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The Meta-Cross-Paradigmatic Order and Stage 16

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The Model of Hierarchical Complexity has identified orders and their corresponding stages through Order 16. There are examples, descriptions, and definitions of the Orders of Hierarchical Complexity through Order 15. To date, the discourse on Order 16 comprises just defining the new order and suggesting that it empirically demonstrated Orders of Hierarchical Complexity further along than Order 15. However, Stage 16 has now been named and defined as The Meta-Cross-Paradigmatic Order 16. There is now examples for this order and corresponding stage. This article explains Stage 16 and provides an example that maps Order 15 paradigms of Physical Science and Order 15 Behavioral Science onto another.

Keywords: Model of Hierarchical Complexity, stage, cross-paradigmatic, meta-cross-paradigmatic, coordination, Newtonian and quantum physics, Quantitative Analysis of Behavior, chaos theory

Ross, Commons, Li, Stålne, and Barker (2014) described what is now termed Stage 16 metacross-paradigmatic. However, because of its incompleteness, and the lack of a well-worked-out example, they said the description was transitional to Stage 16. In this article, we present not only a complete description of Order 16, but also present an example of it. We also show that the Physical Sciences are Cross-paradigmatic. The Behavioral Sciences are also Cross-paradigmatic Hence, crossing these two cross-paradigmatic sciences will be metacross-paradigmatic.

The arguments are made in steps. First, we start by describing the metasystems that are integrated into the two paradigms. Then the paradigms get integrated into cross-paradigms. As part of this, we show that one of the Newtonian and quantum mechanics cross-paradigms is incomplete because of the difficulty of testing the present string theory. Finally, the cross-paradigms get integrated into meta-cross-paradigms. In order to accomplish all of the above, we first must start by briefly introducing the Model of Hierarchical Complexity.

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Model of Hierarchical Complexity

The Model of Hierarchical Complexity (MHC; Commons, Gane-McCalla, Barker, & Li, 2014; Commons & Miller, 1998; Commons & Pekker, 2008; Commons & Richards, 1984a, 1984b; Commons, Trudeau, Stein, Richards, & Krause, 1998) is an enhancement and simplification of Inhelder and Piaget's (1955/1958) developmental model. Although Inhelder and Piaget were pioneers in the field of developmental psychology, they only defined the stages of childhood and adolescent development. However, they established that there is an invariant pathway along which stage development proceeds regardless of content area or culture (Piaget, 1976). The MHC adopts some of the developmental stages and behavioral characteristics of Inhelder and Piaget's model; however, it does not incorporate the mentalistic theorizing or inferences used in cognitive models. More specifically, the MHC is an instantiation of axiomatic theory, or a logically derived formal system, of measurement (Krantz, Luce, Suppes, & Tversky, 1971). The different levels in a hierarchical sequence of task complexity are "orders," and the successful completion of a task (i.e., the behavioral performance) of a given order is a "stage." Each order in the model is represented by the orders of hierarchical complexity (OHC; Commons, Gane-McCalla, et al., 2014; Commons & Miller, 1998; Commons & Pekker, 2008; Commons & Richards, 1984a, 1984b; Commons et al., 1998); the higher the OHC, the more difficult the task. In previous research (Commons, Gane-McCalla, et al., 2014) 17 orders of hierarchical complexity with examples have been classified and defined (Commons, Crone-Todd, & Chen, 2014).

In the MHC, there are three major definitions (conditions) for the higher order task to coordinate the previous, lower order tasks. These conditions are logically derived rules that, when followed, determine how the MHC orders actions form a hierarchy. If the following three conditions are satisfied, then a sequence of actions A is of Order $n + 1$. These conditions are that Order $n + 1$ is (a) defined in terms of tasks at the immediately prior, lower OHC task action; (b) defined as the higher order task action that organizes two or more less hierarchically complex actions (i.e., the more hierarchically complex action specifies the way in which the less complex actions combine); and (c) defined as that the lower order task actions have to be carried out in an nonarbitrarily manner.

