

On Complementarity and Causal Isomorphism

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In a recent article, Kirsch and Hyland proposed that the notion of complementarity can be useful in understanding relations between mental and physical processes. Though this may be so, their introduction of causal isomorphism belies the mutually exclusive character of different descriptive levels concerned with these processes. Further, their own arguments illustrate the inadequacy of causal isomorphism as a descriptive construct. Other shortcomings in their article are also pointed out.

In their article, Kirsch and Hyland (1987) used the concepts of complementarity and causal isomorphism as the metatheoretical basis for explaining the relation between mind and body. In commenting upon their formulation, it should be emphasized that the meaning of complementarity as used by Kirsch and Hyland is different from that employed by Bohr, the originator of the term. Essentially, Bohr (1935) used complementarity to refer to mutually exclusive circumstances involving measurements, and knowledge, of the physical world. In quantum mechanics, where the term was used first and where it has had its widest acceptance, there is an unavoidable finite uncertainty in the measurement, or knowledge, of certain paired quantities. In the case of the position and momentum of an electron, for example, to the extent to which one precisely measures the position of an electron, greater uncertainty is introduced regarding knowledge of its momentum. Greater precision in the measurement of the momentum of the electron is associated with increased uncertainty regarding knowledge of its position. For Bohr, this uncertainty is tied to the unavoidable interaction between the concrete experimental apparatus and the physical entity studied. This unavoidable interaction between the concrete experimental apparatus and the physical entity studied is a central element of Bohr's notion of complementarity.

Kirsch and Hyland adhere to the notion of mutually exclusive descriptions of the physical world in their concept of complementarity, but they do not adhere to the concern Bohr adopted as regards the role of concrete experimen-

tal circumstances determining which mutually exclusive description of the world will be applicable. Instead, Kirsch and Hyland implied that complementarity is not rooted in the unavoidable interaction involving the concrete experimental apparatus and the physical entity measured. Essentially, for Kirsch and Hyland, complementarity has become a fundamentally theoretical concept in which mutually exclusive descriptions can be applied to the same concrete experimental circumstances. This is essentially what I proposed in "On the Nature of Relationships Involving the Observer and the Observed Phenomenon in Psychology and Physics" (Snyder, 1983a). Accepting Bohr's notion of complementarity, I discussed the possibility of mutually exclusive theoretical situations involving the same concrete experimental circumstances.

Though I was concerned in that paper with different theoretical approaches to some psychological or physical phenomenon, Kirsch and Hyland applied this notion to the relation of mental and physical processes. This is a very intriguing notion, but their particular development of complementarity does not seem quite right. My concern is with their notion of causal isomorphism and its inclusion in their concept of complementarity. Kirsch and Hyland's causal isomorphism appears to incorporate the idea of a one-to-one correspondence between mental and physical events.

The notion of mutually exclusive levels of description, though, is at variance with this proposed one-to-one correspondence. There is no reason why mutually exclusive descriptive levels necessarily lead to causal isomorphism. If one level of description is completely mimicked by another descriptive level such that an identity relation can be set up for corresponding steps on the respective levels of description, then there is no fundamental need to maintain two levels of description. One descriptive level will surely do, and its adequacy would seem to indicate that only one level of reality corresponding to this descriptive level is necessary.

In attempting to combine causal isomorphism with complementarity, Kirsch and Hyland lose sight of the crux of complementarity: it is concerned with mutually exclusive descriptive levels. Such levels cannot be reduced to one another through proposing identity relations. Though Kirsch and Hyland maintain that their notion of complementarity prohibits this reduction, their notion of causal isomorphism, which they include as part of their conception of complementarity, does indeed allow for it. Kirsch and Hyland are inconsistent in maintaining mutually exclusive descriptive levels on the one hand and a one-to-one correspondence between the levels on the other, this correspondence implying the possibility of reduction to one descriptive level. This possibility belies Kirsch and Hyland's proposed mutually exclusive character of descriptive levels.

