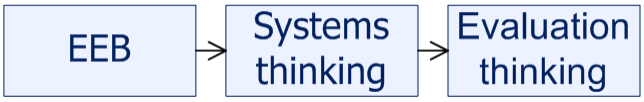
More Powerful Evaluation by Linking Systems Thinking With Ecology and Evolutionary Biology

Jonny Morell jamorell@jamorell.com
Theresa LeGros drejza@arizona.edu
Josh Joseph Josephjjoseph@pewtrusts.org

We are part of a small interest group that has been contemplating the question of how concepts from Ecology and Evolutionary Biology (EEB) can result in more powerful evaluation by adding a dimension to systems thinking that is presently missing. This is one of five blog posts that show how we are thinking about this subject.

1. Example of applying EEB to a program for early parenthood child support. .
2. Example of how rates of change across boundaries in an ecosystem can be useful in evaluating services to a homeless population.
3. Research agenda.
4. Technical elements of EEB as they fit with technical elements of systems. (This post.)
5. EEB within the general context of systems thinking.

Posts four and five present our working hypothesis that the contribution of EEB to evaluation works through EEB's contribution to systems thinking. It's a simple, plausible, but untested idea.



Probing the EEB : Systems Link

It is obvious that EEB and systems (along with a few "systems-adjacent" notions) share some concepts. As an example, *networks* are important in both Systems Thinking and EEB. If enough concepts are shared, there is no point going further because the EEB element of our hypothesis becomes subsumed into the systems thinking element. If only a few elements are shared, there is reason to proceed.

So what is the degree of overlap? It will take us a while to fully answer this question, but we have begun to populate a framework and to work out its implications for doing evaluation. Tables 1 and 2 show what we have done so far.

Table 1 is a crosswalk between systems and EEB.

- EEB concepts are listed in the rows.
- Systems concepts are listed in the columns.
- Some concepts are contained in both lists. These are shown as dark blue cells.
- Light blue cells indicate substantial overlap between an EEB and a Systems concept. "Substantial" is defined as a condition where the concept plays a similar role in both fields with respect to theory and model building, while at the same time containing uniqueness to each field.

We make no claim that the row and column entries are complete. But they do represent some of the more well-known and often used items.

Table 1: Evaluation / EEB Overlaps

	Systems							
EEB	Agnosticism	Feedback	Network	Synergy	Stock	Flow	Reinvention	Part
Agnosticism								
Feedback								
Network								
Synergy								
Birth and death rates								
Evolution								
Mutation								
Ecosystem								
Coevolution								
Fitness landscape								
Selection pressure								

Table 2 provides some explanations and definitions of the terms listed in Table 1. Most important is the third column – "System / EBB overlap. Not all the rows in Table 1 are discussed in Table 2. That would make Table 2 too long. We want to be illustrative, not comprehensive.

Table 2: Explanation of System / EEB

Term	Definition	System / EBB Overlap
Birth and death rates, Stock, Flow	Can pertain to "A measure of some event, disease, or condition in relation to a unit of population, along with some specification of time."	One could think of this as analogous to stocks and flows. However, evaluators seldom include measures of stocks and flows in their work, while birth and death measurements are central to much research and theory in EEB.
Evolution	Change in the heritable characteristics of biological populations over successive generations	Programs are not biological, but they do have characteristics that pass across implementations. (See "mutation.) Strictly speaking, this is akin to "soft inheritance", i.e. the transmission of acquired characteristics across generations. See "mutation" for a discussion of relevant issues.
Feedback	Occurs when outputs of a system are routed back as inputs as part of a	Critical in theory and research in both systems and EBB. The entities among which feedback takes place are different systems and EBB, but the

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	chain of cause-and-effect that forms a circuit or loop.	construct of feedback, and the dynamics of its operation, are similar in both fields.
Mutation	A sudden departure from the parent type in one or more heritable characteristics, caused by a change in a gene or a chromosome.	Programs often seem to change for unknowable reasons, unrelated to any design or operational characteristics of program. These can be treated as random occurrences, much as genetic mutations are. There are two similarities to evaluation. 1- The situation is akin to "sensitive dependence" in the Complexity Science sense of the term. This idea of often invoked in evaluation with respect difficulty in anticipating program or effect change. 2-There are echoes of "reinvention" as borrowed from the research on innovation spread, and often used to discuss context-specific program changes from one implementation to another. EBB and Evaluation differ, however in the priority given to tracking rates and frequency of changes over time.
Network	Objects that are connected together. The connections between the nodes are called edges or links.	Critical in theory and research in both systems and EBB. The entities among which feedback takes place are different in systems and EBB, but the construct of feedback, and the dynamics of its operation are similar in both fields.
Selection pressure	The pressure exerted by the environment, through natural selection, on evolution	Systems does not have a concept like this.

Implications of Crosswalk Between Evaluation and EEB

It is evident from the overlaps and the blank cells in Table 1 that there is a lot of opportunity to apply EEB concepts to evaluation. The partial overlaps suggest possibilities for existing EEB/Evaluation relationships. The sheer number of full and partial overlaps hint at the possibility that even blank cells in the matrix may contain possibilities. What follows are some examples of how individual EEB concepts, and several EEB concepts combined, can have implications for program theory, model building, and methodology.

Evolution: Evaluators have methodologies to track changes over time, and there are many evaluations that try to do so, for example by using process tracing. But we have seen only a small number of evaluations that describe these changes in a systematic and rigorous manner with respect to a program's behavior, successive changes of subsequent programs, or differential impact of those changes. Moreover, these evaluations tend to focus on whatever program was originally implemented, not on

how forms of the program may diverge (aka reinvention), or multiple program implementations may differ along their paths of development.

EEB has a rich tradition of invoking models, methodologies, and data interpretations to address these kinds of phenomena. For instance, a model might reflect the possibility of diminishing cross-organism influence as development paths diverge. Based on such a model, a methodology would be developed to detect those influences. Data analysis would then include methods to calculate velocities and rates of change, and to use that information to understand the implications for the ecosystem. These ways of thinking are second nature to practitioners of EEB, but foreign to evaluators. It's not hard to imagine how different evaluation designs might be if this mode of thinking drove the work that we do.

Selection pressure: Traditional systems thinking embraces the notion that an environment will affect whatever system is under consideration. Systems thinking does not, however, place much emphasis on assessing the extent to which a system "feels" a need to adjust to that environment, or the characteristics of that need. Inquiry of this kind is built into EEB thinking. (Let's leave aside for the moment the thorny question of measuring that force, and the rhetorical license of talking about systems in terms of feeling and sentience.)

An EEB model would include an environmental influence factor. It would implement qualitative and/or quantitative methodologies to measure that influence. It would develop an analysis strategy to derive meaning from that data. We do not believe that an evaluation that was generated from a traditional evaluation mindset would include these aspects of model, methodology, or data analysis.

Applying Multiple EEB Behaviors in Combination: The contribution of EEB expands when individual concepts are taken together. To extend the previous examples, selection pressure might be factored into models and methodologies used to understand change along evolutionary paths. Apply this thinking to an evaluation exercise, particularly one that had a developmental evaluation flavor. The result would be data collection and analysis that would provide an understanding that would be unlikely to flow from a traditional evaluation.