Complementary Constructs in Psychology from the Perspective of Quantum Physics

by

Eddie Oshins, VISITING SCHOLAR
Department of Physics, Stanford University, Stanford, California 94305

Abstract: Kelly's constructive alternativism approach to personal construct psychology (PCP) is surveyed. The Mental Research Institute (MRI) perspective to strategic therapy is overviewed. Oshins' quantum psychology approach to intrinsic construct ambiguity is introduced. The nature of complementary constructs is discussed. The principle of complementarity is proposed as a formal, metalogic structure for "second order change." The necessary ingredients for double binds and Orlovian doubt states are presented. Empirically meaningful similarities and differences are suggested for future research.

Introduction

In the middle of the twentieth century, a type of representationalism was developed within clinically-oriented psychology. George Kelly's personal construct psychology (eg. Kelly, 1963) and MRI's strategic therapy (eg. Watzlawick, et.al., 1974) are two examples of attempts to construct axioms governing the structures and processes of frames of reference, as used by individuals and by collections (or systems) of individuals in constructing their experience and in communicating and interacting with each other. Kelly's constructive alternativism and MRI's second-order change have been selected to illustrate how a quantum psychology might be used to reconstruct the formal basis of complementary representations.

Kelly's Constructive Alternativism: A Brief Perspective. George Kelly's image was of "man-the-scientist" who "...looks at his world through transparent patterns or templets which he creates and then attempts to fit over the realities of which the world is composed" (Kelly, 1963, p.9). He introduced the "name constructs to these patterns that are tentatively tried on for size. They are ways of construing the world" (Ibid.), where "By construing we mean 'placing an interpretation': a person places an interpretation upon what is construed ...he erects constructs of similarity and contrast" (Ibid., p.50).

Man-the-scientist uses his construct system in an effort to make sense out of and to function effectively in the world in which he lives: "A person's processes are psychologically channelized by the ways in which he anticipates events. ...[He] lives his life by reaching out for what comes next and the only channels he has for reaching are the personal constructions he is able to place upon what may actually be happening" (Maher, 1969/1958b, p.228). His "ultimate aim is to predict and control" (Kelly, 1963, p.5).

From Kelly's perspective, the role of a psychotherapist is to help the client to discover "the relevant axis of reference" (Maher, 1969/1964, p.117: Also, 1958b, pp.228-232: 1968, pp.296-297). In so doing he "relies heavily upon the propositional use of constructs" (Ibid., 1968, p.297). Propositional thinking involves making an assertion about an observed behavior in relation to a frame of reference and "occurs when a person considers new information as a way to reformulate existing conceptual structure. It may be used as a replacement (or substantial redefinition) of an existing concept _[or] to link two or more concepts that were hitherto viewed as independent" (Cromwell, 1984, pp.4-7).

An exemplary scientist and propositional thinker himself, Kelly postulated that experience is constructed from "incompatible," "competing," dicotomic constructs. His formal axiomatics for personal constructs (Kelly, 1963, Ch.2), included: (1) a dichotomy corollary (Ibid, pp.59-64; Also, Maher, 1969/1961, pp.103-104); (2) a postulate of constructive alternativism: an individual "simultaneously sustains a vast variety of competing theoretical formulations" [emphasis added] (Ibid., p. 99); (3) a postulate of double entity choice: when a person "says that 'A is B' _he is also asserting that 'A is not C.' The choice he makes is not, therefore, between 'B' and 'not-B,' but between 'B' and 'C'—between two entities._'the double entity choice,'_[is distinct] from 'the single entity choice' envisioned by classical logic" (Ibid. p.98); and (4) a fragmentation corollary: that one may successively use "construction subsystems which are inferentially incompatible with each other" [emphasis added] (Kelly, 1963, p.87).

Quantum theoreticians have developed similar axiomatics of experience. I encourage the reader who is interested either in Kelly's formalism or in the general structure of experience to look at H. Drieschner's formulation (von Weizsäcker, 1980, pp. 201-221). In particular, his Postulates of (Finite, Separable) Alternatives and of Ultimate Objects, called "urs" by von Weizsäcker, seem to embody what Kelly has in mind by "dichotomous constructs." In the technical, physical literature, they are also referred to as "Yes/No proposition" (Birkhoff & von Neumann, 1936; Jauch, 1968, esp. "The Propositional Calculus," pp.67-89; See, also, Oshins & McGoveran, 1984, footnote 10, and references therein, for a discussion of "empirical truth").