To illustrate how lower actions become organized into more hierarchically complex actions, consider a simple example. Completing the entire operation $3 \times (4 + 1)$ constitutes a task requiring the distributive act. That act is defined in terms of two primary order tasks (definition 1), multiplying and adding. That act nonarbitrarily (definition 3) orders (definition 2) adding and multiplying to coordinate the next lower order actions. The distributive act is therefore one order more hierarchically complex than the acts of adding and multiplying alone; it indicates the singular proper sequence of the simpler actions (Commons, Crone-Todd, & Chen, 2014). To explain in more detail why distribution organizes addition and multiplication nonarbitrarily, a counter example is given. If a wrong order is chosen such as performing multiplication before addition, one then gets $(3 \times 4) + 1 = 13$, which is different from $3 \times (4 + 1) = 15$.

The meaning of coordination in the second definition, an MHC term that is central for this discussion, must be explained (Ross et al., 2014). The principle of coordination here is the same modern measurement theoretical principle of $a \circ b$, which is the concatenation of a and b, where a and b are some object of arbitrary length. That is, when object a and object b are placed end to end, they are concatenated, thus forming a new object c (Krantz et al., 1971). This combination has been done in a nonarbitrary way, which is the third part of the definitions of the MHC. Tasks performed at an order of complexity $n + 1$ are actions that coordinate lower-order actions n. To coordinate means to operate on the lower order actions. These operations may take a range of forms: reflect on, compare, contrast, transform, define, and/or synthesize the properties and behaviors of actions (Commons, Ross, et al., 2012; Ross, 2008). Note that "to understand" information is not one of the operations. This is because one can understand information at an order n, but could not have created the information nor coordinated it in a higher-order synthesis at $n + 1$. Piaget's operational concept is central in this present discussion, as well as axiomatic in MHC theory: tasks of any order of complexity, n, operate on tasks performed at the $n-1$ order of complexity by coordinating them (Ross et al., 2014).

The Model of Hierarchical Complexity of tasks leads to a quantal notion of stage, and therefore delineates the nature of stage transition (Commons & Richards, 2002). Piaget's dialectical model of stage change was extended and precisely specified. Transition behavior was shown to consist of alternations in previous-stage behavior. As transition proceeded, the alternations increased in rate until the previous stage behaviors were "smashed" together. Once the smashed-together pieces became coordinated, new-stage behavior could be said to have formed (Commons & Richards, 2002). Because stage transition is quantal, individuals can only change performance by whole stage. The steps and substeps of transition to change stage are shown in Table 2 (Commons & Richards, 2002).

The OHC can be used to predict the difficulty of a task. To classify a task in terms of its hierarchical complexity, the model deconstructs tasks into the actions that must be done at each order to build the behavior needed to successfully complete the task (Commons, 2015). There are 17 known OHCs. An individual's stage of development has the same name and number as the OHC of the task that it correctly completes. If an individual completes a task that is at OHC 11 (Formal), then their performance on that task is also considered to be at the Formal Stage 11. The model of hierarchical complexity (MHC) is used to generate stimuli in the form of either problems or stories. The stimuli within a domain consist of an ordered series of tasks, usually from Preoperational Order 7 up to Metasystematic Order 13. For the studies presented here, and in other publications, tasks have been generated in several domains—for example, (a) reinforcement contingencies (behavioral economic); (b) mathematical and scientific; and (c) moral, interpersonal, political, and social domains. In these studies, the hierarchical complexity of the task has been shown to predict performance with *r*'s varying from .7 to .98 depending on which instrument was used (Commons, 2015).

Motivation

The motivation for this paper is to create a complete description of an Order 16 task and a corresponding example of Stage 16. This may make it easier to apply to future studies of the highest stages. Once an example exists, it can be used in the further development of quantitative analysis of behavior, stage analysis, and the creation of other paradigms and cross-paradigms. Learning is probabilistic; therefore, this paper considers how things happen rather than when things happens. It is posited that an instance of learning occurs all at once. One either understands a concept or does not. There is a buildup in between, but there are thresholds that are reached. Some concepts can be considered to be memes. Memes are units of information. Humans learn memes instantaneously. One goes from not knowing to knowing, and is able to either have the answer to a yes or no question or not. In order to increase stage, "bridges" are necessary. Because of the genetic and maturational restrictions, it is assumed that only one stage increase is possible. However, if the stage of performance is increased through support, one can provide the correct support to increase stage by possibly two.