For example, in considering mental health and illness, I proposed (Snyder, 1983a) that client-centered and psychoanalytic frameworks can be applied

simultaneously to the same behavior. Whereas in one theoretical system, this behavior might be considered a manifestation of disorder, it might very well be considered as evidence of emotional well-being in the other. The possibility of a one-to-one correspondence between these mutually exclusive characterizations of the behavior is not proposed in my article because to do so would negate the significant point that the concern is with fundamentally distinct descriptive levels.

Another example of the misdirectedness of Kirsch and Hyland's notion of causal isomorphism is found in their interesting discussion of the mental, or psychological, consideration of behavior and situations as contrasted with the physical consideration of these phenomena. The term *situation* as used by Kirsch and Hyland does not have the same meaning that I gave it in an earlier work closely related to their concerns (Snyder, 1983b). For Kirsch and Hyland, a situation appears to be akin to a stimulus or environmental circumstance.

Kirsch and Hyland proposed essentially that the psychological and physical descriptions of behavior and situations are complementary modes of description. This proposal is an outgrowth of their originally stated thesis concerning complementary description of mind and brain.

But, in extending their ideas, Kirsch and Hyland illustrate a problem with their notion of causal isomorphism. In an example, Kirsch and Hyland proposed that there exists a one-to-one correspondence between mutually exclusive descriptions of a lion in terms of physical characteristics and in terms of the lion's threatening *meaning* for an observer close to the lion. Causal isomorphism holds only when the concern is with events and entities on the different levels of description that are fundamentally alike. This is not the case here. If some event or entity in the world has meaning for an observer, it is because the observer has in some way been involved in this assignation of meaning to the event. Kirsch and Hyland referred to the theory-laden nature of observation in this regard. In allowing that meaning for an observer is an important theoretical construct, Kirsch and Hyland admit the referential aspect of an observer's experience.

If the meaning of a situation is found in the world and yet is inextricably bound to the observer, the question arises as to what brain state can correspond to this psychological circumstance? Are Kirsch and Hyland prepared to admit that brain states are also referential in nature, specifically, that they are found in the world of the observer and yet are possessed by the observer? I think not. Kirsch and Hyland's notion of one-to-one correspondence between mind and brain appears viable when both mind and brain are considered as encapsulated within themselves. But as Kirsch and Hyland proposed, mind is referential in nature, and with this designation, relations between mental and physical processes cannot be adequately described by their notion of causal isomorphism.

It is because of my concerns with the referential aspect of experience that I proposed the notion of situation in which the experiencing observer is immediately linked to the world (Snyder, 1983b). I did not propose that this fundamental awareness existed in a one-to-one correspondence with underlying physical events, partly for the reasons I have just presented. I am confident that some correspondence exists between mind and brain but that it is not the one-to-one correspondence proposed by Kirsch and Hyland.

In sum, I believe the notion of complementarity, or some variation of it, is potentially of great importance to psychology. I also believe Kirsch and Hyland's application of this notion to mental and physical processes is intriguing and should be explored further. The notion of causal isomorphism, though, negates the significance of their contribution in that it proposes an avenue through which apparently fundamentally different levels of description may be reduced to one another. Further, their discussion of behavior and situation illustrates the difficulty in characterizing relations between mental and physical processes in terms of a one-to-one correspondence.

I should note that Kirsch and Hyland's discussion of complementarity in physics is weak. Their quote by Popper regarding Einstein's evaluation of Bohr's use of complementarity is presented without historical context and is a bit gratuitous. Further, contrary to Kirsch and Hyland's implication, Bohr's complementarity does not necessarily include the notion that the observer alters what is being observed.

I believe the distinction between methodological and metaphysical complementarity is weak. Kirsch and Hyland's formulation of complementarity has metaphysical implications, just as Bohr's has. The metaphysical implications of a theoretical proposal seem to be part of the essence of the proposal. To not allow the consideration of a theoretical proposal in terms of its metaphysical implications precludes a thorough investigation of its full scope.

Finally, the title of Kirsch and Hyland's paper, "How Thoughts Affect the Body: A Metatheoretical Approach," is a puzzle. After stressing repeatedly the lack of causal relations between different levels of complementary description (e.g., mind and body), the use of *affect* in the title connotes that just such causal relations exist.