These urs or yes/no propositions are the propositional realizations of a mathematical entity called a spinor. Spinors are similar in their representational power to what a bit is in computer science. Similar to, yet more general than, vectors, they can be used to construct the fundamental representations of physics. Oshins (Oshins & McGoveran, 1980; Oshins, 1984a; See, also, Orlov, 1982) has introduced spinors into psychology as the fundamental building blocks for experience and has interpreted them as "bits with ambiguity" —or, a "bit of ambiguity"!

Later in the paper, I shall describe how quantum psychology provides an explicit formalization of the nature and consequences of competing, incompatible construct systems through the "principle of complementarity".

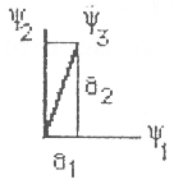
A Geometrical Representation Space of Rays. In order to represent the formal structure of experience, Kelly introduced a geometric notion of direction, but specificly avoided using the concept of a vector (Maher, 1969/1961, pp.104-105): "...our psychological geometry is a geometry of dichotomies rather than the geometry of areas envisioned by the classical logic of concepts, or the geometry of lines envisioned by classical mathematical geometries....there are no distances. Each axis of reference represents not a line or a continuum..., but one, and only one, distinction. However, there are angles...represented by contingencies or overlapping frequencies of incidents. Moreover, these angles of relationship between personal constructs change with the context of incidents to which the constructs are applied...the relationships between directions change with the context."

Kelly has introduced something like a vector space. A vector is a multicomponent, geometric object which has a magnitude, ie. the distance between the end points, and a direction. But Kelly rejects the associated notion of distance. In a similar manner, quantum psychology represents the logic of experience in terms of rays or directions in an abstract projective (Hilbert) space, resulting in a projective geometry instead of a vector space. This distinction is of fundamental importance. Quantum representations deal with rays, not vectors.[1] For a vector, the components themselves are important; but for a ray, only the ratio of components is relevant. As a consequence one can multiply a ray by any number and obtain the same ray, viz. the identical state of information encodement.

In such a projective (or ray) representation space, the projection of one direction upon another provides a measure of the probability that a state of experience represented by the former will lead to a state of experience represented by the latter. Let Ψ = ray encodement of all measurable or observable properties of the system. Representing Ψ_1, Ψ_2, Ψ_3 as unit rays such that none line up and only two are independent, if you add two permissible rays (unit states) you get a third unit ray,

$$\Psi_3 = a_1 \Psi_1 + a_2 \Psi_2 ,$$

which is a coherent, linear superposition of rays Ψ_1 and Ψ_2:



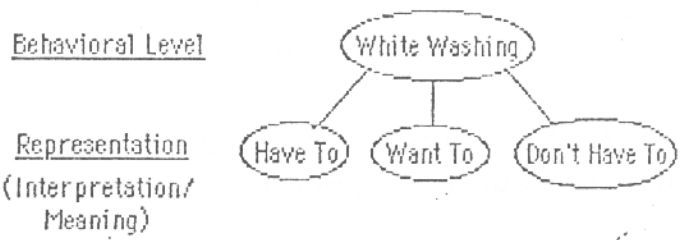
Notice that: (1) that any two vectors, that don't line up, determine a plane (ie. the span which contains any state that can be made up with the other two and which represents the

logical "or") & (2) that if we do not distinguish axes then there will always be a third possible axis that lies in the plane and could replace one of the other two in determining the same plane. Birkhoff and von Neumann (1936) showed that this is the geometric realization of what we shall latter refer to as the logical principle of complementarity. We can think of a_1 and a_2 as the components of Ψ_3 in Ψ_1 and Ψ_2, respectively. One computes probabilities of information in one state being evaluated in another state by computing the magnitudes of the projections.

The Metalogic of MRI's Strategic Therapy Perspective. The Mental Research Institute pioneered an approach to cybernetic communications based upon principles of systemic interaction, and strategic, offtimes paradoxical, interventions. This led to the so-called "double-bind theory of schizophrenia" (Bateson, et.al., 1956) and helped to initiate the family therapy movement.

