CRITERIA DISCUSSIONS WORK PACKET

This packet of five documents provides drafts for several sets of criteria of relevance to SPT and GTS including Criteria that lead up to or are necessary for adequate choice of the SPT/GTS Criteria. These are all drafts that are neither complete nor representative of a broad consensus. The purpose of these discussion sessions is to improve each of the lists by addition, elimination, or embellishment of each. They are included here roughly in the order of their coverage:

(1) Criteria for a Scientific Theory – [because we are defining systems science]
(2) Criteria for Isomorphy & Their Proof – [because SPT is based on isomorphies]
(3) Criteria for A Process, Systems Process – [because SPT isomorphs are processes]
(4) Criteria for Abstraction/De-abstraction – [because must abstract to get isomorphs]
(5) Criteria for the SPT-GTS – [because we are defining systems science]

(1) CRITERIA FOR A SCIENTIFIC THEORY - IW'15

1. Must provide explanatory power

- ✔ Explains diverse phenomena in a category with regular precision and correctness
- ✔ For example, theories explain diverse observations within each of the categories of inheritance (genetic theory), or mechanics, or motion of astronomical bodies (gravitational theory), or geological landscapes (tectonic plate theory), or origins of species (evolutionary theory).
- ✔ Expect successive formulations of theory explain more than previous theories; resolves earlier paradox or dilemma

2. Acquired thru Scientific Method or Math Formalisms

- ✔ Clear Hypothesis
- ✔ Prediction from Hypothesis
- ✔ Experiment
- ✔ Controls
- ✔ Statistical Analysis
- ✔ Limited Conclusion tightly coupled to Hypothesis
- ✔ Cycles of Iteration or Recursion
- ✔ Word "theory" not applicable to "hypothesis" or "model"; these are considered preliminary

3. Demonstrated Predictive Power; Fecundity; Productivity

- ✔ Suggest predictions beyond former understanding
- ✔ Not just one, but many
- ✔ Leads to More and Better Questions or Hypotheses
- ✔ Results in many spin-off fields of inquiry

4. Falsifiable, Testable Predictions

- ✔ Not absolute certainty; and relative to realm applied (e.g. Newtonian mechanics accurate for human realm but not relativistic realm)
- ✔ Not required that all predictions be yet tested especially if supported already by a major body of evidence (e.g. relativity could not be tested initially)

5. Simple and Parsimonious

- ✔ Efficient and conservative in number of entities or steps required
- ✔ However, exceptions (see "Dulling of Ockham's Razor" essay)
- ✔ Scientists often refer to "elegance" or "beauty"

6. Repeatedly Tested & Supported by Many Independent Investigations

- ✔ Repeatedly confirmed, but still modifiable with new evidence
- ✔ Different Investigators find same results
- ✔ Different Institutions find same results
- ✔ Often different disciplines find results consistent with Theory
- ✔ Accumulates evidence over time; strengthens confidence

7. Requirement of Replicability

- ✔ Investigators using same reagents, instruments, techniques, controls should be able to demonstrate same results
- ✔ Assumed linear causality
- ✔ More difficult to apply in cases of non-linear causality; or controlled limits on non-linear causality
- ✔ Note increased utility of use of meta-statistics to combine results of many similar experiments

8. Inductive; Theories discipline human use of language

- ✔ Theories from experiments eliminate possibilities of semantic description and logical or imaginative explanation
- ✔ As such they reduce human formulations “the more a theory forbids, the better it is” (paraphrase of Popper)

9. Unity and “Fit”

- ✔ Accepted theories should be consistent and compatible with each other (e.g. evolutionary theory time scales fit into and are consistent with geological time scales which fit into and are consistent with astronomical time scales; radioactivity also fits into each of these)
- ✔ Self-consistent, internally and externally