Change in Orders of MHC

The original MHC had 16 orders, beginning at zero. However, in 2014, this was expanded to 17 orders in the following way (Commons & Jiang, 2014). Applying the model to explain the development of operant conditioning (original Order 2) from respondent conditioning (original Order 1) in nonhuman animals has led to the recent discovery of a new stage. Actions that make up respondent conditioning are more hierarchically complex than habituation, sensitization, and other simple actions or behavioral tendencies that had also been included in original Order 1. Thus, the original Order 1 has now been separated into the new *automatic Order 1* and the new *sensory or motor Order 2*. All the orders above the original Order 1 also had their numbers incremented by one. Thus, there are now 17 orders of hierarchical complexity. The complete list of orders is shown in Table 1 (Commons & Jiang, 2014).

Because higher orders coordinate at least two actions from the next lower orders, this article will begin by discussing Orders 14 and then 15.

Table 1
The 17 Known Orders of the Model of Hierarchical Complexity

Order number	Order name
0	Calculatory
1	Automatic
2	Sensory or motor
3	Circular sensory-motor
4	Sensory-motor
5	Nominal
6	Sentenial
7	Preoperational
8	Primary
9	Concrete
10	Abstract
11	Formal
12	Systematic
13	Metasystematic
14	Paradigmatic
15	Cross-paradigmatic
16	Meta-cross-paradigmatic

Note. This table shows the numbers and names of the updated orders of hierarchical complexity (Commons & Jiang, 2014).

Table 2
Deconstruction and Construction in the Transition Steps

Step	Sub-step	Relation	Name	Dialectical form
Deconstruction in the transition steps				
0 (4)		A = A′ with B	Failure—old equilibrium point (thesis)	Previous stage synthesis does not solve all tasks (Deconstruction begins.) Extinction Process.
1		B	Negation or complementation (antithesis)	Negation or complementation, Inversion, or alternate thesis. Subject forms a second synthesis or previous stage actions (Antithesis).
2		A or B	Relativism—(alternation of thesis and antithesis)	Relativism—Alternates among thesis and antithesis. The schemes coexist, but there is no coordination of them (Alternation of thesis and antithesis).
Construction in the transition steps				
3		A and B	Smash—attempts at synthesis	The following substeps constitute transitions in synthesis.
		1	Hits and excess false alarms and misses	Components from A and B are included in a nonsystematic, non-coordinated manner. Incorporates various subsets of all the possible components.
		2	His and excess false alarms	Incorporates subsets producing hits at stage *n*. Basis for exclusion not sharp (Overgeneralization).
		3	Correct rejections and excess misses	Incorporates subsets that produce correct rejections at stage *n*. Produces misses. Basis for inclusion not sharp (Undergeneralization).
4 (0)	4	A with B	Temporary equilibrium (synthesis and new thesis	New temporary equilibrium (Synthesis and new thesis).

Note. Substeps 0, 1, 2, 3, and 4 of Step 3 describe different ways of smashing A and B together, without fully coordinating them. These steps are shown and described in more detail in the above table. Note that Steps 0, 1, and 2 represent deconstruction, whereas Steps 3 and 4 represent construction (Commons & Richards, 2002).

Order 14 and 15

Order 14: Paradigmatic

Descriptions: Paradigmatic actions fit metasystems together to form new paradigms (Commons, Ross, et al., 2012). Such actions work with the relationship between very large and often disparate bodies of knowledge in order to reflect on, compare, contrast, transform, and synthesize multiple principles and metasystems (Commons & Ross, 2008a; Commons, Ross, et al., 2012). This coordination of Stage 13 Metasystems may also be done in order to show it is impossible to coordinate such metasystems. In a domain, this may happen if the highest stage task is showing that metasystems are incomplete and adding to them creates inconsistencies. No further stages in that domain on that sequence are then possible (Sonnert & Commons, 1994). Definition: A paradigm is a systematized set of relations among metasystems that reflects a coherent set of assumptions (Commons & Ross, 2008a).

Examples of Order 14 Tasks and Performance

Newtonian physics is a Stage 14 paradigm. At the Paradigmatic Stage 14, one coordinates Stage 13 Metasystems in a nonarbitrary way. Newton's individual equations form multiple metasystems, which are in turn coordinated or united through calculus. This includes not only derivatives and integrals but also differential equations. It is not a cross-paradigm because it is missing quantum mechanics and relativity. It holds up well at the elevations and accelerations of relatively flat England with which Newton had experience.