The following principles are fundamental to their approach: (1) Interactive whole systems: "_problems that people bring to psychotherapists _[usually are] situational difficulties between people —— problems of interaction" (Weakland, et.al., 1974, p.147); thus, they shifted "from the observation of the individual to the observation of a system and to_the needs of a system rather than the needs of a person" (Haley, 1961, p.78); (2) Metalevel problem reframing: "there are two different types of change: _[first-order change] occurs within a given system and_itself remains unchanged, and_[second-order change] whose occurrence changes the system itself_thus change of change" (Watzlawick, et.al., 1974, pp.10-11); and (3) Pragmatism and avoidance of insight about causes: problem conceptions and interventions are based upon "what is going on in the systems of human interaction.Correspondingly, we avoid the question 'Why?'_[since it] tends to promote an individualistic, voluntaristic, and rationalistic conception of human behavior, rather than one focused on systems of interaction and influence" (Weakland, et.al., 1974, pp.150-151, 155; Also, Watzlawick, et.al., 1974, pp.83, 86) in the present.

A prototype of problem reframing is Tom Sawyer's restructuring of his chore to whitewash a huge fence, not as a burden, but as a desirable opportunity worth paying for (Ibid., pp.90-91): "Like it? Well, I don't see why I oughtn't to like it. Does a boy get a chance to whitewash a fence every day?" This resulted in his friends paying him for the privilege of painting the fence. We can depict this metalevel reframing, thus:



Or, consider the example of a "hostile" women's "frigidity" towards her husband. Successful intervention consisted in supporting the wife's "overprotectiveness" towards her husband, framed as: clearly "he would not know how to cope with the impact of her uninhibited sexuality (Ibid., pp.102-103)." This redefinition of the same circumstances led to her sexual acting out her hostility, thereby "defeating" the "problem".

In these cases, I draw particular attention to the following formal features: (1) metalogic: "_to express or explain something requires a shift to one logical level above what is to be expressed or explained. No explaining can be accomplished on the same level, a metalanguage has to be used" (Ibid., p.79); (2) reframing: "Reframing means changing the emphasis from one class membership_to another, equally valid class membership, or, especially, introducing_a new class membership into the conceptualization of all concerned" (Ibid., p.98); and (3) second-order change: "As long as the solution is sought within this dichotomy of a and not-a, the seeker is caught in an illusion of alternatives_The formula of second-order change_is 'not a but also not not-a'" (Ibid., pp.90-91). Later, I shall explain how quantum psychology provides a structure which accommodates this metalogic of incompatible frames.

On Complementary Constructs

The Quantum Psychology of Fundamental, Irreducible Ambiguity. In 1976, Oshins (Oshins & McGoveran, 1980, and references therein; Also, Oshins, 1987) introduced a quantum logic approach to representing primary processes. In particular, he focused on modeling von Domarus' principle of "identification by predicates" which was alleged to represent the paleologic syllogisms attributed to schizophrenic thinking. The prototype is the paleological syllogism, "I am a virgin. The Virgin Mary was a virgin. I am the Virgin Mary."

In their pioneering 1943 paper, "A logical calculus of the ideas immanent in nervous activity," McCulloch and Pitts (Oshins, 1987/1984a, p.70-71) had proposed a neuronal model identifying neuronal events with a classical propositional logic; this was the precursor to current, black box, neural net models. As pointed out by von Neumann (Ibid.), "McCulloch-Pitts_proves that_there is no difference between the possibility of describing a real or imagined mode of behavior completely and unambiguously in words, and the possibility of realizing it" in this manner.

As an alternative to psychoanalytic related efforts at representing von Domarus' principle with classical set theory and to the McCulloch-Pitts endeavor, which in principle, avoids ambiguity, Oshins proposed a nonclassical realization as a (Dirac) linear superposition of rays[2], or, equivalently, as a nondistributive, quantum logic (lattice). In a quantum lattice, the classical distributive law [A and (B or C) = (A and B) or (A and C)] is replaced by the Principle of Complementarity, in a projective geometry: "If one does not

distinguish between two unit predicates A & B, there will always exist a third possible unit predicate C such that (A or B) = (B or C) = (C or A)". ie. they are equivalent "perspectives" (Jauch, 1968, pp.105-108, 121-126). Thereby, Oshins reinterpreted the above example as a type of equivocation: "I ≡ Virgin Mary (modulo virginity)." Since this law is applied according to an empirical description (Schwinger, 1970), Oshins proposed an underlying physical deficiency, with empirical consequences, to account for this faulty conclusion-forming process.

