A SURVEY OF SEMEIOTIC AS PRACTICE OF INTERDISCIPLINARY REASONING

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ABSTRACT:

From which principal factors did Charles Peirce's scientific theory of Semeiotic evolve? How are those components different from foundational features in accounts of semiotics?

A major difference is shown in the fact that Semeiotic, a scientific theory of natural Semeioses, arises from Peirce's work in logic, especially the logic of relations. A semeiosis is precisely a relational phenomenon, thus a logic of relations is an essential part of the theory of Semeiotic. This essay will provide a roadmap for the development of Semeiotic from Peirce's logical researches. The essay concludes with some examples for use of Semeiotic for objective study of the activity of semeioses within various areas of scientific research.

Instead of extensive textual references readers may consult kenketner.net, which contains resources underlying the account of Peirce's work given here.

PART I. THE NATURE OF REASONING

We—you and I, good reader—are having a conversation; it is a practice in which people constantly engage. We can converse with various persons through sundry media. We have conversations with ourselves. Sometimes we converse with historical persons through documents or other records that survive. Conversations have various purposes: socializing, advising, testifying, entertaining, edifying—we could make a long list. In this effort we will concentrate on conversations meant to acquire a reliable answer for a question that is under study by the discussants. Our focus, then, is **Reasoning**,[1] a sub-type of conversation in which the purpose is to acquire a reliable answer to a common question that is under study by the conversants.

Think, for a moment, about the interesting phrase "reliable answer to a question under study." "**Reliable**" is a condition that envisions a study result that will be effective and dependable in future activities. As we begin to consider how to best ensure that we can attain reliability in our conversations about a common question under study, we soon begin to think about various methods for finding answers to questions. In that way, we encounter a follow-on issue: What **Method** is the most reliable process to guide our conversation such that we can achieve an effective answer for our study question?

1. REALITY AS A GUIDE

To acquire a reliable answer, our study should be guided by **Real** conditions. We need to clarify this important concept. We shall narrow its everyday meaning from a rather wide range of available senses to focus on just one of them. Here the term means this: An item is real when its condition is independent of any single individual's personal preference concerning that condition. Some examples will be useful.

Real

1. Last night I had a dream.
2. Person *A* has dangerously low blood electrolytes.
3. *B*'s bank account is totally depleted.

[1] First appearance of important concepts will be given in **bold face type**.

4. *C* made a promise to *D*.
5. Sun overexposure causes sunburn.
6. John's car is blue.

In example (1) *Last night I had a dream*, it is a real event that the dream actually happened. The content of the dream, that I flapped my arms and flew to China, was not real; that content was a **Figment**—a non-real conception.

Example (2) *Person A has dangerously low blood electrolytes* concerns comparison of a particular set of medical tests with previously researched standard values for blood chemistry. Here past objectively researched findings provide best evidence for real healthy blood chemistry conditions. Case (3) *B's bank account is totally depleted* is structurally similar to (2) in that previously standardized effective accounting procedures show the real state of the depleted bank account.

Item (4) *C made a promise to D* establishes a continuing relational structure in the future behaviors of *C* and *D*.

Number (5) *Sun overexposure causes sunburn* describes a real causal relation.

And (6) *John's car is blue* describes a color perception that is repeatable under standard viewing conditions.

Example (4) *C made a promise to D* concerns establishment of a *real* **Relation** between *C* and *D* in the context of a promise content. The relational structure is "*C* made a commitment to *D* to perform particular action(s) *X*." If we examine this structure a bit, we can discern this slightly more general pattern: "Someone made a commitment to some other person to perform a particular action." This is a **Triadic relation** because it describes a fact about three items. By adopting the convention of using a blank line to stand for the items being related, we can write this form: "___ promised ___ to perform ___." We understand a **Fact** to be the confirmed result of an objective study of a particular question. Thus, a triadic relation is a fact about three items: in this example the three items so related are two persons and the promised action.

Next, case (5) *Sun overexposure causes sunburn* exemplifies a **Dyadic relation**, a fact about two items. The sentence describes a reality about the

effect on bare skin of overexposure to direct sunlight. It is a useful relation to understand because it can guide future activities that involve time spent in strong sunshine. This is an example of the more general form, namely: "___ causes ___."

The last example (6 *John's car is blue*) involves a **Monadic relation**, a fact about a single item. In this case the item is a particular car, and the fact is that it is blue—it has the property "blue." Generalizing this example results in this form: "___ is blue."

While we are discussing examples of our preferred sense of the word "real" it will be helpful for future work to relate that content to another similar concept expressed by the word "**Exist**." Again, this term in general usage has a number of fairly diverse senses. We shall restrict it to mean "items that have weight, mass, that are subject to forces—in effect, matter." In the previously discussed sense of "real," it is clear that such existing items are real.

However, it is also clear that some items that are real do not exist in the sense meant. Case (3) *B's bank account is totally depleted*, the status of *B*'s bank account is not about matter or the sense of "exist" that we are using. The bank account condition is an objective result of real and accurate counting; it is not an issue about matter. So our selected meanings for these words results in the following interrelationships between the two: **Items that are real** contain two subsets—(*i*) **Existing items** such as baseball bats and chocolate candy, plus (*ii*) items that are **Real but nonexisting**, such as the dyadic relation expressed above in example (5) *Sun overexposure causes sunburn*. A causal relation is not an item of matter, yet it is a real relation that can accurately guide future activities. This clarification of terminology is useful for continuing our conversations about methods for objectively answering study questions.

2. ARBITRARY METHODS BASED ON PERSONAL PREFERENCES

Sometimes in conversations concerning a question we find that methods that are not guided by reality and objectivity are used to resolve issues. These are known as **Arbitrary methods**, for reasons that we will soon explicate.

a. **Tenacity**. A participant in a conversation about a question may say "I am sticking to my previously held beliefs and ideas about how to answer this question; no need to consider any objective realities." The **Guiding purpose** of such a technique is simply to continue—by force of will—a previous state after encountering the question, whereas the **Control aspect** of the technique is to employ any means that will interfere with any internal state that is opposed to any changes. It incorporates a resolve to avoid an objective method, and in effect is a conversation stopper. Often tenacious clinging to a personally-preferred answer is expressed as "That is the way I feel." However, the point to remember is that an individual's "feel" does not establish an objective truth about reality.

b. **Authority**. The guiding purpose here is to align one's answer to the study question with the answer given by some preferred authoritative figure or writing or preferred institution. The control aspect is merely to ensure that one's answer is consistent with the answer given by the authority factor that the questioner prefers. For instance, a conversant might say "As a loyal member of the Communist Party, I chose to follow their answer." Emotions such as respect or admiration can be present in the selection of an authority in this sense. A good thought to remember is that no statement is objectively true because some person or institution claims or prefers that it is true. Notice these comments would not apply to seeking advice from a proper physician, or lawyer, or engineer. Such persons have acquired objective results in their studies and through those of their profession, and such studies (subject to human failings) thus are relevant objective truths that can guide our future activities and decisions.

c. **Fashion**. A conversant using this method follows the fashions of the day. The guiding purpose is to be consistent with the preferred peer group. The control factor requires one to stay consistent with the ideas and practices of that group without giving the matter any other thought.

These methods—Tenacity, Fashion, Authority—are **arbitrary** (non-objective) because each of them incorporates the principle or goal or technique of using a guiding factor that is reliant upon some preference of the questioner.