However, Newton could not have learned these equations or how they were coordinated from others. Rather, he had to invent the equations and their coordination. To create the paradigm of Newtonian physics, Newton must have had one more level of negative support (Commons, 2014). Therefore, he must have been performing at the Cross-paradigmatic Stage 15. Newton had to perform at the cross-paradigmatic stage to create the theory, because certain of the actions that he had to coordinate had to be invented and were not already available. Yet the theory itself is not cross-paradigmatic.

Order 15: Cross-Paradigmatic

Descriptions: Cross-paradigmatic actions fit paradigms together to form new fields (Commons, Ross, et al., 2012). They form new fields by crossing paradigms or integrating paradigms into a new field or profoundly transforming an old paradigm. A field contains more than one paradigm and cannot be reduced to a single paradigm.

Definition: A cross-paradigm is a systematized set of relations among paradigms that reflects a coherent set of assumptions (Commons & Ross, 2008a).

When the Paradigmatic Stage 14 for behavioral development stage and evolution and Paradigmatic Stage 14 of value in behavioral economics, as included in behavioral analysis, were crossed, the stage-value became a Stage 15 cross-paradigm, for example seen in Miller et al. (2015). This is the process of using difference and not differential equations to unite behavioral analysis. Acquisitions and evolution are also considered for behavioral analysis because probability of an event is considered. Evolution includes chaos, which is related to quantum probability. However, Newton does not include probability. So it is necessary to cross these paradigms to even begin to approach behavioral science.

At Stage 15, the Newtonian Laws Map Onto the Behavioral Laws

Newton's Laws of Motion describe the relationship between a body and the forces acting upon it, and its motion in response to some force. Newton's second law provides the formula representing external forces and their relation to the mass and acceleration of an object. In Newton's formula, F is the net force applied, m is the mass of the body, and a is the body's acceleration. Thus, the net force applied to a body produces a proportional acceleration. In other words, if a body is accelerating, then there is a force on it. Momentum is mass times velocity. $F = ma$ is a rate change of momentum, and this is related to his other formulas through calculus. Acceleration is the derivative of velocity with respect to time and velocity is the derivative of position with respect to time. "Jerk" is the derivative of acceleration with respect to time (Newton, 1729).

History of Order 16

The beginning of the discourse on Order 16 was written in 2007 in the editors' introduction to the *World Futures* special issue on hierarchical complexity and postformal thought (Commons & Ross, 2008a; 2008b). That introduction traced the history of the MHC's development to that point, with the last entry in the history as follows. Sara Ross is the one who pointed out that the model is fractal because it shows, by measuring any tasks, that it is self-similar to all the other tasks in the scale in the way it is constructed. Therefore, the Model of Hierarchical Complexity is fractal and every stage exhibits a repeating pattern. In Ross (2008), the fractal characteristics of both the transition steps and the smash sequence that is within the transitions is explained. This is the stage-generator characteristic of the Model's definitions and axioms in action. Commons and Ross, 2008a, p. 302 showed that to reflect on the tasks of a given order, one has to be performing at the next highest order. This is informally referred to as Dawn Schrader's law (D. Schrader, personal communication, 1983).

The Coordination of Stage and Value Form a Cross Paradigmatic Action at Stage 15

As explained in the Model of Hierarchical Complexity section, behavior can be analyzed by the difficulty of tasks that an individual successfully addresses. Therefore, animals and people solve different problems differently at different stages. The distribution of stage is roughly normal with a mean stage of 10.5 for people and a standard deviation of 1. To reasonably predict behavior, one must consider (a) the stage of development of a person or animal, measured here in terms of the successfully completed hierarchical complexity of tasks and (b) the value of outcomes of behavior, operationalized either as the overall value obtained, the value that is discounted because of delay, and perceived value under conditions of risk. Commons (2015) has proposed such an integration summarizing a body of work on the issue. On one hand, it shows that stage of pricing predicts income (Miller et al., 2015); stage predicts those who earn more than one million a year (Goodheart, Commons, & Chen, 2015). On the other hand, it shows that stage of an item predicts how biasing it will be perceived (Commons, Miller, Li, & Gutheil, 2012). Last, reinforcing correct answers of a few trials increases the stage of performance (Adhikari, 2016; Commons & Davidson, 2015).