Oshins (1987, pp.24-25; Also, Heisenberg, 1958, pp. 181-185) pointed out that for the predicates A and not-A to be not empirically distinguishable, one could not operationally conclude from "A or not-A is true" that "A is true" nor that "not-A is true", since then the A/not-A construct system itself would then be distinguished. This provides a metalogic: Classically, it follows from [<<'statement-A' is 'true'>> is <<'false'>>] that [<<'statement-A' is 'false'>>]. Such inference is not valid in quantum logic since neither A nor not-A need be contextually appropriate. Thereby, Oshins postulated a principle of fundamental, "irreducible" ambiguity[3]. Additionally, Oshins (1987, pp.15, 24; 1980; Also, Orlov (1982)) has interpreted the paradox of "This statement is false" as "This statement is 'true or false'" does not necessitate that "This statement is 'true'" nor that "This statement is 'false'". It is irreducible to either alternative, and the truth valuation induces a transition in the truth value.

An Introduction to The Nature of Complementarity. The fundamental consequence of Planck's introduction of the "quantum of action" into physics was that "phenomenon refer only to observations obtained under circumstances whose description includes an account of the whole experimental arrangement" [Emphasis added] (Bohr, 1987a/1954, p.73). This "forces us to adopt a new mode of description designated as complementary in the sense that any given application of classical concepts precludes the simultaneous use of other classical concepts which in a different connection are equally necessary for the elucidation of the phenomena" (Bohr, 1961/1929a, p.10).

Bohr (Ibid., 1961/1929b, p.96) pointed out that "this mode of description is perhaps familiar to us from psychological problems." Indeed, William James' earlier use of the concept of complementarity in a psychological context (Oshins, 1987, pp.17-18) had been an important influence on Bohr.[4] As noted by Bohr: "the nature of our consciousness brings about a complementary relationship, in all domains of knowledge, between the analysis of a concept and its immediate application" (Bohr, 1961/1929a, p.20). Other psychological examples of complementarity include: (1) "when we reflect about a decision and the motives for our decision or when we have the choice between enjoying music and analyzing its structure" (Heisenberg, 1958, p.179); (2) "justice and charity [for] any occasion which calls for the strict application of law has no room for the display of charity and benevolence and

compassion may conflict with all ideas of justice" (Bohr, 1987a/1954, p.81); (3) "seriousness and humour" (Ibid., p. 79); and (4) "'thoughts' and 'feelings'" (Bohr, 1987a/1938, p. 27).

To Bohr, perhaps the most fundamental of all instances of complementarity involved "the space-time co-ordination and the claim of causality" (Bohr, 1961/1927, p.54). Oshins has likened this complementarity between the locational or situational degrees of freedom and the causal degrees of freedom to a complementarity between a "What?" and a "Why?". He has suggested this underlies the distinction between the MRI approach and the traditional psychoanalytic search for "the cause" as described earlier.

Double Binds and Doubt States (Oshins, 1987, pp.15, 19-25)

I shall now present the formal structures of double binds and of Orlovian doubt states. Then I shall suggest some empirically meaningful aspects for future research.

Necessary Ingredients for a Double Bind (Bateson, et.al., 1956). A double bind situation requires: (1) Two or more persons; (2) Repeated experience; (3) Primary negative injunction; (4) Secondary injunction conflicting with the first at a more abstract level (such as by nonverbal, analogic means), and like the first enforced by punishments or signals which threaten survival; (5) Tertiary negative injunction prohibiting the victim from escaping from the field; (6) Finally, the complete set of ingredients is no longer necessary when the victim has learned to perceive his universe in double bind patterns.

Necessary Ingredients for an Orlovian Doubt States (Orlov, 1982). Yuri Orlov has described a type of intrinsic ambiguity to information which he calls "doubt states" when there is "inadequate resolution to resolve" a situation, eg. "To be or not to be?" (Ibid., p.43).