3. A NON-ARBITRARY OBJECTIVE METHOD BASED ON REAL RELATIONS

The **Objective method** is not arbitrary because the guiding principle is preference-independent reality; the control factor is to seek public, repeatable, real evidence that will support a reliable and publicly feasible conclusion. We now turn to an examination of ways in which that goal can be attained. Within the objective method, an **Argument** is *not* a conversational format in which each conversant is striving to be a winner or dominator or an indoctrinator. In the course of objectively examining a study question, the participants do not consider the activity to be a competition. The guiding principle is to solve the question truthfully and realistically. To do this, the question is divided according to its possible answers. Typically, the possible answers are "Yes" or "No." We will assume that condition in these examples. Our sample question is: "Has my cell phone been stolen?" Now we prepare a simple diagram:

My cell phone has been stolen	My cell phone has not been stolen

We indicate that the two sentences above are prospective conclusions by placing them below a horizontal line. The space above the horizontal line is reserved for placing evidence for each particular conclusion. As objective researchers, we will vigorously pursue results for all possible answers to the question, because our goal is to avoid working only to support just one "favored" answer while neglecting other possibilities. Our goal is to find an objectively reliable answer for our question, which may or may not be the initially favored answer. This factor is very important—it is sometimes described as "having an open mind."

How shall we acquire evidence for each conclusion? This is an instance of an important logical process that humans can perform, the act of guessing, known as **Abduction**. As we consider the first argument, a thought might occur that "If the phone was stolen, there would have been another person in the vicinity who would have been a thief." For an act of stealing to occur, another person would be required to be the thief. If another person passed through this vicinity, perhaps that was observed or

recorded. The result of an abductive guess is called a **Hypothesis**. When hypotheses initially appear, they are not truths, and they should not be treated as preferences; instead, they are *candidates* for truth, and they are subject to further examination and testing. In our example, the initial hypothesis that resulted from our guess that the phone was stolen is that we should test it by seeking confirmation concerning whether another person was in this vicinity at the appropriate time. It is a bad mistake to fall in love with a hypothesis when it first emerges from an abductive guess. Sometimes persons immediately base future actions on the first idea that "pops into mind." Unless action is urgent, that is a poor practice. Remember, hypotheses are not to be loved; they are meant to be tested and rejected if disconfirmed. As abduction proceeds and we produce ideas about evidence, we can describe that in sentences, and place those sentences above the line in our diagram thusly:

1. If the phone were stolen then another person was in the vicinity;
2. a stranger was observed passing by here;

_____

therefore, my cell phone may have been stolen.

This particular argument is not rock solid, but still at least it embodies a likelihood that might be strengthened as additional investigation occurs. It is sufficient for the moment as a sample to consider argument structure. When a piece of evidence is described in a sentence such as (1) or (2) above, it is known as a **Premiss**. The double-s ending is employed in logical study to distinguish from the similar sounding word "premise" that typically means "a location." In the above, notice also the use of the word "therefore": it is a **Conclusion indicator**. We employ it, or synonyms such as "thus" or "hence," to clearly designate the conclusion from the premisses of an argument. Or, one could use another technique to accomplish the same goal by designating the premisses with a **Premiss indicator** such as "because" (or synonyms). We could rewrite the sample argument above using a premiss indicator, thus:

My cell phone may have been stolen, **because** (1) if the phone were stolen, then another person was in the vicinity, and (2) a stranger was observed passing by here.

The rewritten passage is the same argument but expressed with slightly different language tools.

The argument concept is a very rich notion that is basic to our efforts. Note that arguments are not environmental events such as an earthquake or a solar eclipse. However, they are natural in that they occur within the world in the process of conversation when one person, usually after some abductive processes, proposes a complete argument, as in the above example. We shall designate the role of such a person as the **Argument presenter**. Within such a conversation another role is required to ensure objectivity, that of **Argument evaluator**. More than one person can be involved in each of these roles, or a single person through time can switch roles back and forth in the process of internal objective thought which is a kind of conversation within the thinking of a single person. This suggests that one's internal reasoning processes can be objective. But it is also the case that one's internal conversation can be conducted by means of arbitrary methods, or by simply adopting the first hypothesis that arrives. The latter condition often is not a reliable guide to future decisions or actions.

Another feature of argument structure is that the premisses are **Jointly asserted**. So, in this example, there is an implicit "and" relation between (1) and (2). The argument presenter is making a two-part claim:

a. Both premiss (1) and premiss (2) are true, *also*
b. the fact of (a) plus the reliable structure of the argument
means that the conclusion is true or likely to be true.

The argument evaluator task is to perform an objective check of that two-part claim. How is this accomplished?

In the case of (a), checking can consist of observations or testimonies or evidence in general. In the second case (b), the situation is somewhat

more complicated. We will need a technique for examining the reliability of argument relational structure. The approach that has been widely used in logical research since the days of Aristotle (born 384 BCE) is to construct a diagrammatic model of the relations found in the argument structure. By studying such models, we can learn if a structure is objectively reliable. This technique is known as **Diagrammatic thought**.[2]

PART II. DIAGRAMS OF ARGUMENT STRUCTURE

1. ARGUMENT STRUCTURE INVOLVING CLASS RELATIONSHIPS

An argument structure is a factual matter involving real relations and as such can be studied objectively using modelling diagrams. We begin with structures that involve **Monadic relations** which are typically the form by which we express that a particular item has a particular property such as: "John's beach umbrella is green." We see that a specified umbrella has the property "green." If we were to **Deny** the property, the describing sentence would be "John's umbrella is not green." We could also deny the entire sentence by stating "It is not true that *John's umbrella is green.*" In addition to individuals, at this level we could deal with a **Class**—a collection of items sharing a common property—for example, "the umbrellas now on this beach" or "umbrellas that are green." With these distinctions we can write sentences that describe relations between classes. By combining words that express quantities of **All** or **Some**, along with words that express **Inclusion** and **Exclusion** of classes or individuals, we note these four possibilities (cited with an explanation of the relational structure of each sentence form):

i. All umbrellas on this beach are green.

Sentences with this structure are named **Universal Affirmative** because *all* members of the **subject class** *umbrellas* are described, and the relation between that class and the **predicate class** is that the former class is *completely included* in the latter.

ii. All umbrellas on this beach are not green.

This sentence structure is **Universal Negative** since *all* umbrellas on the beach are *excluded* from all of the class of green umbrellas.

iii. Some umbrella on this beach is green.

Here we have a description of a relation known as **Particular Affirmative** inasmuch as less than all but *at least one* umbrella on the beach is *included* in the class of green umbrellas.

[2] See Ketner 1984: "Peirce on Diagrammatic Thought."

iv. Some umbrella on this beach is not green.

In this case, known as **Particular Negative**, *at least one* umbrella on the beach is *excluded* from the class of green umbrellas.

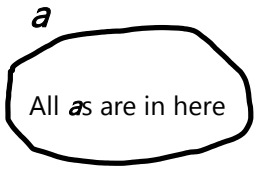
To get a clear example of how we can use **diagrammatic reasoning** to objectively examine argument structure, we consider this example:

All ***c***ows are ***b***ovines.	All ***c*** are ***b***.
bovines are ***a***nimals.	All ***b*** are ***a***.
_____	_____
Therefore, All ***c***ows are ***a***nimals.	Therefore, All ***c*** are ***a***.

The expression above right employs a convention of using an appropriate bold lower-case letter to abbreviate a class name.

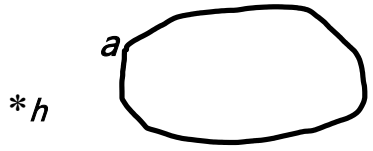
Now we need to agree on the tools for constructing a model diagram of the structure of the above argument.