10. Vast Body of Evidence; Consistent with Former Experimental Results

- ✔ A theory does not derive from one experiment or one technique or tool. It is supported by many experimental designs, techniques, and tools giving the same answers (conclusions; interpreted data)

11. Consensus of Experts in that Field

- ✔ Concept of Paradigm
- ✔ Importance of extensive Peer Review

12. Scientific Theories are not Scientific Laws

- ✔ Laws are more restricted to how entities will behave in highly specified conditions; theories are wider in scope
- ✔ Theories may contain several laws simultaneously
- ✔ Both produced via application of the scientific method

(2) DRAFT CRITERIA FOR ISOMORPHY & THEIR PROOF

In summary, each candidate isomorphy should exhibit or have the following:

1. Found or demonstrated and documented in (>1) **phenomena of all five superdomains** (physical; biological; social; human; symbolic).
2. Found or demonstrated and documented in (>1) **phenomena of all known scalar levels** (from quantum to subatomic to galactic to cosmic including the middle levels of life and consciousness).
3. Found or demonstrated and documented in (>1) **all time zones** (from origins of the universe to the present.
4. Found or demonstrated and documented across (>1) **all known origin mechanics** (emergence of new types of natural entities).
5. Every phenomenon (case study) demonstrates the **same Identifying Features** for the isomorphy; one to one mapping, general to specific
6. Every phenomenon (case study) demonstrates the same **Identifying Functions** for the isomorphy; one to one mapping, general to specific
7. Each phenomenon (case study) exhibits many of the same **Linkage Propositions** between that isomorphy and the other isomorphies.
8. The f**orm (expression)** the isomorphy takes in the theory may be in descriptive language, models, or mathematics.
9. Best if expressed as a **"process"** (cf. relation to pattern, what process leads to structure, what effected by fields)
10. Generates insights and understanding beyond those used or required to arrive at the original integration.
11. May appear in modified form as in "discinyms" or in cases of antecedents, precursors, roots, foundations across
12. ARE NOT merely topical (e.g. semester on "light" or "dinosaurs" using cross-disciplinary input)
13. ARE NOT merely anthropomorphic (different disciplines take on an issue or problem)
14. ARE NOT merely taxonomic (subsets of a category)
15. ARE NOT sensitive to minor variations, in fact minor variations are expected (define minor)

(3) CRITERIA FOR A PROCESS, SYSTEMS PROCESS

EXCERPT FROM A PAPER SPT I: SoSPT endeavors to produce and work on the most parsimonious list of isomorphic systems processes, yet miss none that are relevant. We continue to use the seven criteria for limiting the Integrative Themes to Principal Systems Concepts (PSCs) of the original paper in this series (Troncale, 1978a) or its educational applications (Troncale, 1993). But we have added additional criteria. The current list includes the following (not in order of importance):

1) fulfills the working definition of "process;"
2) fulfills the working definition of "systems-level;"
3) can be proven to be isomorphic; found in many if not most mature systems; all sciences
4) can be demonstrated to increase persistence or sustainability of manifest systems;
5) has very rich associations or influences on the other systems processes;
6) exhibits all of the identifying features for that process (but do not overlap with other SPs);
7) rich in associated literature of empirical or experimental or formal data;
8) is domain-independent, discipline-independent, tool-independent, scale-independent, and phenomenon-independent;
9) illustrates key disciplinary phenomena for each case study;
10) understood in sufficient detail;
11) recognized by workers in relevant specialties (or key enough to deserve future work);
12) has exemplars of application to improve systems functions in defined contexts;
13) enables citation of the range of systems for which it is present or valid;
14) represents an intriguing advance in human knowledge in itself;
15) can be used to teach or train others in detailed knowledge of how systems work;

Table One lists the starting set of candidate Systems Processes we intended to compact, shorten, justify using these criteria. Clearly applying these criteria to "test" each and every candidate process is an iterative and evolving task. We eliminate all terms that function as human descriptive expressions, all terms that are naming human-based methods, all that designate classes or taxonomies humans use to talk about systems, and such. The terms remaining are supposed to be only those that describe how systems work. …(that is we restrict use to ONLY phenomenological terms))… Thus many of the purely human terms found in catalogues, dictionaries, and encyclopedia's are eliminated (e.g. see Francois, 2004). This is not a criticism of such needed attempts at comprehensive citation of words involved in systems thinking. Our goal is different. We want only those words naming demonstrable change processes that result in system survival and performance of function.

