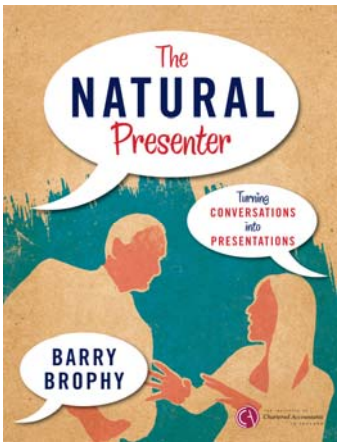
"Forgetting What it Was Like Not to Know"

Barry Brophy



www.barrybrophy.com

- Analogies
- Examples
- Demonstrations
- Stories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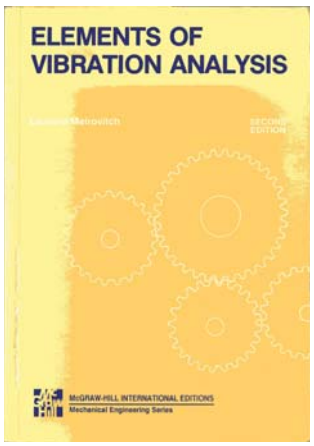
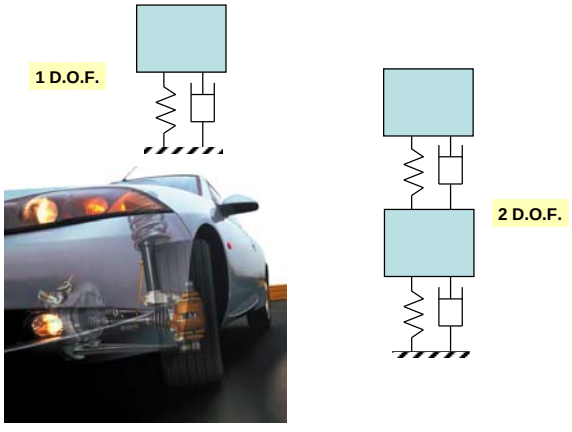
Schematic Reasoning

- Analogies
- Examples
- Demonstrations
- Stories





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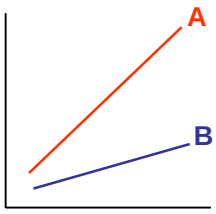
Describe:

1. Ellipse or Parabola
2. Taste of Carlsberg
3. Portugal
4. Spades (suit of cards)



5. Which instrument is more sensitive ?

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GROUPS

Professionals	Students
• 22–60 years old	• 19-22 years old
• 23 companies	• 2 colleges
• 240 engineers	• 510 eng. students
• 1 or 2 day course	• 4 x 2-hr. work shops

FEATURES

Professionals	Students
• Deep Knowledge	• Weak Knowledge
• Some Experience	• Little/No Experience
• Goal-Focused	• Not Goal-Focused
• Real Audience	• Hypothetical Audience

OBSERVATION

Professionals	Students
• Generated fewer examples & analogies, mainly from local sources. Reluctant or indifferent to need use these tools.	• Generated many examples and analogies from a wide variety of sources.

Kevin Dunbar – “The Analogical Paradox”

(Analogical Mind, MIT Press, 2001)

Overall, the results of our analyses of scientists reasoning live or "InVivo" reveal a number of important features of the analogical reasoning process. First, analogy is common. Second, while the scientists do make analogies based on superficial features, they more frequently and spontaneously generate analogies based deep structural features and higher-order relations. Third, the goals that the scientists have influences the range over which an analogy is applied. Fourth, the scientists appear to be using the analogies as scaffolding. Once the analogies serve their purpose of building new explanations and models they are discarded and this is why they forget them. Before discussing the implications of these findings for theories of analogy, I will discuss our work on analogy in another naturalistic context - Politics.

Professional

- “The facts should speak for themselves.”

- A presentation is necessary for those occasions when the facts **don’t** speak for themselves.

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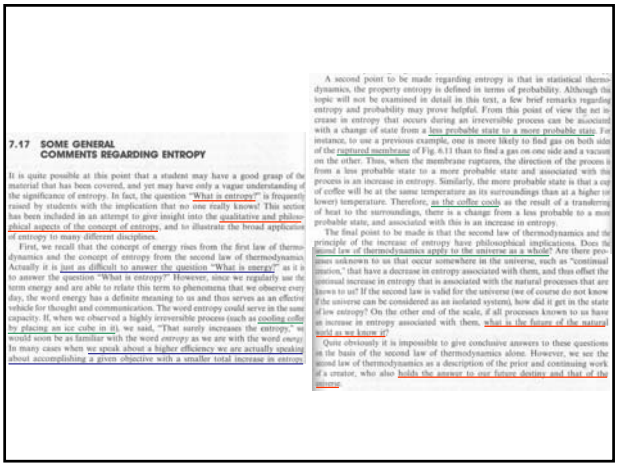