Agreement 1: The interior of a circle, with an appropriate class name to label the circle, will be understood as containing the members of that class, whereas the outside of that circle indicates items that are not members of that class. So, if we draw a circle and label it *A* (for the Animals class), we are modeling that class:

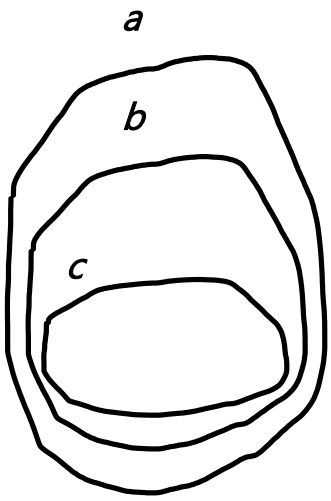


Non-***a***s are outside the circle

Agreement 2: if we wish to show an individual item we use a large asterisk with an appropriate subscript letter, thus: $*_h$. So, the particular negative sentence "Some ***h*** is not ***a***" will be diagramed as:



With these easy diagrams we are now able to demonstrate an example of our modelling strategy that is known as **Diagrammatic reasoning**; it is a basic tool in logic, and through that path it is basic in all objective disciplines. Returning to our initial example argument about Cows, Bovines, and Animals. Our diagram method shows *both* premisses, considered as true, in this fashion:



Now we closely *observe* this diagram of the joint assertion of *both premisses* of the argument. We see the first premiss is modeled (represented) as true because all the ***c***s are inside the ***b*** circle; also, the second premiss is shown as true because all the ***b***s are inside the ***a*** circle. Continue to *observe* this diagram *while retaining a diagram of the conclusion in your mental image area*—that will be a ***c*** circle inside an ***a*** circle. As you view our three-circle diagram of the premisses just above, you can observe that the conclusion diagram is necessarily included in a diagram of both premisses represented as true. So, the result of this modelling diagram is an analogy of the relational structure of the whole argument. And our use of this technique is an objective experiment guided by reality.

So, we now know that this argument has a relational structure such that ***if*** the premisses are true, ***then*** the conclusion is also necessarily true (independent of any preferences—it just ***is*** *really, factually* that way). This condition of the relational structure of arguments is known as validity; an

argument with such a structure is designated as **Valid**. This word is widely used in everyday speech to mean something rather broad such as "acceptable in every way." One should note that in our usage "valid" is narrowly restricted to the sense of meaning *given*. In other words, validity does not tell us that the premisses *are* true; it only tells us *what would be a real consequence of the premisses* ***if*** each *were* true. To get a true conclusion, we must (1) establish that the premisses *are* true, *and* (2) that the structure is valid. An argument that possesses both properties (1) and (2) is known as a **Sound argument**.

This process leads us to an even more general result. Consider this structure:

All {} are [], and All [] are (), therefore, All {} are () .

If we make uniform substitutions of class names into the three empty place-marker types, the resulting argument will be valid; however, some uniform substitution patterns may not result in a sound argument. Here are two examples:

I. Valid and Sound

All {existents} are [items with mass], and
All [items with mass] (exhibit inertia),
_____
therefore, All {existents} (exhibit inertia).

II. Valid but not sound

All {trees} are [animals], and
All [animals] are (flying creatures),
_____
therefore, All {trees} are (flying creatures).

It is important to notice in these examples that validity is a property of structure and relational form. True premisses do not guarantee a valid argument form, and a valid form alone does not guarantee a true conclusion *unless* we can also show within the valid form that the premisses are indeed true, thus exhibiting a sound argument.

The technique of diagrammatic reasoning includes an interesting component. Our discussion above shows that it is an observational science: that is correct because the argument evaluator within the conversation about the dependability of this argument structure can directly *observe* that a diagram of the premisses as true will necessarily display the truth of the conclusion. Such a matter is objective, and any other objective person

can also come to the same result through familiarity with the diagramming agreements plus a direct observation. Thus, the method provides a reality-based reliable experimental result about the validity or soundness of this kind of argument structure. The method applies as well to more complicated arguments or to those composed of sentence structures that are more complex than these sample sentences about class relationships. We shall examine some examples of these additional complexities as we proceed.

2. Argument Structures Involving Simple and Compound Propositions

A **Proposition** is a sentence that is capable of being true or false. In some cases it is useful to study whole **Simple propositions** only in terms of their truth or falsity as well as their capability for combining through the use of connecting words such as "and," "or," and "deny." Here are some examples of such simple propositions:

1. My dog has run away. (*R*)
2. The quality of mercy is not strained. (*M*)
3. These cherries are delicious. (*T*)

Simple propositions (sentences of this type) like these have in common the property of not containing additional independent clauses. For convenience, we abbreviate each simple sentence with an appropriate capital letter (as indicated above).

A compound sentence is formed when two or more simple sentences are joined with a connecting word such as those mentioned above. Presently we are examining compound sentences only in terms of their overall truth or falsity. Consider creating a compound using sentence *R* and sentence *T* (above) with the "and" connector: "*R* and *T*." The question we need to answer is: Under what conditions are the individual sentences *R* and *T* true (or false)? There are only four possible combinations of truth or falsity for the combination *R T*. Each possible combination is given by the rows of the following table—left side. The right side shows the truth or falsity (truth value) of the entire compound proposition given the condition for *R T* per each of the four possible rows. (Notice that we use "&" as an abbreviation for "and.")

	R	*T*	*R* & *T*
1.	t	t	t
2.	t	f	f
3.	f	t	f
4.	f	f	f

Figure i.

A second abbreviation needed will represent the operation of denying either a simple or compound sentence; we select "¬" for this operator. Its action can be summarized in this table:

	R → ¬*R*	<REVERSE>	¬*R* → *R*
1.	t f		f t
2.	f t		t f

Figure ii.

That is—for row 1—if *R* is t, then ¬*R* is f; and if ¬*R* is f then *R* is t (similar relations hold in row 2). We see that the denial operator incorporates a reversible situation in that if we know whether a simple or compound sentence is true (or false) we know that its denial is the opposite value; likewise, if we know the truth value of a denied sentence of either kind, we know the truth value of the sentence without the denial operator.

These two conceptions—the compound connector "&" and the denial operator "¬" are sufficient to create other familiar connectors such as "__ or __" as well as "if __ then __." We abbreviate the "or" connector as "∨" and the "if/then" connector as "⊃" (can also be read as "*X* implies *Y*"); also note that to deny a compound proposition we use parentheses to indicate the whole compound and then place the denial operator in front of the parentheses. These tables show how this result can be accomplished:

	R *T*	¬(¬*R* & ¬*T*) = *R* ∨ *T*	¬(*R* & ¬*T*) = (*R* ⊃ *T*)
1.	t t	***t*** f t f f t t ***t*** t	***t*** t f f t t ***t*** t
2.	t f	***t*** f t f t f t ***t*** f	***f*** t t t f t ***f*** f
3.	f t	***t*** t f f f t f ***t*** t	***t*** f f f t f ***t*** t

4.	f	f			***f***	t	f		t	t	f		f		***f***	f				***t***	f	f	t	f		f		***t***	f

Figure iii.

The tables we have been considering are also diagrams that experimentally show all the possible combinations of truth value for a given expression, and as such they are *observable* models of the sentence structures or argument structures that can be expressed concerning using this second kind of sentence content. This approach in logic is known as **Truth-Functional** calculus. That name is given because the truth of compound sentences expressed in the method is a function of—via the tables given—the truth values of the simple sentences in the expression plus the nature of the connecting words or operators. An analogue of this technique is employed in electrical circuits and computing wherein switches in series perform in a manner similar to the "and" connector while switches in parallel act like an "or" connector. Negation can also be incorporated into such a system through an arranged reversal of a switch.

How would this method apply to an argument? Here is an example of two classical argument structures that we use constantly in our practical activities (the abbreviation "$\therefore$" means "therefore"). The construction method for this model is to use the rules previously established (see *Figure iii.*) to track, for each row, the resulting truth values.

			I. Modus Ponens					*II. Modus Tollens*				
	R	*T*	*R* $\supset$ *T*, *R*	$\therefore$	*T*			*R* $\supset$ *T*, $\neg$*T*	$\therefore$	$\neg$*R*		
1.	t	t	t	***t***	t	***t***	***t***	t	***t***	t	***f***	t	***f*** t
2.	t	f	t	***f***	f	***t***	***f***	t	***f***	f	***t***	f	***f*** t
3.	f	t	f	***t***	t	***f***	***t***	f	***t***	t	***f***	t	***t*** f
4.	f	f	f	***t***	f	***f***	***f***	f	***t***	f	***t***	f	***t*** f

Figure iv.