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Methodological Complementarity: With and Without Reductionism

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Snyder argues that Kirsch and Hyland's concepts of complementarity and causal isomorphism imply reductionism. We show this not to be the case. Although specific mental events are identical to corresponding physiological events, this does not imply that the classification of mental events corresponds to the classification of physiological events, which is necessary for reductionism. The methodological complementarity of our formulation is contrasted with Bohr's metaphysical complementarity. Snyder is correct to assert that complementarity carries metaphysical implications; however, it does not require a commitment to any particular metaphysic. Also, methodological complementarity is heuristically useful even if its metaphysical implications should prove unwarranted.

Snyder (1988) agrees with us that "some correspondence exists between mind and brain," but argues that it is not the one-to-one correspondence that he interprets as implicit in the idea of causal isomorphism. He argues that if mind and brain were identical, one could be reduced to the other. However, complementarity, as he interprets it, refers to descriptive levels that are mutually exclusive in the sense of one not being reducible to the other. Snyder also objects to our distinction between methodological and metaphysical complementarity, arguing that metaphysical implications are essential aspects of theoretical proposals.

Contrary to Snyder's argument, the supposition of identity relations does not imply reductionism. In fact, complementarity in physics involves identity relations without reductionism. Particle theory cannot be reduced to wave theory, nor can wave theory be reduced to particle theory. Nevertheless, waves and particles are descriptions of the *same* event, just as Muhammad Ali and Cassius Clay are names for the same person. All that is meant by the claim

that complementary descriptions are identified with each other is that they are descriptions of the same event, and that supposition is sufficient to deduce causal isomorphism.

In this reply to Snyder, we demonstrate that methodological complementarity and causal isomorphism are neutral with respect to reductionism. We also elaborate the reasons for distinguishing between methodological and metaphysical versions of complementarity.

Identity Without Reductionism

Let us begin with a definition of reductionism. According to Nagel (1961), "a reduction is effected when the experimental laws of the secondary science (and if it has adequate theory, its theory as well) are shown to be the logical consequences of the theoretical assumptions (inclusive of the coordinating definitions) of the primary science" (p. 352). Thus, reductionism is based on the assumption that the laws of one science can be mapped onto those of another.¹ Snyder interprets our presentation of mind-brain identity as implying a one-to-one correspondence between psychological and physiological laws. This is a mistaken interpretation, but it is one that others are likely to make as well. We therefore welcome this opportunity to clarify the difference between the kind of identity that we propose and the kind of identity that is required by reductionism.

The idea of mind-brain identity without reduction is not an original idea of ours. Instead, it is the insight that gave rise to metaphysical functionalism, which currently is the most popular mind-brain theory among philosophers and cognitive scientists (Churchland, 1984). Identity without reduction is based on the distinction between type and token. A *token* is a given instance of an event—for example, John Doe's experience of pain on December 24, 1986, 3:30 p.m., eastern standard time. A *type* is a category of event—for example, pain in general. *Token identity* is the assertion that every instance of a mental event is some particular physical event. In living organisms, this is assumed to be a physiological state, but the possibility that some mental events are nonorganic physical events (in an as yet unconstructed super computer, for example) is not precluded. *Type identity* is the assertion that any

¹Reductionism also involves the assumption that one science is primary and the other secondary. Both complementarity and isomorphism, as we have defined them (Kirsch and Hyland, 1987), are neutral with respect to the question of whether relations between sciences are hierarchical. It is this aspect of these concepts that renders them compatible both with materialism and double-aspect monism. On this count alone, it is clear that complementarity and causal isomorphism do not imply reductionism. In this context, it is also worth pointing out that methodological complementarity is not the same as emergentism (e.g., Sperry, 1970, 1977), which is the idea that in a hierarchical system, laws "emerge" at the secondary level which can not be derived from the laws at the primary level. Methodological complementarity is compatible with emergentism, but because it does not assume a hierarchical organization of levels, it is equally compatible with alternative theories.

particular type of mental event (e.g., pain) is some particular type of physical state. In other words, it entails the assumption that there is a one-to-one correspondence between *categories* of mental states and *categories* of physical states.