Stålne, Commons, and Li (2014) proposed a way in which string theory might coordinate the two paradigms of quantum mechanics and the general theory of relativity, thus producing a Stage 15 coordination of the two paradigms. The description of the field of physics by using the definitions and axioms of the Model of Hierarchical Complexity to coordinate the two lower order paradigms was taken from string theory itself. String theory integrates Newtonian, Einsteinian, and quantum mechanics into a cross-paradigm at Stage 15. The rules for such coordination were not written explicitly in Commons, Crone-Todd, and Chen (2014). It was the reflection that string theory is difficult to test empirically that makes use of it alone transitional to Stage 16. At the time, the coordination was not translated into the MHC. The coordination then is transitional to Stage 16 at Step 4 Smash (Commons & Richards, 2002).

Old Order 15 has been described since 1984, and Commons and Bresette (2000, 2006; Commons, Bresette, & Ross, 2008) have described many historical examples of Stage 15 performances. But it was not noticed that it would take Stage 16 to compare Stage 15 examples. That reflection requires a performance that is one stage higher in complexity, as Dawn Schrader (personal communication, 1985) pointed out in the early days of developing the MHC. The actions of defining and reflecting on the properties of Stage 15 action point to the existence of Stage 16. To score material without matching it to examples, one has to perform one stage higher than the material to be scored. The performance to date, is exemplified in the Stålne et al. (2014) article.

Stage 16: Definition and Example

Any order of complexity, n, operates on tasks performed at the $n-1$ order of complexity by coordinating them. By this logic, if cross-paradigms from Order 15 are coordinated, Order 16 is formed. Therefore, Stage 16 must exist and it can be named and defined. Stage 16 is the metacross-paradigmatic stage. At this stage, actions reflect on various properties of cross-paradigmatic actions, seeing where the cross-paradigms are consistent, possibly true, and determining other properties of cross-paradigms. Stage 16 is thus the mapping and coordination of two cross-paradigms.

Overall Strategy

To give examples of Stage 16, our strategy will be to present two cross-paradigmatic Stage 15 examples. Then it will be shown how they are related to each other. That will be done section by section of each example, which means property by property.

Four Parallels Between Behavioral Analysis and Physics

There are a number of parallels between physical science based on string theory and behavior science based on an integration of stage and value. These parallels can be represented using similar terms and similar forms of equations. Four parallels will be discussed. First is the relationships between traditional physics and quantitative analysis of behavior including behavioral economics. Second is the hierarchal nature of both physical science and behavioral science. Third is the fractal nature of the physical sciences and the behavioral sciences. Fourth is the probabilistic nature both of quantum mechanics and of behavior.

First Parallel

The first parallel shows that the relationships between traditional physics and quantitative analysis of behavior, including behavioral economics, can be shown. To address this first parallel, two cross paradigms from the behavioral sciences of stage and value and from Newtonian physics, relativistic and quantum mechanics in the physical sciences were used. These two cross-paradigms are coordinated. By mapping out the relations between these two cross-paradigms, an example of the metacross-paradigmatic stage is created.

Acquisition of behavior can be measured by examining the acceleration of behavior in a new stimulus situation. Other derivatives (or similar difference equations) will be needed to properly explain behavioral phenomena like that seen in the Matching Law. The Matching Law states that the rate of responding will be relative to the rate of reinforcement in concurrent schedules of reinforcement (Baum, 1974; Herrnstein, 1970). The Matching Law is a fundamental equation showing the reasonableness of behavior, if all variables can be accounted for. Most of the time, people and animals do not respond ideally according to the Matching Law equation. This permits notions of genetics, bias, and other psychological processes. There is an evolutionary benefit in that it ensures different patches of different possible reinforcers. In the Matching Law, it is important to consider the evolutionary advantage of matching. It creates variability through the varying local rate of reinforcement, extinction, deprivation, and satiation. This suggests that the Matching Law has nothing to do with rational optimizing and is better represented through an explanation of the concurrent contingencies, including those for alternative available patterns affecting the behavior.