The initial line of (*I*) reads "given a premiss *R* $\supset$ *T* and another premiss *R*, therefore *T*"; (*II*) reads "given a premiss *R* $\supset$ *T*, and another premiss *not-T*,

therefore *not-R*." We can observe this diagram to discern whether these two arguments are valid (recall the characterization of "valid" above). Notice that these truth tables are also diagrams, similar in modelling aspects to the circle diagrams used in discussing monadic class logic; however, now the diagrams employ algebra-like patterns instead of circles. Taking one argument at a time, we look for at least one row in which both premisses are true and the conclusion is false. *If we observe no such row* among the four possible rows, then the argument structure is such that if both premisses are true the conclusion will be true, and therefore, it is a valid argument structure.

In the first argument diagram—*I. Modus Ponens*[3]—row 1 has both premisses t and conclusion t, and there is no other row in which both premisses are t, therefore the argument structure is valid. Try your hand at checking the second argument structure, *II. Modus Tollens*.

3. ELEMENTARY RELATIONAL LOGIC

Thus far we have examined statements and relations in argument structures that involve (1) sentences describing properties and classes, and those that describe (2) truth functional relations. We now examine sentences that can describe many additional relational types that are expressed between parts of a sentence. Recall above the description of a relation: A *relation* is a *fact* about some number of items. "**Fact**" means "the true result of a properly conducted objective experiment." So, we shall describe a relation that is a fact about one item (usually described as a "property") as a **Monad**; a relation that is a fact about two items will be known as a **Dyad**; one that is a fact about three items is a **Triad**, and so forth with quadrads, pentads or higher forms. These structures are also common in everyday language. Consider these examples:

1. Sam is tall.
   Monadic relation: ___ *has a property "tall"*

[3] These names derive from medieval logical tradition; *Modus Ponens* means "positing mode," whereas *Modus Tollens* means "negating mode." These two forms often appear in everyday communication and are essential in objective experimentation. An experimental disconfirmation takes the second form, while experimental confirmation appears in a closely-related variant of the former.

2. Bob is a friend of Beverly.

Dyadic relation: *___ is a friend of ___*

3. Howard contributes money to a charity.

Triadic relation: *___ contributes ___ to ___*

4. Dorothy sold her car to Monica for $650.

Quadradic relation *___ sold ___ to ___ for ___*

In these sentences we have generalized the various items in each relation; as individual items, they are known as **Co-relates**. Thus, in sentence (2) the co-relates—the items related by the relation "___is a friend of___"—are "Bob" and "Beverly." We understand the sentence, if true, to be an accurate description of that real relation between those two persons. Having generalized the co-relates to become represented by a blank line, we can complete our generalization of all aspects of these sentences by also generalizing the relating component. We do that by drawing a large dot with the proper number of blank lines attached to it. Here are appropriate general diagrams for the structure of three of the above sentences.

Diagraming fully generalized relational structures

1. ——● means

"Some as yet undesignated item (the line) has some as yet undesignated property (the dot)."

2. ——●—— means

"Some as yet undesignated item (left line) is in an undesignated dyadic relation (the dot) with a second undesignated item (the right line)."

3. ——●—— means
   |

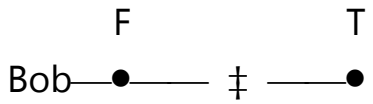
"Three undesignated items (the left line, the vertical line and the right line) are in a triadic relation (the dot)."

The number of undesignated items in a specified relational expression is known as **Valency**, which is the count of available specifiable co-relate

places within a given structure. In the example above, the valency of sentence (1) above is one, of sentence (2) is two, of sentence (3) is three.

We will need another concept that will allow us to join two relational structures. The process is known as **Bonding**. Given two undesignated locations, one each in two relational structures, given appropriate additional conditions, we may join two locations (blank lines) as one with a bond. In concrete cases, there will be a contextual aspect that will justify a bond. However, because we are now exploring generalized structures, experimentally we can form various bonds to discover how a particular action *might* change the structures involved. For instance, imagine this expression (where "‡" indicates a bond has occurred):

Bonding example

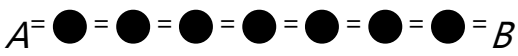


The diagram to the left of "‡" states "Bob is a friend of an undesignated person." The diagram right of "‡" says "An undesignated person is tall." After bonding, the undesignated items to the left and right of "‡" become designated as identical, so the resulting bonded expression would state: "Bob is a friend of a tall person." The valency of this example, prior to bonding, is two—after bonding the valency is zero. A bonding operation always "connects" two undesignated items thereby reducing valency by two.

One more feature of Peirce's approach to logic is needed: the distinction between **Bi-identity** (Id_2 abbreviated in the usual way as "=") and **Ter-identity** (Id_3 abbreviated as "$=_3$"). Id_2 is the more familiar form: identity between two items. We are all familiar with many mathematical examples such as "64 divided by 2 = 32." Ter-identity is less familiar, it is often presupposed but not overtly mentioned; it means that three items are at once identical. For instance, we might observe that "32, xxxii, 64/2" are ter-identical. In the logic of his Beta Existential Graphs, Peirce initially described a **Line of Identity** in terms of Id_2. Thereby he could express that two

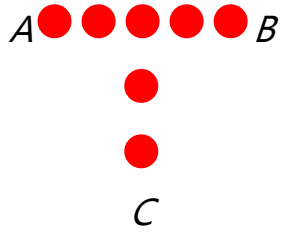
components connected by a heavy line are bi-identical. Later in his studies he realized that completion of his graphical logic required that lines of identity must be capable of branching. To enable that function he realized that such lines should instead be based upon ter-identity. A diagrammatic analogy can illustrate the situation.

Let us imagine that a line of identity is composed of a series of inter-connecting black dots wherein tangential touching of two dots represents an Id_2 connection, thus:



Here the component *A* is Id_2 to the first dot, as is the first dot to the second dot, and so to B, therefore *A* is Id_2 to *B*. However, there is no capacity that allows a branching of this line. If we change each dot to be ter-identical (shown as red) then we can express both the above as an Id_2 line, but with the third connection point un-used in each red dot, a figure that still expresses that *A* is bi-identical to *B*, thus (imagine the red dots touching tangentially):

But since each red dot in this image has an unused third connection, if contextual conditions justify a branching line to be added, it can be connected to the available unused point on a ter-identical dot. But with this change, a branching line is possible. The following figure, then, states that *A*, *B*, *C* are ter-identical. (Imagine the horizontal line of red dots, and that of the vertical ones above *C* to be tangential.)



Thus, as Peirce eventually concluded, lines of identity within his graphical logic, are always lines of ter-identity that can be employed either with or without branching.

4. TWO IMPORTANT THEOREMS IN SEMEIOTIC

We now have enough tools to permit establishment of two important theorems about relational structure. These are essential theorems for Semeiotic; *they appear to be unknown within semiotics*. The first is the **NonReduction Theorem** (NRT). It states that within this system of diagrams (within this logic of relations), it is not possible to construct a triadic relation from resources consisting only of monadic and dyadic relational structures and the process of bonding; however, from resources consisting only of triadic relational structures and bonding, it is possible to construct dyads and monads as well as larger triads from combinations of smaller triads. The NRT shows that from triads and bonding, every relational type can be constructed. One reason that is an important result lies in the fact that from efficient causal resources (or stimulus/response and other dyadic relations), triadic resources may not be constructed. For example, from Skinnerian resources, communicational activities—which are triadic—cannot be constructed. However, if at the start one has triadic resources, dyadic resources can be constructed. So, if a computational device were limited only to dyadic algorithms, no fully intelligent device (intelligence presupposes communication which is triadic) could be constructed. On the other hand, if a computational device included triadic relations in its principles, more triads and some needed dyads could be constructed. Such a component would justly be known as a **Peirce Device**.[4] It would not be known as a Peirce Machine because it would not be based upon dyadic mechanical principles.