This distinction between type identity and token identity is illustrated in Figure 1, which shows the correspondence between color labels in three languages, English, French, and "Tribal," the latter being the language of a fictitious tribal culture. The relation between English and French is one that involves both token and type identity. When speakers of English label the color of some particular object, they are naming the same color that is seen by French speakers (token identity) *and* if the color happens to be *red* in English, it is necessarily *rouge* in French (type identity). In contrast, the relation between Tribal and either English or French involves token identity, but not type identity. Any instance of red to an English speaker is an instance of some color to a Tribal speaker (token identity), but different instances of red may belong to different color categories in Tribal. One instance of red may be "abu" and other may be "bet."

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|----------------|--------|-------|------|-------|
| <u>Tribal</u> | Abu | Bet | Camu | |
| <u>English</u> | Yellow | Red | Blue | Green |
| <u>French</u> | Jaune | Rouge | Bleu | Vert |

Figure 1. Token identity and type identity as illustrated by the correspondence of color terms in three different languages.

A moment's reflection should make it clear that type identity implies token identity, but that token identity does not imply type identity. If there is a corresponding type of physical event for every type of mental event (type identity), then every instance of a mental event corresponds to some instance of a physical event (token identity). However, it is possible for every instance of a mental event to be a physical event even if different instances of the same type of mental event are instances of different types of physical events (e.g., brain states in one case and microchip states in another).

Type identity is consistent with reductionism. The laws of color combination in English can be deduced from French and vice versa. Similarly, psychological laws can be deduced from the theoretical assumptions of physiology only if type identity is true of mind and brain descriptions. In contrast, token identity without type identity is inconsistent with reductionism. Tribal and English have incompatible laws of color combination. If token identity is valid

but type identity is not, then the reduction of psychological laws to physiological laws is not possible.

It is typically assumed that type identity necessarily implies reductionism. There are, however, two reasons why this assumption is not true. First, reductionism requires the additional assumption that one science is subordinate to another. Second, meaning attenuation may occur even if the one-to-one correspondence of categories posited by the notion of type identity is true. For example, let us suppose there is meaning attenuation between English and French so that in English speaking countries, the color *red* carries the connotation "stop," but in French speaking countries, it does not. Type identity still characterizes the relation between French and English color labels, and the laws of color combination in one language can be deduced from the corresponding laws in the other. However, because the type of color signifying stop in English does not correspond to a type of color signifying stop in French, one cannot deduce "stop" signification between English and French. Hence, there is reduction with regard to the laws of color combination, but not with regard to the connotations of colors.

Type identity probably does not characterize the relation between mental and physiological terms. For example, because approach and avoidance can consist of the same physical movements, there cannot be a physiological category that corresponds to either of these psychological terms. This alone would preclude deducing psychological laws from physiological laws or vice versa. However, even if type identity was valid, it would not necessarily mean that psychological laws and physiological laws could be deduced from each other. The reason for this is that meaning attenuation occurs when events are described either physiologically or mentalistically. For example, stopping at red lights cannot be deduced from the effects of the color red on the retina or the brain. Other examples of meaning attenuation were presented in our previous article (Kirsch and Hyland, 1987).

Methodological complementarity and causal isomorphism are consistent with type identity as well as with token identity. However, whereas they require token identity, they do not require type identity. As described by Hyland (1985), complementarity involves different types of description of the same underlying event, but this does not imply that descriptive categories in one theoretical language can be translated in a one-to-one fashion into the theoretical language of another. Similarly, Kirsch's (1985) principle of isomorphism is based on the assumption that "any particular instance of a subjective experience is associated with some specific state of the organism" (p. 1198). Therefore, for any particular instance of a causal relation between one mental state and another, there must be a corresponding instance of a causal relation between two physical states. This does not mean that causal laws involving *types* of mental states can be deduced from physiological laws. Kirsch's (1985) concept of causal isomorphism is a token isomorphism. The

stronger claim of type isomorphism is not made. Our proposal is that token identity and isomorphism be accepted as heuristics, but that the questions of type identity and isomorphism be left open as empirical questions.

