Polarities

Polarities describe the structure of the system. They explain what would happen if there was a change. They <u>do not</u> describe the observed behavior of the variables.

We have used simplified definitions of link polarities so far in our class:

1. A positive link means that a change in the cause influences a change in the effect in the *same direction*.
2. A negative link means that a change in the cause influences a change in the effect in the *opposite direction*.

Example 1: There is a positive link polarity between outside temperature and ice cream sales. The polarity describes the relationship between the two variables on both hot and cold days: if the outside temperature increases, ice cream sales should also increase and if outside temperature decreases, ice cream sales should decrease. The positive link polarity <u>doesn't</u> mean that ice cream sales have actually increased.

This simplified definition of link polarities is fine for most relationships, but sometimes things can get a little confusing. Let's take illustrate with an example.

Example 2: There is a positive link polarity between the number of births and the population. An increase in the number of births increases the size of the population, but a decrease in the number of births does not decrease the size of the population! Births can only increase the population, they can never decrease it. A decrease in the number of births simply means that the population will be lower than what it would otherwise have been.

We need to refine our definition of link polarities. We will use the definitions provided by the preeminent systems dynamics scholar, John Sterman (p. 139):

- A **positive link** means that if the cause increases, the effect increases above what it would otherwise have been, and if the cause decreases, the effect decreases below what it would otherwise have been.
- A **negative link** means that if the cause increases, the effect decreases below what it would otherwise have been, and if the cause decreases, the effect increases above what it would otherwise have been.

These definitions also remind us that there is often more than one cause of a variable. We need to interpret link polarities while *holding all else equal*.

The difficulties interpreting link polarities highlights a large weakness of causal loop diagrams. In the real world some variables, such as a population accumulate but such details are missing from causal loop diagrams. Causal loop diagrams are great for quickly drawing systemic structure but they cannot show all of the details of the causal mechanisms at work. In unit three, we will improve our causal loop diagrams by adding accumulations (stocks) and flows.

References

Sterman, J. D. (2000). *Business dynamics: systems thinking and modeling for a complex world* (Vol. 19). Boston: Irwin/McGraw-Hill.