A little work with scratch paper will show that the bonding of two dyadic generalized forms produces yet another dyadic form. Also, the bonding of a dyadic structure with a monadic structure produces a monadic structure; moreover, bonding two monads produces a zero-valency expression, a Medad. Moreover, three triads and three bonds will yield a triad: that is another important formal property. While this group of features is not a demonstration, it is sufficient for present purposes.

The second result is known as the **Relational Completeness Theorem** (RCT). It states that given resources consisting of monadic, dyadic, triadic

[4] See Beil 2004, Beil and Ketner 2003 and 2006.

relational structures and bonding, it is possible to construct any quadradic or higher valency relational structure. Again, with scratch paper draw two generalized triads with all items undesignated. Then bond one co-relate of one with one co-relate in the other. The result will be a tetrad. Take that structure and bond in one more triad and the result will be a pentad. This process can continue as long as one wishes, so the theorem is established. These two theorems are basic in semeiotic and will be important in later sections. [5]

Notice that within semeiotic the active employment of the distinction between bi-identity and ter-identity is a consequence of the establishment of those theorems.

5. ARGUMENT TYPES—REVIEW AND INTEGRATION

Having examined some argument patterns found in basic logic, it will be useful to pause for a brief review before taking up Semeiotic. Within the context of objective method we have classified **Argument types** against a background understanding of inference types. An **Objective Inference** is the process of reasonably and realistically supporting the establishment of a *Conclusion* from the basis of truthful *Premisses* (or evidence) as well as valid structural considerations. An *Argument* is a description in sentences of the activity of such an Inference.

For example, on the basis of the two thoughts that "All men are mortal," and "Socrates is a man," one could infer that (make an inference that, conclude that) "Socrates is mortal." In such an instance, the first two sentences are serving as evidence in support of the third sentence, so the first two sentences are serving as premisses. The third sentence is inferred from the first two, so the third sentence is the conclusion. The entire set of three sentences along with a claim about the relation between premisses and conclusion constitutes an *Argument*. Thus, in this example (of the deductive type), the argument is:

All men are mortal, and Socrates is a man, therefore Socrates is Mortal.

[5] For a full history and discussion of NRT and RCT, see articles by *Interdisciplinary Seminar on Peirce*, especially 2011.

We see the elements of this argument are: the premisses or evidence (sentences 1 and 2), a word *therefore* that states a claim about the relation between the premisses and the conclusion (sentence 3). Arguments are claims by argument presenters to be objectively evaluated by an argument evaluator using an experimental diagrammatic modelling procedure to discern the reliability of the argument structure.

We will be concerned with three **Inference types**, which are these.

ABDUCTION (guessing). In the background of an abduction, one has identified in advance (or **Predesignated**) a problem to solve. (This problem is expressible as a question, or as a doubt, or as a declarative sentence the truth of which is indeterminate at this time.) If one lacks a pre-designated question, one does not yet have a research project. One guesses what a possible answer for that problem might be. The content of the resulting guess is known as a **Hypothesis**. The act or process of producing a guess is the inference process we designate as Abduction. The process of Abduction does not produce a truth—it produces a *candidate* for truth. Abduction and Hypothesis are not the same, but they are related, as above. Abduction can produce *new proposed* answers for new problems. The purpose of Abduction is to produce Hypotheses. The sole function of a hypothesis is to be the object of a fair and vigorous test. Hypotheses that survive such tests are said to be **Confirmed**; those that fail such tests are said to be **Disconfirmed**. Hypotheses are for testing, not for preferring or loving.

DEDUCTION (exploring logical consequences of prior known statements): Deduction considers this general problem: "Given that some specified evidence is true (such evidence is collectively known as *Premisses*), is another statement (known as the *Conclusion*) also true?" An *Argument* is created when a person makes a **Deductive Claim**. This claim occurs in one of two general forms:

(1) These Premisses are each true, *therefore*(←this word is a conclusion indicator) this Conclusion must be true; or

(2) This Conclusion is true, *because*(←this word is a premiss indicator) each of these Premisses is true.

The same Argument can be expressed using either of these general forms. And there are many synonyms for both conclusion or premiss indication functions.

When beginning to study an argument, always the first step is to clearly identify the premisses and the conclusion, using one's knowledge of premiss or conclusion indicators.

Arguments do not exist independently—they come into being when an argument presenter makes an appropriate claim.

Deductive arguments can be evaluated objectively, the general question being: "Is the claim true?" In testing the matter objectively, a model is constructed in order to answer the question (in the instance of some particular claim) whether, given true premisses, the relation between the premisses and conclusion is such that it is *impossible* for the conclusion to be false. An argument that possesses the foregoing relational structure is said to be *Valid*. If the relational structure of an argument is such that it is *possible* for all its premisses to be true while at the same instant its conclusion is false, the argument is said to be *Invalid*. A classic example of an Invalid argument is the **Two-Sentence Fallacy**:

Simple Sentence 1, therefore Simple Sentence 2;
example: It is Spring, therefore Chicago is the capitol of Texas.

It is clear that the structure of this argument is such that if Sentence 1 is true, there is no relational necessity for the conclusion to the true.

A completely dependable deductive argument will be (1) valid in its structure, and (2) each of its premisses will be true. Such an argument is known as a **Sound** argument.

INDUCTION (experimental design): **Induction** is the process of testing hypotheses. Performance of Induction requires use of both Abduction and Deduction. In general, one begins with a question, from which one guesses (Abduction) about possible answers (giving equal effort to all possible answers to the question). Such possible answers are known as Hypotheses. To test hypotheses, one *deduces* observable consequences from a hypothesis, then one *designs a test* to discover whether the consequences will hold in reality. If the test is executed, and predicted consequences are observed in reality, the induction is successful (or one can say the

hypothesis is *Confirmed*); if the consequences are not observed in reality, the induction fails (or one can say the hypothesis is *disconfirmed*). A hypothesis that is disconfirmed is rejected, and a new hypothesis is sought for future tests.

The ***Abduction/Deduction/Induction*** **cycle** is the process of (1) attaining a *predesignated question*, (2) using *Abduction* to guess possible answers, (3) using *Deduction* to trace out testable consequences of the hypothesis, and (4) designing an experiment (Induction) for testing that question. When that process is repeated, we have the self-correcting process of objective **Inquiry** (**Research**, **Science**).

6. A SHORT HISTORICAL REVIEW: FROM LOGIC TO SEMEIOTIC

Logic is a long-standing and widely effective component of everyday life as well as within research and study. Beginning with Aristotle, Class logic—a type of deductive argument—received a good basis and in the form of syllogistic was the principal tool for reasoning through the Middle Ages. During that period, it was regarded as essentially synonymous with the whole of logic. The Stoic School of scholars, who were roughly contemporaries of Aristotle, developed some aspects of Truth-Functional Logic (also a deductive argument type), but these techniques did not come into widespread use or further elaboration until the nineteenth century beginning with the studies of George Boole. Relational Logic (another deductive type), while implicit in some aspects of earlier research, also did not begin to be fully appreciated and examined until the middle of that century through the work of Augustus De Morgan and Charles S. Peirce.

In was Peirce who realized and elaborated the next development by working out a new possibility that became apparent once a functioning Logic of Relations was available. Peirce also pioneered the integration of all three argument types into a cyclical research sequence consisting of *abduction* (to gain a testable hypotheses), *deduction* (to determine testable consequences of a hypothesis, and *induction* (the process of designing and executing an experiment to test the consequences of a hypothesis). In using those new tools, Peirce noticed that a particular relational structure was widespread in nature and society. He designated it as ***Semeiosis***, in keeping with the terminological usage of some prior researchers who made some

partial studies of the phenomenon.[6] We turn now to a discussion of *Semeiotic* (pronounced See-my-OH-tick; compare German *Semiotik*, French *Semiotique*, Italian *Semiotica*) which is the *logical theory* of the phenomenon of semeiosis.[7] We will employ Peirce's researches as a starting point.