Methodological versus Metaphysical Complementarity

One of the reasons for Hyland's (1985) choice of the term *complementarity* is the assumption that mind terms and brain terms, though referring to the same events, are incomplete descriptions of those events. This is true even if a translation of psychological constructs into physiological constructs is possible (i.e., if types of mental events can be identified with types of physical events). Descriptions of events in either mind terms or brain terms alone are incomplete because there is some attenuation of meaning whenever a translation is made from one to the other. Brain descriptions do not tell us how pain feels, for example, and descriptions of experience are not descriptions of neuronal connections.

We have called our approach "methodological" complementarity because it implies a method (or set of rules) for carrying out research in the field of mind-body relationship. We use the term methodological because that term has been used elsewhere in psychology where no metaphysical statement is being made. For example, methodological behaviorism is used as a label (Misiak and Sexton, 1966) to denote the rejection of subjective data. This rejection of subjective data exists because introspection is deemed to be an invalid method, rather than because of any doubt over the ontological status of subjective experiences.

However, Snyder is right in suggesting that our ideas appear to have metaphysical implications. Methodological complementarity is logically implied by many mind-brain philosophies, but it is inconsistent with others, interactive dualism for example (Kirsch and Hyland, 1987). Therefore, adopting the conventions of methodological complementarity seems to imply a rejection of certain metaphysical positions. On the other hand, it does not imply any specific alternative, as it is consistent with almost any monist philosophy. In fact, monism can be defined as the assumption that the relation between mind and body is one of identity.

A second reason for calling our stance methodological is because we do not assert that complementarity is a true description of mind-body relations. Our position is merely that the conventions of methodological complementarity are useful in organizing research at the current stage of psychology's development (Kirsch and Hyland, 1987). We believe that the current usefulness of these conventions are independent of the ultimate truth of monism. In other words, complementarity is a currently useful assumption even though a particular mind-body metaphysic which is incompatible with it *might* ultimately be found to be true.

As Snyder correctly notes, our use of the term complementarity is different from Bohr's and this is one further reason why we used the term methodological complementarity in our earlier paper. Specifically, the way Bohr uses the term "complementarity" is irrelevant to the arguments we present (Hyland, 1987). Bohr and Heisenberg saw indeterminance as a description of how the world works, in principle, rather than simply as a methodological tool for action. Many authors (e.g., Feyerabend, 1958; Globus, 1976) see complementary viewpoints as ultimately replaceable by some superordinate type of description. We do not take issue with such arguments. Our position is simply that complementarity and causal isomorphism are useful heuristics at this moment in time.

It is unfortunate that the term "complementary" is so often associated exclusively with the writings of Bohr. In fact, the term *complementary* was used earlier by William James (1890/1950) who suggested that different types of mental content were complementary to each other, i.e., together they made up the complement or whole. Hyland's (1985) concept of complementarity has its intellectual roots in the writings of MacKay (1958, 1974), rather than Bohr. MacKay uses the term complementarity in a theoretical or descriptive sense as we do. For example, MacKay (1974) uses the term complementarity with respect to the relationship between scientific and religious perspectives on the world. In so doing, MacKay does not make an ontological statement about the science-religion relationship but simply suggests a way of adopting two mutually incompatible alternatives. However, as pointed out before (Hyland, 1987), Hyland's use of the term complementarity does differ from MacKay's in terms of how complementary categories of description are arrived at.

In sum, Snyder's criticisms do not alter our underlying thesis that methodological complementarity and causal isomorphism are useful heuristics in the field of mind-brain theory. However, Synder's critique has prompted us to be more specific about the meaning of the term "identity" thereby showing how our stance does not imply reductionism. Furthermore, it has led to a clearer formulation of the relation between methodological complementarity and metaphysical complementarity, thereby helping reduce potential misunderstandings about our term "methodological complementarity."

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