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Causal Isomorphism: A Concept in Search of a Meaning; Complementarity and Psychology

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Unresolved technical issues regarding Kirsch and Hyland's notion of causal isomorphism are discussed. It is demonstrated that their deduction of causal isomorphism is based on an incorrect understanding of physics. The recent development of complementarity in psychology advanced independently by three sets of psychological researchers is compared to Bohr's idea of complementarity in physics. The formulations of the psychological researchers differ from Bohr's notion concerning whether mutually exclusive descriptions of some entity or process can exist simultaneously. The concepts of complementarity in psychology incorporate notions of simultaneity and time that are based on the intrinsic relation of the person to the world, whether this world is that of psychological or physical phenomena. Bohr's notion, on the other hand, relies on an objective character of the physical world as the foundation of simultaneity and time.

Various issues related to technical aspects of Kirsch and Hyland's arguments presented in their recent articles in *The Journal of Mind and Behavior* are first discussed. Notwithstanding the criticism presented, particularly as regards their deduction of causal isomorphism, the introduction of a particular form of complementarity into psychology independently by three sets of researchers, and the importance of this introduction, are then considered.

Unresolved Issues with Kirsch and Hyland's Articles

It is interesting that the type versus token distinction that Hyland and Kirsch (1988) adopted in their attempt to save their concept of causal isomorphism is nowhere to be found in their original article in *JMB* entitled "How Thoughts Affect the Body: A Metatheoretical Approach" (Kirsch and Hyland, 1987). In their original article, the distinct implication was provided in the text and the accompanying diagrams that there is a one-to-one correspondence between mental and physical descriptions of some phenomenon. In the text, for example, they wrote "there is (in principle) a physiological counterpart

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to any instance of a mental event. . . . If there are physiological substrates to all mental events, then for any causal sequence of mental events, there must be a corresponding sequence of physical events" (pp. 421–422). In their diagrams, they repeatedly used a single line to connect the mental and physical manifestations of a phenomenon. It was only after my criticism in "On Complementarity and Causal Isomorphism" (Snyder, 1988) of the reductionism found in their concept of causal isomorphism that the type versus token distinction was introduced. Kirsch and Hyland's discussion of meaning attenuation in their original article in *JMB* does not significantly alter the explicit and repeated indications of a one-to-one correspondence between the mental and physical descriptions of a phenomenon.

Even granting that the introduction of this type versus token distinction was made seriously by the authors, there remains a significant problem with causal isomorphism. Causal isomorphism is little more than this distinction, a distinction which appears to have already been explored in depth by others. As Hyland and Kirsch (1988) wrote, "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. . . . Identity without reduction is based on the distinction between type and token" (p. 6). The issue thus arises as to whether the notion of causal isomorphism has anything new of substance to offer that has not been previously considered. I do not think it does.

Hyland and Kirsch (1988) are correct in noting that in quantum mechanics, the wave characteristics of some phenomenon cannot be reduced to its particle characteristics. But, they are inaccurate in writing that "waves and particles are descriptions of the *same* event [in quantum mechanics], just as Muhammad Ali and Cassius Clay are names for the same person" (p. 5). An event in physics is not the same thing as a physical entity. An event in physics is an occurrence in spacetime, such as the measurement of the position or momentum of an electron. As the measurement of position essentially reflects the particle aspect of the electron and the measurement of momentum essentially reflects the wave aspect of the electron, Hyland and Kirsch's statement is incorrect. (The momentum of the electron is related to the electron's wavelength through the de Broglie relation $p = h/\lambda$, where p is the momentum of the electron, λ is the wavelength of the electron, and h is a small quantitative value known as Planck's constant.) And it is just their statement quoted above that Hyland and Kirsch used to justify their notion of causal isomorphism. Thus, they are incorrect in concluding that "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" (pp. 5–6).

Hyland and Kirsch's comment that it is unfortunate that the term *complementary* has come to be closely associated with Bohr is misguided. Bohr was one of the prime architects of the quantum mechanics, and he is considered one of the most rigorous thinkers involved in the development of this theory. This theory is, of course, part of the bedrock of modern physical theory and is supported by extremely precise experimental data. The term *complementary* refers to the heart of what distinguishes quantum mechanical theory from classical physical theory, namely the unavoidable uncertainty in our knowledge of some physical existent arising from measurement of this existent. Thus, it is not inappropriate that the term *complementary* should be associated so closely with Bohr, the physicist who introduced the term into quantum mechanics. I would also suggest that had quantum mechanics not been so successful, MacKay (1958) would very likely not have examined the relevance of complementarity to areas outside of physics. And it was MacKay whom Hyland relied on initially for his own development of the concept of complementarity.

I should note that I am still puzzled by the title of Kirsch and Hyland's original article in *JMB*. What do the authors intend by the use of the term *affect* in "How Thoughts Affect the Body: A Metatheoretical Approach"? It seems to indicate that a causal relation does indeed exist between mind and body. I believe Kirsch and Hyland attempted to provide an explanation for their title in writing that "statements indicating causal relations between mental and physical events are either abbreviated references to a conjunction of . . . three types of relations [none of which incorporate such causal relations] or they are meaningless" (p. 432). This apparent explanation of theirs mystifies me.