PART III. SEMEIOSIS, A NATURAL RELATIONAL PHENOMENON

Acquiring the resources of relational logic was a breakthrough for gaining an understanding of Semeiosis (See-my-OH-sis. Without going into the details of that development, we will begin with a description. We have been considering conversations and proceeding with that aspect in the background of our discussions. A conversation is a strong example of the more general semeiosis relation, which, like conversation, has a triadic relational structure. In a spoken conversation, there is a speaker, a common element often called a message, and a hearer. In the more general case of meaningful communication there is a transmitting factor, a message, and a receiving or interpreting factor. However, semeiosis occurs more widely than within conversations—it is a process that is found throughout in human affairs and in the activities of nature.

There is a tendency to conceive of communication as a dyadic structure in which the transmitting factor directly causes[8] a receiving factor, however that hypothesis can readily be disconfirmed with a simple experiment. As you are walking in a public place, say to each passerby, "You have excellent garments." You will find that the responses will be varied. This argument describes the experimental results.

(1) If communication were strictly causal, the response

[6] For two of many examples, see the logician and physician Galen (129-210 CE), and the physician and social theorist John Locke (1632-1704 CE).

[7] See Max. H. Fisch, "Peirce's General Theory of Signs," in Fisch 1986.

[8] We are considering the word *cause* in this case to mean the following: "*X* causes *Y* is true" *if and only if* (1) "If *X* happens, then *Y* happens" and (2) "If *X* does not happen then *Y* does not happen." This sense of *cause* is widely used in controlled experiments in medicine and other sciences wherein one group is given a possibly effective agent and another group is given a disguised ineffective agent. If *X* indeed does cause *Y*, then the group with the effective agent will show a significant result, whereas the control group with an ineffective agent will show no result.

from each person should be the same.
(2) The response is not the same from each person.

_____

Therefore, It is not true that communication is strictly causal.

You will recognize our old friend, the argument structure for *Modus Tollens*, which is often the argument structure found in an experimental disconfirmation. What is missing in a causal exchange that is not missing in a meaningful communication such as conversing? The missing element is a third factor involving interpretation.

Given, then, that genuine communication is not a causal event, what is its nature? Basically, it is a triadic relation process in which there is an **Object** (***o***) element, a **Representamen** (***r***) element, and an interpreting factor or function designated as the **Interpretant** (***i***) element. Note there are four realities here: Object, Representamen, Interpretant, and the triadic relation involving those three items (the three co-relates). The entire general relational process *type* is known as **Semeiosis**. **Semeiotic** is the scientific study of Semeioses. Notice that such a study is not possible without a basic grasp of the logic of relations. Thus, these factors are basic:

- All semeioses are triadic relations.
- Some triadic relations are not semeioses.
- No exclusively dyadic sequence can be a semeiosis.
- Semeiotic is not a section or subset of Semiotics because the latter is based upon different theoretical basics usually involving dyadic relations as foundational. (That is to say, to absorb the semeiotic of Peirce as a subset of semiotics is to initiate a theoretical conflict by reducing a triadic relational theory to a dyadic one.)

Sometimes the discussion of semeiotic is undertaken as a study of the "theory of signs." This approach has produced some useful studies, however, there is an ambiguity problem that should be resolved. In that context the word "**Sign**" can mean (1) the item—Representamen—that represents the Object to an Interpretant within a semeiosis relation, ***or*** it can mean (2) the entire triadic semeiosis relation involving an object, a

representamen, and an interpretant. Sense (1) is the narrow meaning of "sign"; whereas sense (2) is a broad sense of the word. These two senses are seriously different. Clarity is important in objective study, so we will drop "sign" and use "semeiosis" for the broad meaning (2) and use "representamen" for the narrow sense (1).

We shall now proceed with a review of the basics of semeiotic as they can be developed out of the logical principles we have reviewed; then derive some of its consequences and benefits. As before, we need to establish a system of modelling diagrams to study the relational patterns at hand.

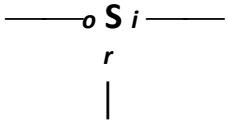
1. GENERAL PATTERN OF SEMEIOSIS

Here is a specific example of a common semeiosis.

Howard waved a greeting to Mr. Samuels.

The *Object* of this semeiosis is Howard's intention to greet another person. The *Representamen* is the commonly recognizable greeting wave, whereas the *Interpretant* is Mr. Samuels's possession of a cultural habit that gives a basis for interpreting Howard's particular wave as a greeting.

We wish to move from such concrete examples to a more generalized picture of a semeiosis event. First, using a diagrammatic approach, we will generalize all four components of the phenomenon: the triadic relation itself, plus the Object, Representamen, and Interpretant co-relate items.



This image will describe a fully generalized structure of a single semeiosis. The letter **S** (in this typeface) stands for a generic triadic relation that has the semiosis structure involving ***o***, ***r***, ***i***, the specific content of which is not now designated or specified. Letters ***o***, ***r***, ***i*** stand for the Object, Representamen, and Interpretant positions—also generic for now—within the triadic semeiosis relation. The lines extending from each of those three positions indicate a place where a designated content for that particular item could be placed if specification were to occur. In this general form, each letter ***o***, ***r***, ***i*** in effect designates a class of *possible* items that could be placed in any one of those positions if appropriate information becomes

available. We could describe the meaning of this diagram in this sentence: "There is some kind of triadic semeiosis relation having an object ***o*** of some kind, a representamen ***r*** of some kind, and an interpretant ***i*** of some kind." To elaborate a bit more:

- the *object* item is what the semeiosis is "about,"
- the *representamen* is some aspect of the object, and
- the *interpretant* gives meaning to the object through the representamen.

The interpretant is an interpreting *function*, which is a wider concept than "interpreter" (a person)—often such a function is a law or a habit. For instance, in a neurobiology event there might not be an interpreter, but there could still be an interpreting function in the form of some regularity. In another way of expression, one could remark that an interpreter is one sub-type of interpretant functions overall.

The initial concrete example above about Harold's greeting can be instantiated into the general semeiosis structure by specifying the triadic relation plus designating the specific object, representamen, and interpretant.

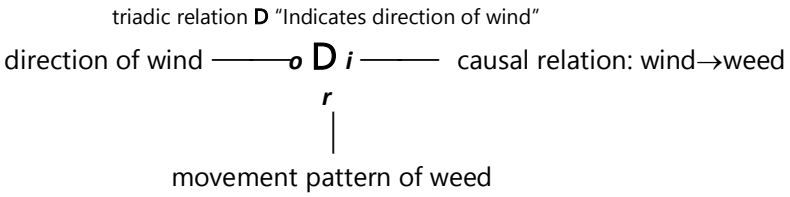
2. SOME SPECIFIC SEMEIOSIS TYPES

If we transition toward more detail within the generalized structure mentioned just above, we will be able to discern some sub-types of semeiosis processes. We will work with three types; there are more, however, these will suffice for a beginning.[9]

Indexical Semeiosis: An **Index** is a sub-type of the general semeiosis relation S such that the Object is in some causal relation with the Representamen, and the Interpretant is "recognition of that causal relation as holding between the object and representamen." A careful distinction is needed here in order to be clear about the nature of this process. An adult may observe a tumbleweed move across an empty parking lot on a windy day. Because this adult has grasped the law-like relation that the wind causes this weed to move on a particular path, we have an indexical

[9] Some of the additional semeiosis types will involve the interesting step of using semeiotic to reflect back upon the processes of logic itself. Thus, terms like "proposition" or "argument" can be analyzed in semeiotic terms. This is another topic altogether and will be saved for later.

semeiosis present: “The weed direction of travel shows the direction of the wind.” We can diagram this example by filling in some designations within the general semeiosis pattern for ***o***, ***r***, ***i*** and by changing the generic triadic relation label S to **D** as a specific name showing that the triadic relation now is “wind Direction indicator” (**D**).