Behavioral momentum is the tendency to keep doing what one has already been doing as long as it pays off a certain amount but not what an alternative action might pay (Nevin, 2005; Nevin & Grace, 1999, 2000). Therefore, behavioral momentum studies behavior's resistance to extinction; it is the study of behavior when the responses fail to match (Nevin & Shahan, 2011). The Matching Law is the delay of reinforcement, which is the first difference equation of value. This is the equivalent of discounting of value (Commons, Woodford, & Ducheny, 1982; Commons, Woodford, & Trudeau, 1991).

Responding can be related to the value of (a) immediate reinforcement; (b) delayed reinforcement or time between possible reinforcements; (c) change in delays (risk); and (d) change in change of delays (change in risk). An account should integrate over micro-, molecular, and molar levels. A microview looks at the contribution of each occurrence or nonoccurrence of a reinforcer or other event. A molecular view looks at a sample or local rates of reinforcement. A molar view looks at the overall rate of reinforcement (Commons, 2015).

In quantitative analysis of behavior, the equivalent of force is the change in rate of reinforcement. In physics this is the change in momentum, mass times velocity. One can change the behavior of an organism by applying a force, such as the rate of reinforcement. In order to move a particle that is moving with momentum out of its path, one must apply a force. This is the same as changing the allocation of behavior. For example, a person may prefer to win a game; their behavioral drive is the reward for wining. In turn, this will affect how much effort they put in. These are the forces pushing them to win, and thus affecting their behavior during play. These forces are analogous to the forces that make particles move in physics. Likewise, when a person begins to think on a deeper level, they are driven to do so by some force. They have been changed by a force or another person who has changed the way they think. They had a drive to *do* so or a motivation to make this change.

Second Parallel

To address the second parallel, as explained in the Model of Hierarchical Complexity section, the Physical Sciences behavior can be analyzed by looking at how many combinations of elementary entities are organized. The entities have to (a) "recognize" which other entities they may combine with; and (b) they have to "dock" with them. For example, only certain quarks may combine with other certain quarks to form elementary particles. Only certain of those elementary subatomic particles may combine with other certain subatomic particles yielding atoms. Only certain atoms may combine with other certain atoms yielding molecules. Again, only certain molecules may combine with certain other molecules to form larger molecules. The whole process describes a hierarchical chain or orders of entities.

In the behavioral sciences, the difficulty of tasks that an individual successfully addresses form a hierarchy. Therefore, organisms including people solve different problems differently at different stages. To reasonably predict behavior, one must consider (a) the stage of development, measured here in terms of the hierarchical complexity of tasks successfully completed, and (b) the value of outcomes of behavior, operationalized either as the overall value obtained, the value that is discounted because of delay, and perceived value under conditions of risk (Commons, 2015).

As explained in the Model of Hierarchical Complexity section, behavior can be analyzed by the difficulty of tasks that an individual successfully addresses. The distribution of stage is roughly normal with a mean stage of 10.5 and a standard deviation of 1.

Third Parallel

To address the third parallel, the fractal nature of both the physical sciences and the behavioral sciences will be described.

The fact that there is a fractal nature to stage change has a parallel to physical sciences. Chaos theory in the behavioral sciences, including stage and value, have a parallel in quantum mechanics. The rate of reinforcement of learning will be looked at, and also the time at which a response occurs and when learning starts. In cross-paradigmatic Stage 15, behavioral economics, behavioral analysis and behavioral stage, the fractal nature has two forms. Ross et al. (2014) pointed out that the Stage 13 Model of Hierarchical Complexity is fractal, because it shows by measuring any tasks that it is self-similar at all scales. Stage change is always the combining of two adjacent lower order actions.

When the combining occurs developmentally or evolutionarily, the process is chaotic and probabilistic. This is true when one is predicting when an action will occur. Change is what action occurs, including stage change during even a short period during a lifetime or across life items as in genetic evolution.

The stage argument is at the core. The higher order organization of forces in the physical sciences is based on the “recognition” of what will fit together. “Docking” is what gets it to fit together. This is a parallel to how in the behavioral sciences higher order actions are defined in terms of lower order ones and organize them nonarbitrarily.