Complementarity and Psychology

Notwithstanding the foregoing comments concerning Hyland and Kirsch's latest paper in *JMB*, their notion of complementarity for psychology is potentially of great significance. It is very interesting that the recent discussions of such a notion by Hyland and Kirsch and two other researchers (Rothenberg, 1988; Snyder, 1983a, 1983b) incorporate a notion of time that is fundamentally different than that found in the concept of complementarity in physics discussed by Bohr.

As noted, the central feature that distinguishes quantum mechanics from classical physics (notably, Newtonian mechanics and relativity theory) is complementarity. In classical physics, physical quantities characterizing some existent can, in principle, be known with unlimited precision. There is nothing in the act of measurement that, in principle, unavoidably affects the existent measured.

In quantum mechanics, all of the physical quantities that can characterize some existent cannot be known simultaneously with unlimited precision. There is an unavoidable finite uncertainty as regards knowledge concerning these quantities. In general, an increase in the knowledge concerning one quantity (e.g., the position of a particle) is tied to a decrease in the knowledge of another paired quantity (in this case, the particle's momentum). Thus, with certain knowledge concerning one of these quantities (for example, 100% probability that a particular value will be obtained if a measurement is taken), the value of the other paired quantity is completely unpredictable. Or, as one of the postulates of quantum mechanics is that a measurement of some quantity yields a particular value known as an eigenvalue, the value of its paired quantity is completely unpredictable when a measurement of the former quantity is taken. As regards the determination of the position and momentum of a particle, Bohr (1935) wrote:

> The renunciation in each experimental arrangement of the one or the other of two aspects of the description of physical phenomena,—the combination of which characterizes the method of classical physics, and which therefore in this sense may be considered as *complementary* to one another,—depends essentially on the impossibility, in the field of quantum theory, of accurately controlling the reaction of the object on the measuring instruments, i.e., the transfer of momentum in case of position measurements, and the displacement in case of momentum measurements. . . . We are not dealing with an incomplete description characterized by the arbitrary picking out of different elements of physical reality at the cost of sacrifying [*sic*] other such elements, but with a rational discrimination between essentially different experimental arrangements and procedures which are suited either for an unambiguous use of the idea of space location, or for a legitimate application of the conservation theorem of momentum [and thus, of course, suited for an unambiguous use of the idea of momentum]. (p. 699)

It is emphasized that in quantum mechanics there is no basis for assuming that a definite value exists for the quantity that is completely unpredictable.

Please note that Bohr maintained that differences in concrete experimental arrangements lead to the precise measurement of one quantity and the complete uncertainty in the other. The interaction between the particular experimental apparatus and the existent measured is responsible for both the precise measurement result for one quantity and the complete lack of predictability for the other.

It is very interesting that none of the proposals independently made by Hyland and Kirsch, Rothenberg, and myself relies on concrete circumstances as the basis for mutually exclusive descriptions of some psychological entity or process. In fact, these investigators proposed that such mutually exclusive descriptions occur simultaneously, and they essentially posited that the same concrete circumstances can simultaneously support these mutually exclusive descriptions. I (Snyder, 1983a, 1983b) went so far as to suggest that this notion could be carried over to physics itself, the result being that physics would

no longer rely on an objective characterization of the physical world (i.e., a characterization in which the physical world is independent of the experiencing person).

A key point in the concepts of complementarity in psychology proposed by Hyland and Kirsch, Rothenberg, and myself is this: awareness, or one's psychological state, including that of which one is aware, does not ultimately depend on an objective world for its existence. Rather, awareness is capable of sustaining its own existence.

What is at stake in the discussion of complementarity by Hyland and Kirsch, Rothenberg, and myself is nothing less than the nature of time. Does the limiting notion of simultaneity as concerns mutually exclusive descriptions proposed by Bohr apply to psychological as well as physical phenomena? Do psychological as well as physical phenomena ultimately depend on concrete circumstances to support them? Or, rather, is the person intrinsically linked to the psychological and physical world and thus a participant in sustaining awareness of the psychological and physical world found in mutually exclusive descriptions? Is time, which is founded upon simultaneity, ultimately dependent on an objective physical world, or does time ultimately and unavoidably involve the individual?

It should be noted that the special relativistic notion of simultaneity (Einstein, 1905/1952), defined in terms of the motion of light, does not alter the circumstance discussed above. In special relativity, the notion of complementarity does not hold. All of the physical quantities that can characterize some existent can, in principle, be known simultaneously with unlimited precision. There is no unavoidable finite uncertainty as regards knowledge concerning these quantities.

Conclusion

Causal isomorphism is a concept that Hyland and Kirsch deduced from an incorrect understanding of physics. Previously, I (Snyder, 1988) have argued that causal isomorphism is antithetical to complementarity. Four researchers devoted to psychological investigation have now proposed a concept of complementarity for psychology. A comparison of Bohr's development of complementarity in physics with the notions developed for psychology have revealed a key difference. This difference concerns whether an objective world, psychological or physical in nature, is necessary to sustain the mutually exclusive descriptions at the heart of complementarity. The nature of simultaneity, and consequently the nature of time, are at issue in this difference. The person's intrinsic connection to the world is the basis for simultaneity and time in the recent formulations of complementarity in psychology. The objective character of the physical world is the basis for simultaneity and time in Bohr's concept of complementarity.

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