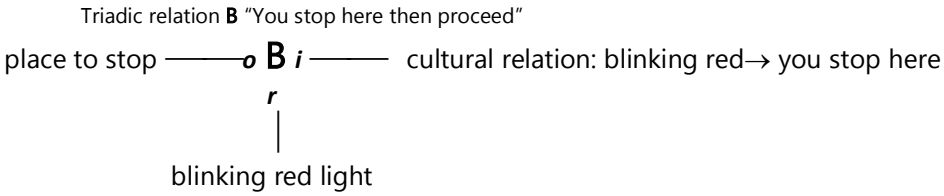


Without the interpretant, “Wind direction causes weed movement path,” there is no Index. (Note that an Index is not a causal relation, but is a triadic relation, a sub-component of which, the interpretant, is a dyadic relation.) For instance, a young child sees that event, but lacking an interpretant, there is no index for the youngster: the child sees a moving weed and feels the wind but does not apprehend the “direction of the wind” from those observations because that interpretant relation has not yet been learned.

Understanding indexical semeioses was among the first results of semeiotic study, especially in medicine from ancient to contemporary times. A disease symptom is an indexical semeiosis in the understanding of a knowledgeable physician. A person unschooled in medicine might observe a particular bulls-eye shaped skin rash and think nothing of it, whereas a physician who comprehends various kinds of causal relations involving diseases would immediately understand that such a rash is an index of underlying Lyme Disease, a condition caused by microbes from tick bites. The phrase “theory of signs” has often been understood as a method of analyzing medical symptoms (signs broad sense, indexical semeioses in other words) to diagnose diseases. As we have noted, in light of increased knowledge of semeioses of multiple kinds it is wise only to assign this phrase (sign theory) to a historical context, at least when considering various possible forms of semeiosis other than indexes.

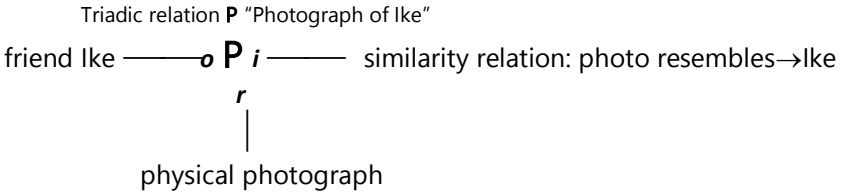
Symbolic Semeioses: **Symbols** have interpretants that are cultural or conventional habits. Consider a blinking red light at a street intersection in

the United States. There is no causal relation between the blinking light and the fact that cars stop at the intersection. However, there is a cultural habit in the community that is widely shared such that the blinking light routinely has an interpretant for drivers: "Stop, then proceed with caution." Words in a national language are full of symbol examples. Conventionally established symbols are common in mathematics, computing, and throughout science.



Symbols have been widely researched,[10] however, as in the case of "theory of signs," there are more sub-types of semeiosis than one finds through a study limited only to symbols. It would be inappropriate to substitute "symbol" for "semeiosis" because the former is a subset of the latter (and not vice versa).

Iconic Semeioses: An **Icon** operates by having an interpretant that incorporates a relation of similarity or of analogy. In a photo of friend Ike, the printed photograph serves as a representamen of Ike within an iconic semeiosis.



Similarity is a condition of shared properties. In the case of analogies, two items can have similar forms or structures. For example, a model airplane can have a smaller version of the analogous structure of a passenger airplane. In engineering, research on a scale model can more easily be performed, then the results scaled up to the actual larger project; basically, that is a process employing iconic semeiosis. You may have noticed that the

[10] Peirce and Cassirer made extensive studies of symbolic semeioses: see Cassirer 2000 and Ketner 2011.

procedure of Diagrammatic Thought (Diagrammatic Reasoning) depends upon some iconic semeiosis processes involving similar relational structures.

These three semeiosis forms are not exhaustive of all possible semeiosis structure types. However, they are appropriate for an introductory survey of the basics as developed according to Peirce's methods.

3. OBJECTIVE CONSEQUENCES AND PRINCIPLES OF SEMEIOTIC

Now we can list a number of possible results for the practice of semeiotic that follow from these basic considerations. We can expand from noticing structural patterns of semeioses to consider some consequences that produce guidelines for analysis within research processes across various academic disciplines. The following *principles* have the status of developed working hypotheses within semeiotic.

* Semeiotic is the objective study of semeioses.

* A semeiosis is a triadic relation—never a dyadic relation; each semeiosis relates an object, a representamen, and an interpretant. As the content details vary, differing sub-types of semeiosis can be discerned.

* Neither a stimulus-response relation nor a strictly causal relation alone is a semeiosis; however, if comprehension (Interpretant) of the regulating aspect of a such relations is present there may be a semeiosis.

* Triadic relations, and therefore likewise semeioses, (a) cannot be constructed from dyadic relations, whereas (b) dyadic relations can be constructed from triadic relations, and (c) relations higher than triads can be constructed from triads (see NRT and NCT).

* Each genuine communication is a semeiosis.

* All thought is in semeioses.

* If any given semeiosis is to be further interpreted, it will have to be in terms of other semeioses.

* Every semeiosis can always be further interpreted.

* There is no absolutely determinate (fully specified) semeiosis; to be interpretable is to be indeterminate in some respect.

* There is no absolutely first or absolutely last interpretation.

* To understand (explain) one semeiosis (communication), another semeiosis (communication) will be required. From explanatory resources containing only dyadic relations, no successful explanation of a semeiosis can be constructed.

* Semeioses are real—they are composed of non-existing real relations.

* An actual interpreter or interpretation is not necessary for an item to be a semeiosis: all that is needed for an item to be a semeiosis is that the representamen in question is *potentially* interpretable by an interpretant function.

* The Self, or I, of a human, is but an internal dialogue (semeiosis) between the self of now and the self of the future. That dialogue is a process about which we can refer hypostatically. (Hypostatic abstraction is the process of using an abstract noun to refer to an operation or a process as if it were an existent.) The human self is a symbolical semeiosis. A human being is a symbolic semeiosis.

* Knowledge is knowledge of relations.

* An absolutely private semeiosis is impossible. This is the case because thought or cognition is a dialogue, which implies that the self is not an individual.

* There is a formal parallelism between interpretation, questioning, and choosing, in that there must be options. (Moving from indeterminate to more determinate is a move from more options to less options.)

* Interpretation involves a hypothetic inference (Abduction), and since to think is to engage in a process of semeiosis, we are always interpreting, hence always inferring, both self-consciously and non-self-consciously.

* Some of our inferring is for the sake of reaching a correct or true interpretation. Hence, objective semeiosis is controlled by ideals of objective method. There is a parallelism between the inquiry processes of objective method and of semeiosis.

* The universe (nature) is intelligible, and intelligibility is a matter of semeiosis processes; hence, semeiosis is a phenomenon found throughout the universe that is not merely limited to cultural contexts, or only to self-conscious contexts. There are examples of natural semeiosis in all academic disciplines.

4. SAMPLE ANALYSES OF INTERDISCIPLINARY EXAMPLES USING SEMEIOTIC:

Semeiosis in Biology: Consider a scientist observing an interaction between two hummingbirds at a patio syrup feeder. When hovering at the feeder, the birds run their wings in a helicopter-like mode but keep their tail feathers closed (*photo 1*).

Photo 1: Hovering Flight

To change from hovering at the feeder into fly-away mode, a bird must initiate a new wing and tail feather arrangement. In particular, according to relevant laws of aerodynamics, a bird must spread its tail feathers like an open fan (*photo 2*) to provide a "push point" needed to facilitate transition from the physics of "hovering" to the physics of "flying away." This physical law represents an example of a hard habit.

Photo 2: Fanned Tail

Previously, when this feeder was installed, the scientist watched a brightly colored male hummer (Anna's Hummingbird *Calypte Anna*) find the feeder and take a healthy swig, then apparently come back for several more meals before sunset.

The next day the scientist noticed two male birds—*A* and *B*—at the feeder; the following sequences were observed.

