Abduction as Practical Inference

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Abstract:

According to C. S. Peirce, abduction is a rational attempt to locate an explanation for a puzzling phenomenon, where this is a process that includes both generating explanatory hypotheses and selecting certain hypotheses for further scrutiny. Since inference is a controlled process that can be subjected to normative standards, essential to his view of abductive rasoning is that it is correlated to a unique species of correctness that cannot be reduced to deductive validity or inductive strength. This irreducibility claim is of considerable importance for the logical and epistemological scrutiny of scientific methods, but it is not clear that Peirce produced a convicing argument for it. To the contrary, when the full structure of abductive argumentation is clarified, especially as presented in Peirce's later writings on the topic, a good case can be made for viewing every inferential step in the abductive process as dissolving into familiar forms of deductive and inductive reasoning. Specifically, hypothesis-selection is a special type of practical inference that, if correct, is deductively valid, while the creative phase, hypothesis-generation, is not *inferential* at all. Once this is understood, it emerges that the familiar descriptions of abduction as "inference to the best explanation" or as a process of "belief revision" are, at best, misleading.

Keywords: Abduction, Inference, Validity, Belief, Acceptance, Directive

1. Introduction

According to C. S. Peirce, *abduction* is a rational attempt to locate an explanation for a puzzling phenomenon that includes two stages: generation of explanatory hypotheses and selection of the most promising explanations for the phenomena at hand (CP 6.525). But in his numerous writings on abduction Peirce presented a number of conflicting suggestions about the sort of rational procedures involved in locating and selecting explanations. Accordingly, care must be taken in piecing together a coherent *Peircean* account of abduction that will secure mutually consistent answers to the following questions:

(1) What is the purpose or goal of abductive reasoning?
(2) What is the basic form, or forms, of abductive reasoning?
(3) What sorts of premises and conclusions typify abductive reasoning?
(4) Insofar as abductive inferences are "valid" or "correct," is this correctness distinct from that which typifies valid deductive arguments or strong inductive arguments?

In current literature on the topic, abduction is often characterized as *inference to the best explanation*, specifically, as an inference whose ultimate conclusion is an explanatory hypothesis and whose premises include statements about the hypothesis, the surprising datum, and the relevant background beliefs. There are two important consequences of this manner of answering questions (2) and (3). First, the response to (4) would then be affirmative; the correctness (validity) of an abductive inference must be distinct from, and irreducible to, the correctness of deductive and inductive arguments since there is no way of deductively or inductively deriving a hypothesis from the information supplied.[1]

Second, the answer to (1) would be that abduction aims at the adoption of an explanatory hypothesis (Wirth, 1998). Assuming that one "adopts" a hypothesis by accepting it as true, then abduction is a process that alters one's *beliefs*, either through adoption of a new belief, abandonment or revision of standing beliefs, or both (Aliseda, 2000, p.54).

But if we focus upon Peirce's writings on abduction after 1900,[2] there are several reasons for thinking that these descriptions present an inaccurate picture of abductive reasoning. Peirce is there explicit that the process of rationally coming to believe a hypothesis is principally a matter of *inductive* inference since it is through induction that hypotheses are evaluated and added to our stock of beliefs (CP 2.755, 5.171, 6.468-477). Abduction by contrast, "commits us to nothing" (CP 5.602) and is not a matter for belief (CP 5.589, and see also CP 5.60, 1.634-635). Moreover, Peirce became increasingly convinced that abductive thinking extends beyond the confines of scientific discovery, with "scientific retroduction" being but one species of a generic type of reasoning (MS 637:5-6). That is, we engage in the creative thinking characteristic of abduction whenever we seek solutions to problems, e.g., in thinking of what to do, what to say, or how to interpret and describe what we observe (MS 692:27-8, and see Moriarty, 1996). We are continually searching for "action-guiding" hypotheses just as the scientist seeks explanatory mechanisms, though we operate under differing time constraints (MS 637:5). If so, then rather than being an inference that sanctions belief in a hypothesis, abduction is a process of *practical reasoning* that culminates in an intention or a recommendation of a particular course of action. In the search for scientific explanations, the abductive "selecting" of a hypothesis is the formation a practical attitude, specifically, a *directive*, to further examine it.