7.17 SOME GENERAL COMMENTS REGARDING ENTROPY

It is quite possible at this point that a student may have a good grasp of the material that has been covered, and yet may have only a vague understanding of the significance of entropy. In fact, the question "What is entropy?" is frequently raised by students with the implication that no one really knows! This section has been included in an attempt to give insight into the qualitative and philosophical aspects of the concept of entropy, and to illustrate the broad application of entropy to many different disciplines.

First, we recall that the concept of energy rises from the first law of thermodynamics and the concept of entropy from the second law of thermodynamics. Actually it is just as difficult to answer the question "What is energy?" as it is to answer the question "What is entropy?" However, since we regularly use the term energy and are able to relate this term to phenomena that we observe every day, the word energy has a definite meaning to us and thus serves as an effective vehicle for thought and communication. The word entropy could serve in the same capacity. If, when we observed a highly irreversible process (such as cooling coffee by placing an ice cube in it), we said, "That surely increases the entropy," we would soon be as familiar with the word *entropy* as we are with the word *energy*. In many cases when we speak about a higher efficiency we are actually speaking about accomplishing a given objective with a smaller total increase in entropy.

A second point to be made regarding entropy is that in statistical thermodynamics, the property entropy is defined in terms of probability. Although this topic will not be examined in detail in this text, a few brief remarks regarding entropy and probability may prove helpful. From this point of view the net increase in entropy that occurs during an irreversible process can be associated with a change of state from a less probable state to a more probable state. For instance, to use a previous example, one is more likely to find gas on both sides of the ruptured membrane of Fig. 6.13 than to find a gas on one side and a vacuum on the other. Thus, when the membrane ruptures, the direction of the process is from a less probable state to a more probable state and associated with this process is an increase in entropy. Similarly, the more probable state is that a cup of coffee will be at the same temperature as its surroundings than at a higher (or lower) temperature. Therefore, as the coffee cools as the result of a transferring of heat to the surroundings, there is a change from a less probable to a more probable state, and associated with this is an increase in entropy.

The final point to be made is that the second law of thermodynamics and the principle of the increase of entropy have philosophical implications. Does the second law of thermodynamics apply to the universe as a whole? Are there processes unknown to us that occur somewhere in the universe, such as "continuous creation," that have a decrease in entropy associated with them, and thus offset the continual increase in entropy that is associated with the natural processes that are known to us? If the second law is valid for the universe (we of course do not know if the universe can be considered as an isolated system), how did it get in the state of low entropy? On the other end of the scale, if all processes known to us have an increase in entropy associated with them, what is the future of the natural world as we know it?

Quite obviously it is impossible to give conclusive answers to these questions on the basis of the second law of thermodynamics alone. However, we see the second law of thermodynamics as a description of the prior and continuing work of a creator, who also holds the answer to our future destiny and that of the universe.

48 pages earlier…

7.1 INEQUALITY OF CLAUSIUS

The first step in our consideration of the property we call entropy is to establish the inequality of Clausius, which is

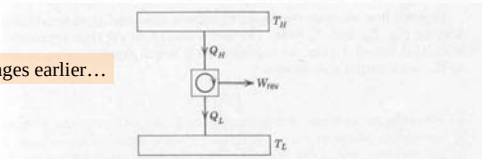
$$\oint \frac{\delta Q}{T} \leq 0$$

The inequality of Clausius is a corollary or consequence of the second law of thermodynamics, and will be demonstrated to be valid for all possible cycles. This includes both reversible and irreversible heat engines and refrigerators. Since any reversible cycle can be represented by a series of Carnot cycles, in this analysis we need only consider a Carnot cycle that leads to the inequality of Clausius.

Consider first a reversible (Carnot) heat engine cycle, operating between reservoirs at temperatures T_H and T_L, as shown in Fig. 7.1.

For this cycle, the cyclic integral of the heat transfer, $\oint \delta Q$, is greater than zero.

$$\oint \delta Q = Q_H - Q_L > 0$$



The central and northern parts of the county are low-lying and composed chiefly of Carboniferous Limestone, with some millstone grit to the north and northwest, and some Silurian and Ordovician rocks behind Balbriggan.

Dublin

Encyclopedia Britannica 1959

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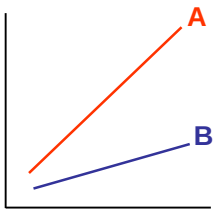

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