SEQUENCE I

Activities of bird *A*	Activities of bird *B*
I-1. *A* is hovering and feeding at Feeder.	
	I-2. *B* approaches close to *A*.
I-3. *A* notices *B* and spreads tail to change flight pattern from hover to straight flight.	
I-4. *A* flies in direction of *B*.	
	I-5. *B* flies in opposite direction of *A*'s flight vector;
I-4. *A* returns to hover near feeder.	
	I-6. *B* remains nearby.

Sequence I repeats several times.

SEQUENCE II

	II-1. *B* approaches close to the feeder.
II-2. *A* hovers while showing tail spread, stays near feeder, does not fly toward *B*.	
	II-3. *B* departs.
II-4. *A* returns to feeding.	

Sequence II has now become the activity pattern if *B* approaches whenever *A* is at the feeder.

We might entertain the hypothesis that these events display some relational semeiosis patterns. Specifically, we might think abductively to guess that during sequence I, bird *B* learns an interpretant function that *A*'s tail-spread is a representamen within an indexical semeiosis concerning the consequent chase that has followed several times. Why does tail-spread indicate an imminent chase? The answer lies in aerodynamics of flight

change from hovering to pursuit: tail-spread is an initial physics requirement for *A* to change flight pattern from hovering to chasing. (We prefer to designate such a principle of physics as a **Hard habit**.[11])

Moreover, *A* learns that tail-spread without chasing is sufficient to produce *B*'s retreat. At this point in the sequences, both *A* and *B* have acquired a common habit that *A*'s tail-spread means "*B* will depart." With this new learned habit (we shall designate this as a **Soft habit**[12]) in common, the two birds have developed a symbolic semeiosis in which the interpretant is supported by the common learned (soft) habit. Therefore, perhaps we have a hypothesis that can be tested, in later research, to the effect that one way in which symbolic semeioses develop is through mutual community learning of a commonly experienced indexical semeiosis.

A Discussion of Conspiracy Theories: Increased use of the internet has made conspiracy theories more visible. The phenomenon has been studied from the standpoint of several disciplines. Here is one account based on analysis using Semeiotic.

A proper starting place is the moment when a person experiences an unresolved *Why* question. As an example, "Why is juvenile crime increasing?" A *What* question—What is that person's name? or What brand of car is that?—typically has a short answer, such as "Bob" or "Farrari." A *Why* question—for instance, Why was there an extremely bright light in the sky last night—usually requires a longer answer, almost a narrative or story.

After the moment of acquiring a question, the next event is to guess at an answer. This we have discussed as Abduction. Basically, Abduction is the process of objectively seeking an Interpretant. Abduction can be either objectively controlled or not.

In an **Objectively-controlled Abduction** the output guess is a hypothesis that is immediately considered as a *candidate* for objective truth that is then placed into a testing sequence (Abduction/Deduction/Induction as previously discussed) by a community of objective investigators with reality as the controlling factor for the tests. In a **Non-objectively controlled Abduction** the appropriateness and acceptability of the emerging

[11] On the use of the word "habit" in physics, see Smolin 2013; see also *Interdisciplinary Seminar on Peirce* 2019 concerning use in biology.
[12] See *Interdisciplinary Seminar on Peirce* 2019.

hypothesis is simply *preferred* by the guesser, and then designated as "truth," and propagated as such to others without any resort to testing in a community of objective investigators as controlled by reality. Usage of "truth" in those two approaches for handling a newly-conceived hypothesis deserves closer consideration.

The bare set of marks—T-R-U-T-H—does not become a complete word until a meaning sense is added to the marks. Speaker one's sense for those marks may be "I personally accept or believe or *strongly* believe *X*," where *X* is some hypothesis arrived at through an arbitrary non-objective abductive guess. Speaker two may use the same marks in discussing *X*, but thereby means "*X* is only a *candidate* for truth that is held temporarily until it has passed (or failed) rigorous tests against reality within a community of objective researchers." Speakers one and two use the same marks, but once the meaning senses are added, we see that they are talking about two different words that are not equivalent. The marks are the same, but the meanings are different.

Abduction that is not objectively controlled is a weak point in human cognition because the instant of arriving at a conscious awareness of an answer typically is accompanied by a positive, even joyful feeling. Moreover, an answer to a *Why* question carries a narrative, as well as the felt appropriateness of the narrative, and perhaps a social encouragement from other persons with a same or similar narrative. Such a narrative with its emotional factor, and perhaps an internal consistency, can be an attractive candidate for an Interpretant for the answer of a question being considered. The weak point is the fact that the only support is an arbitrary personal preference or a personal positive feeling.

Abduction that is self-controlled (arbitrary self-preferences under objective control) incorporates the positive feeling, but the personal preference and such feelings are under control so that the hypothesis is subordinate to the objective tests to come. The desire of the self-controlled investigator is to obtain the correct real answer by subjecting the hypothesis, at first joyful, to strenuous test, and to let it go if it is disconfirmed, then turn to get a new candidate for objective truth if the question is still active.

The entire process of objective investigation is a series of semeioses. By employing the tools of Semeiotic (in both *Geistes*- and *Natur*-Wissenschaften), these processes, in more detail than this brief summary provides, may be further explored with the goal of improving our abilities as researchers guided by reality instead of personal preference. One important feature to consider about the important Interpretant aspect of semeioses is the fact that an interpretant can be sought—based on reality or based on mere personal preference. The process of interpretation alone does not establish objective truth. An interpretant achieved through personal preferences is insufficient to support an objective factual outcome.

This analysis suggests that conspiracy theories arise from non-objective and self-preferential uses of Abduction. Moreover, those phenomena are semeioses—although unfortunate ones—that can also be studied using Semeiotic.

Semeiosis in Film Studies: Here is an example of semeiosis within film studies. A Director, who is filming a commercial for an insurance company, photographs a series of separate scenes.

(1) A stationary shot of a smiling grandmother sitting in an old-style porch swing with a book in her hand. Quickly a happy young girl dances into the scene, hops on the swing next to grandmother who opens the book. **CUT.**

"Grandmother" and "Child" leave the set for a break. While they are gone Director and Special Effects shoot the next scene.

(2) Camera pans from the rope support attachment point at the swing, progressing upwards to focus on the support hook in the porch ceiling. As rigged by Special Effects, the rope seriously frays and begins to collapse. **CUT.**

"Grandmother" and "Child" return to the porch swing.

(3) Stationary shot of Grandmother closer than before, rope supports are not visible, but "Child" is partially visible. Special Effects arranges for the swing to drop three centimeters (safely). "Grandmother" shows a surprised face. **CUT.**

(4) Title Department provides a shot of a black background with red letters:

ACME INSURANCE *ACME.COM* .

FOR THE UNEXPECTED MOMENTS .

CUT.

The Cinematographer now has four scenes that are separate and unconnected in real time and film time. He takes them to the Editor who splices them together in a sequence: (1) then (2) then (3) then (4). This produces a commercial for Acme Insurance that airs on cable television. (It would be interesting to imagine various sequences of the four scenes based on all the different order permutations.)

Perhaps you would like to try a semeiotic analysis of the transition from separate scenes to the finished commercial as you could view it on TV.

5. CONCLUSION

I hope this essay is a useful outline of the path Peirce employed to derive Semeiotic, proceeding from objective common sense, then through various basic to more complex forms of scientifically and experimentally established phases of logic, concluding with a logic of relations sufficient to support an objective analysis of the natural relational phenomenon of Semeiosis. This shows that Semeiotic is not a "theory" in the sense of an arbitrary "view." Given such a tool one can experimentally examine various natural processes of semeiosis as found in many fields of scholarship. In such a research program Peirce's Semeiotic, the study of Semeioses, can provide a well-founded, objective, experimental method that can establish bridges for enhanced interdisciplinary research. Toward that goal, three examples of applied semeiotic analysis within three different disciplines, are presented showing Semeiotic as a common method that can be employed across biology, social psychology, and film studies, as well as other fields of self-controlled (non-arbitrary) scholarship.

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