This assessment has an immediate bearing upon the claim that abduction involves a distinct and irreducible kind of inferential correctness. Attempts to locate irreducibility

in either the discovery or preference phases of abduction raises problems. First, it is difficult to demarcate the reasoning involved in hypothesis-preference from the deductive and inductive strategies used to evaluate hypotheses (Thagard, 1981, p.258). Second, since the heuristic strategies involved in discovery are not rules of inference by Peirce's own account of inference, then there is doubt that Peirce developed a distinctive *logic* of discovery (Lauden, 1980, p.174; Foss, 1984, p.30; Brown, 1988, p.404). Third, if we now add that abduction does not sanction belief in an explanatory hypothesis, yet retain Peirce's conception that correct inference sanctions acceptance of a proposition, it follows that the explanatory hypothesis is not itself the abductive conclusion. We are then forced to reexamine the grounds for claiming that abductive validity is irreducible.

This later issue must be addressed with reference to Peirce's overall views on inference and validity. When this is done, there remains little to secure the irreducibility thesis; a close analysis of his writings reveals that while the initial conceiving of a novel hypothesis is not the product of an *inferential* transition, every inferential phase of the abductive process can be analyzed in terms of inductive or deductive methods (Pera, 1980, 1987; Zahar, 1983). If so then there are grounds for denying Peirce's claim that abductive correctness is distinct from deductive or inductive validity. This is not to say that abduction fails to be a distinctive *form* of reasoning; distinctive forms of reasoning abound within both deductive and inductive logic. Instead, it is abduction's *practical* character, specifically, its movement *from* a "best explanation" *to* a directive, that makes Peirce's account of scientific method both novel and instructive.

2. Inference and Validity

Peirce described an inference as "the conscious and controlled adoption of a belief as a consequence of other knowledge" (CP 2.442, 2.144, 5.109), which "consists in the thought that the inferred conclusion is true because *in any analogous case* an analogous conclusion *would be* true" (CP 5.130). Its aim is "to find out, from the consideration of matters and things already known, something else that we had not known before" (MS 628: 4), thus, to increase our grasp of truth. The occurrences of the phrases "as a consequence of" and "because" in these passages not only indicate a premise-conclusion relation, but carry a *causal* significance since inference "produces" or "creates" a belief in the mind of the reasoner (CP 2.148). A *belief*, in turn, is a "holding for true," or "any kind of holding for true or acceptance of a representation" (NEM 4: 39-40), and "to say we really believe in the truth of any proposition is no more than to say we have a

controlling disposition to behave as if it were true" (MS 652: 15).[3]

These characterizations pose a problem if abduction is practical reasoning that culminates in a directive. But Peirce adjusted his view of inference when he wrote that it culminates in *acceptance*, where acceptance is a "favorable attitude towards" a proposition, though not necessarily positive belief (MS 873: 23). Recourse to this broader notion is essential in preserving Peirce's normative conception of inference. In particular, while not productive of a full-fledged belief, abductive inference still results in a type of acceptance. It is another matter to determine what particular mode of acceptance is appropriate to abduction.

Three steps are essential to any inference: colligation, observation, and judgment (MS 595: 35). Inference begins with *colligation*, the conjoining of distinct propositions and asserting the whole (CP 2.442-3, 5.579). One then deliberately contemplates the colligated data (MS 595: 30, CP 7.555) which, in turn, yields an observation that some proposition C will hold if the single colligated premise *P* does. Next follows a *judgment* which embodies first, an acceptance that what is observed in the premise yields, by following a rule, the proposition *C* and, second, an acceptance of C itself (CP 7.459, 2.444, 1.606). Control is exercized over colligating, contemplating, and both phases of judgment, but not over the observing (CP 7.555).

Because it is controlled, an inference can be subjected to rules or norms indicating what one would be warranted in accepting. Since norms are appropriate only in relation to ends (CP 5.594), then by following the appropriate inference rules we might realize the end of reasoning, namely, acquisition of truth, a goal which we are justified in both presuming can be reached and, therefore, in pursuing (MSL 75: 271). An inference is *valid* if it is conducive to such acquisition, more precisely, if it follows a method (norm) which (i) it professes to follow, and (ii) has the truth-producing virtue it is supposed to have, i.e., *qua* being an inferential method of one of the three elementary kinds (CP 2.780).[4] In this way, Peirce effectively linked validdty to *truth-productivity*.

