook experiences they are, at least in their ideal form, consistent sets of statements.

Kuhn states that paradigms also, within "normal science," function as guides to research through both direct modeling and through abstracted rules.

> Normal science can proceed without rules only so long as the relevant scientific community accepts without question the particular problem-solutions already achieved. Rules should therefore become important and the characteristic unconcern about them should vanish whenever paradigms or models are felt to be insecure (Kuhn, 1962:47, my emphasis).

Interpreting Kuhn's statement in terms of the model being presented here, we can say that the "problem-solutions" constitute paradigms only as long as their statements are accepted and used by the relevant scientific community as necessary and invulnerable.

Scientific systems have not been placed at any of the "extremes" of the graphic model. They do not then constitute an ideal type in terms of some combination of

the extremes of the dimensions of the model. This is because scientific thought systems establish empirical interpretations for systems of formal theory. The statements of scientific systems gain their justification and meaning from both the formal theoretic and the empirical level.

Empirical statements are used to check and illustrate the "correctness" of the connections at the symbolic level. Scientific knowledge systems result from this form of connecting the abstract and empirical levels. These systems consist of the reciprocal connections of formal theoretical systems and empirical systems. Scientific thought is the establishment of such connections through abstraction.

All knowledge systems have methodologies. Concerns with the specification of procedures and activities for developing and maintaining the form and type of the specific knowledge system are located here. Concerns with methodology in this sense overlap with those of sociology of knowledge and epistemology. The implication is that a thorough understanding of scientific methodology, for example, cannot be gained without an understanding of the methodologies of other forms of knowledge. An understanding of such methodologies is not a matter of learning mechanical steps and procedures but also includes realizing the cognitive use to which knowledge is put by each type of system. I am attempting to convey the idea that the "movement" of systems of knowledge "within the cube" are as much a matter of the cognitive orientation toward knowledge as it is a matter of specific procedure. Carlos Castaneda in the books The Teachings of Don Juan and A Separate Reality reports his encounters with a system of mystical knowledge. His cognitive orientation toward his experience, as he reports it, shifts between attempts to make objective scientific sense of what was going on, and full participation in the mystical system itself. Both of these orientations are "anchored to" the same experiential world and yet both lead to different sorts of knowledge about that world - and most interestingly - the systems do not seem to be necessarily mutually exclusive in the sense that if you "have" one you cannot "gain" the other. They are, however, mutually exclusive in the sense that "operating" with one prohibits simultaneously operating with the other.

This paper has suggested a model for the structure of knowledge systems. There has also been some attempt to illustrate aspects of the model by describing some familiar types of knowledge systems. However, descriptions of ideal types is not the only, nor the most fruitful use of the model. The model is intended as an initial step for the development of a theory of knowledge. Two useful "next steps" might be to attempt the description of empirically existing knowledge systems and descriptions of changes that they have undergone over time. Attempting to explain these changes in terms of societal conditions would be an aspect of sociology of knowledge; specifying the effects such a change has for intellectual functioning would be an aspect of cognitive psychology. The integration of all such approaches into an overall theory would constitute a theory of knowledge.

Footnotes

[1]See Judith and David Willer's discussion on religion in Judith Willer, 1971: 29-30; 56-90.

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