We consider this a very important strategy. Some of the terms below are similar to others but we use them all to ensure rigorous inclusion. One of the persistent problems in systems theory is the lack of a widespread consensus on explicit criteria for even recognizing a systems-level theory much less the elusive general theory of systems. A consensus on requisite processes and only those requisite processes might help form the needed consensus on GST criteria.

The full citation for this abstract is:
Friendshuh, L. and L. Troncale (

(4) CRITERIA FOR ABSTRACTION/DE-ABSTRACTION

(1) Contains essential units found in all manifestations
(2) Contains essential relationships and influences found in all manifestations
(3) Independent of particulars of instances or manifestations
(4) Many to one mapping
(5) One to many applications
(6) May be expressed in descriptive language or in mathematical formalisms
(7) Characterized by transformation from concrete or particular to representations
(8) Multiple similarities or commonalities
(9) Pure Pattern
(10) Properties invariant across a given range of manifestations
(11) Allows description of most invariant aspects of a range of manifestations or particulars
(12) Enables derivation of manifestations or particulars from the generals

USES OF ABSTRACTION

a) Expresses or discloses the most essential relations across different
b) Relations in one area can be suggested for other areas.
c) Unifies, integrates or synthesizes formerly different areas

(5) DRAFT CRITERIA (Heuristic; Goal) for the SPT as a candidate GTS (and example of Systems Science)

In summary, the SPT-GTS should exhibit or have the following:
Incorporates comments by Duane Hybertson

1) Consists of a **highly detailed set of isomorphic** principles, patterns, processes, axioms, or equations so it can be mapped on many diverse real systems.
2) Provides protocols for compiling and evaluating evidence to indicate that these elements are **isomorphic (abstraction)**.
3) Demonstrate each isomorphy by **mapping it** to real systems in their **domain language** and at their scale
4) Provides **protocols for deabstraction** from the general isomorphies to particular problems (a method for relating the universals to anyone's particulars).
5) Exhibit an appropriately **high level of abstraction and correspondence** from the real system models (particulars) to prove that it's elements are truly isomorphic across disciplines, domains, and scales.
6) the candidate GST has a heuristic for inclusion of the **minimal** yet **complete set of isomorphies** and methods collecting evidence for this.
7) Provides descriptions of **how** these **isomorphies interact** to produce the characteristics of systemness, and its dynamics and sustainability (meta-level of relations among the isomorphies)
8) Provides protocols and predictions of multiple ways or **how systems do not work**.
9) Demonstrate **ability to improve the models** of manifest (real) systems that increase understanding and possibilities of intervention.
10) Provides **better methods** for defining the boundary conditions for **identifying systems** as well as for identifying strategies to relate differently defined boundaries.
11) Incorporates a way to indicate **its position** in a non-anthropomorphic **typology / taxonomy / ontology** that classifies the many different candidate GST's.
12) Should exhibit **close mapping between the theory and its applications** to provide examples of manifest systems that do not match or are outside the theories scope marking its **extent and limits.**
13) Provides a mechanism to describe **how systems come into being** (their origins).
14) Indicate its **utility for** producing specific, deep guiding questions for future research (**generates alternative hypotheses**).
15) E**vidence** of **successful application** of its elements to improving models of real systems, or solving systems problems.
16) Explains how a system fulfills its **"function" or "purpose."**
17) Provides evidence that it could be go beyond descriptive to prescriptive**.**