In both the physical sciences and the behavioral sciences, including stage and value, actions are always combined. Likewise, in physics, there is the combining of particles and forces to generate new levels. It is also fractal and therefore hierarchical in nature. The reason it is fractal is that the process of combining means that the particle or force must “recognize” the other to “dock”—come together. Strings make up quarks, quarks make up particles, particles make up elements, elements make up molecules, and so on.

At the micro level in physical science, change is also chaotic and probabilistic at small scales. Both are probabilistic. The probabilistic part of quantum mechanics roughly parallels chaos theory and the probabilistic behavior of individual behavior. In both cases there are overall attractors that determine the average behavior, time, or event occurrence. In the behavioral sciences, in addition, when evolution and new genes are introduced, they have similar probabilities patterns.

Fourth Parallel

To address the fourth parallel, we examine how both the physical sciences and behavioral sciences have uncertainty and chaos at the small-scale level. At the large level, they have attractors. Even the Newtonian laws map on to the behavioral laws. To reasonably predict behavior, one must consider (a) the stage of development of a person or animal, which is measured here in terms of the hierarchical complexity of tasks successfully completed, and (b) the value of outcomes of behavior, operationalized either as the overall value obtained, the value that is discounted because of delay, and perceived value under conditions of risk (Commons, 2015).

Implications

There are a number of implications of coordinating the paradigms and then the cross-paradigms together. Consider, for example, the application of Newtonian physics to behavioral analysis. Because Newtonian physics consists of both structural elements and notions of momentum, this suggests that a more complete behavioral science should also consist of more parallels to those elements. The application shows how stage and value could change the way quantitative analysis of behavior is understood. This coordination could be used for understanding and developing more effective reinforcement contingencies, and changing the way people think about nature. Understanding behavioral drive in relation to force could shed a new light on what influences people to do what they do and how that can be changed. This can be applied to "smarts" and how and if that can be improved. "Smarts" has been traditionally measured by intelligence or more recently by Behavioral Developmental Stage (Herrnstein & Murray, 1996). It has been suggested that IQ should be considered from a developmental stage perspective. As such, developmental stage may be heavily genetically based also (Harrigan & Commons, 2014). To get a person's highest possible performance stage, the analogy to IQ is used. One looks at the highest stage behavioral development stage in any domain. If this has a large genetic component, what is left for reinforcement contingencies is producing generalization of this highest stage performance to other domains. Once a person is operating at their highest stage, one does not change that stage in that domain and content with reinforcement. Also, are the effects of reinforcement contingences inherited through genes, or changed by experience? However, one may change the application of stage of action to a task in domains different from the one measured. Therefore, a person will do new and different tasks by applying the stage to tasks that are new to them and in different ways.

Conclusion

We have shown that string theory is a Stage 15 cross-paradigmatic action. We have also shown that behavioral sciences of stage and value also form a Stage 15 cross-paradigm. Then the parallels between physical sciences and the behavioral sciences of stage and value of behavior can be represented using similar terms and similar forms of equations. This will show that there is a Meta-Cross Paradigmatic Stage 16 coordination of the two.

The Meta-Cross-Paradigmatic Stage 16 has now been named and defined. A well worked out example has been provided. This is the mapping of the physical sciences, including Newton, relativity and quantum physics, with the behavioral sciences of behavioral developmental stage and behavioral economic science of value. It shows that force in physics is analogous to change of rate of reinforcement of behavior. This has connected two cross-paradigms, showing the parallels between them.

There is an analog to OHC in physics. That is, as each new discovery is made, it coordinates old discoveries, forming new stages of knowledge. For example, before Newtonian physics, there were unrelated assertions. He built on these assertions, creating a new stage of physics. It was then necessary for Einstein to have Newton to build his theories. As each new development in physics is created, a new stage analogous to those of the OHC is created. Behavioral analysis was considered here in relation to stage and value. Learning is considered as a fact of happening, through reinforcement, rather than when it happens. When learning happens is a probability, and can thus be related to chaos theory and quantum mechanics. The creation of Newtonian physics connects equations through calculus, but does not include probability. Probability in physics is included in chaos theory and quantum mechanics (Einstein, 1905). In future research, this may be able to be coordinated with the probability of learning through memes.

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