From Orlov's perspective (Ibid., p.46): "the earliest type of doubt to appear in the evolution of life is doubt that the information from the sense organs is interpreted correctly. For an individual to experience this type of doubt, it is necessary that: (a) there are information signals; (b) these signals evoke at least two competing associations and the individual is not indifferent to at least one of them; (c) it is necessary to make a decision as to whether that one to which the individual is not indifferent is correct; (d) the resolution is inadequate to choose between the competing associations; (e) the individual cannot entrust the decision making to random acts (i.e., he is convinced that he must do it himself)."

Illustration of an Orlovian Doubt State[5] (Ibid, pp. 43-46). An adult says to a child, pointing at a pack of wool: "This is a wolf." If the phrase "wolf", has some meaning for the child, and it is essential to him to decide whether it is a wolf, then he may find himself in one of three states: (1) He believes the adult's statement is certainly true:

$$\zeta_1 \equiv \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

(2) He is certain it is not a wolf, believing the adult's statement is certainly false:

$$\zeta_2 \equiv \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

(3) He has insufficient information to solve the dilemma—he lacks sufficient resolution. The adult is known to be insincere, or there is a sign that he was kidding:

$$\zeta_3 \equiv \begin{pmatrix} a \\ b \end{pmatrix}, \quad |a|^2 + |b|^2 = 1; \quad a, b \text{ are complex numbers} \neq 0.$$

The spinor ray ζ_3 which describes "This is a wolf." is an elementary doubt state. If forced to choose, $|a|^2$ is the probability he will say "True" and $|b|^2$ is the probability he will say "False". The child manifests this doubt state by words ("This—is it a wolf???"), intonation (ie. ???), facial expressions, and other ways that form a continuum—an (analogical) nonclassical proposition—an adequate manifestation of which cannot be rendered classically.

Toward an Empirical Understanding of Double Binds and Doubt States. Orlov has proposed measures for certitude of experience and for the interference of doubt states (Orlov, 1982, p.46), termed "Orlov inequalities" by Oshins. Oshins has noted the similarity between the necessary ingredients for an "Orlovian doubt state" and those of a "double bind." He has suggested that the difference may lie in the locus of control of the decision (Rotter, 1966). Oshins (1987, p.15) also has pointed out the need to distinguish between "removable ambiguity" and "intrinsic ambiguity," which follows complementarity.

Conclusion

In this paper, we have reviewed Kelly's constructive alternativism and related it to MRI's strategic therapy through common constructs of quantum physics. The structure of complementarity has been discussed, as has the relation between double binds and Orlovian doubt states. Since these formal structures have empirical correlates, we have suggested that quantum psychology might provide a tool for the further investigation of these important areas of psychology. It has the potential to shed light on such areas as creativity (from doubt) and psychopathology (from binds).

In a invitational spirit, similar to Kelly's (Maher, 1969/1961, p.95), I invite the reader to continue traveling this course through the formal, physical modeling of personal constructs. Although I do not have answers, tools exist for an interesting and potentially significant journey. In any case, I hope that the reader had enjoyed this part of the trip!

Notes

1 There exists confusion in the psychological literature about this point. Specificly, there have been erroneous claims (Pribram & Carlton, 1986) that holograms are relevant to a quantum approach to mind/brain modeling. Oshins (eg. 1984b; See. also. 1984a. 1984c) has refuted this.

2 Although "The holographic hypothesis on brain function takes the form of superposition" (Pribram, 1971, p.142), this is a superposition of "wave front[s] of light (Ibid.)" (ie. physical, vector fields) not of rays, and, thereby, is irrelevant to a quantum context.

3 See also Bohr (1961/1929a, p.17): "only with the help of classical ideas is it possible to ascribe an unambiguous meaning to the results of observation."

4 There is an extensive literature on the notion of complementarity in its physical, psychological and philosophical contexts (Bohr. 1961. 1987a. 1987b; Heisenberg. 1958; Oshins. 1987; von Weizsäcker, 1980). In Drieschner axiomatics of experience the principle of complementarity is referred to as the "Axiom of Indeterminacy." (Ibid., p.211).

5 I point out three errors in this paper: (1) the third equation in (11) should = 0 not 1 since it is representing the orthogonality of the indicated states; (2) in equation (24), A_3 should read A_3^2; and (3) the first reference should read (1975) not (1978a).

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