There are three ways in which inferential methods can be truth-producing: a method is deductively valid insofar as it invariably (necessary deduction), or very probably (probable deduction), yields truth from truth: inductively valid if by following it we approximate to the truth in the long run, and abductively valid insofar as it leads to truth if truth can be attained at all (CP 2.781, 5.161). Analogously, one might refer to the *assurance* that a given method is truth-producing, for Peirce also says that " the distinction that is undoubtedly of highest importance … is that which consists in the *nature of the assurance* being different" (MS L231: 56). The two dimensions of

assurance that he invoked were *security* and *uberty*. Security is a measure of the confidence that we are avoiding falsehood in the inferential transition, while uberty reflects the productiveness in knowledge gained, i.e., that we are increasing our grasp of truth. While we lose in security in moving from deduction to induction and, again, in going to abduction, we gain in uberty at each step (CP 8.384-8)[5]

Curiously, these distinctions do not by themselves establish the irreducibility of abductive validity. The matter cannot be settled by agreeing that there are inferences, inferential patterns, or methods of reasoning which are abductively valid. Perhaps *all* "logically good" inferences or inference methods are abductively valid, since abductive goodness, as described, is but the weakest assurance of having reached truth, viz., whatever is deductively or inductively valid leads to truth if truth can be attained at all. What must be shown is that there are some modes of valid inference that can be justified *only* abductively, for unless there are, Peirce's claim to have unearthed an irreducibly third mode of reasoning cannot be substantiated. In short, the claim for the irreducibility of abductive validity requires a supporting existence proof.

3. Abductive Form

Since the time of Aristotle, logicians have studied argument correctness by focusing upon valid *forms* of inference. Within both deductive and inductive logic a number of valid forms have been identified. But Peirce tended to speak of just one form of abductive inference, though he supplied alternative models of abductive form at different periods. In the later writings, the most characteristic form was presented in his 1903 lectures on Pragmatism:

(F1) (1) The surprising fact, *C*, is observed;
(2) If *H* were true, *C* would be a matter of course.
Hence,
(3) There is reason to suspect that *H* is true.[6]

At one level of abstraction, the premises accurately portray scientific procedure; research typically begins with a problem (puzzling or surprising phenomenon) and aims at a solution in terms of an explanatory hypothesis. Yet, from the standpoint of valid reasoning, (Fl) is clearly unsuitable. There are any number of "wild" hypotheses that would explain why I am now reading this paper, but that alone does not provide reason to think that any particular one is true (Achinstein, 1970, p.92). More is required to legitimately conclude, select, or make plausible a hypothesis than what (Fl) reveals and, if anything, the logic of abduction should bring this out.

Peirce realized that there are numerous hypotheses which would explain any given fact were they true (CP 5.591), he viewed it as a "serious problem" whether a given hypothesis should be entertained at all (CP 6.524). Using the label of "economy" (MS L75:284, CP 7.218-23), he claimed that the abductive inference to hypothesis H is justifiable only if *H* is *economical*, or, better, more economical than competing hypotheses. Peirce packed a great deal into his notion of *economy*, as I will explain shortly, but introducing it amounts to abandoning (F1) in favor of,

(F2) (1) Some surprising fact C is observed.

(2) If *H* were true then *C* would be a matter of course.

(3) *H* is more economical than the envisioned competitors.

Hence,

(4) There is reason to suspect that H is true.

Two things stand out about this form. First, it is more suitable for abductive-preference rather than abductive-discovery. Not only does the hypothesis itself fail to be the conclusion, it appears twice in the premises, once as an antecedent and once as a subject of predication. Given Peirce's causal account of inference, a conception of *H* could not originate as a *product* of an (F2)-inference nor could the reasoner's transition from its premises to its conclusion be the moment of creative insight (Frankfurt, 1958: 594).[7] Second, while (F2) more clearly qualifies as a type of inference to the best explanation (Achistein, 1980, p.126), the hypothesis is not itself the conclusion and accepting that "there is reason to suspect that *H* is true" it not yet a *belief* that *H*. At most, (F2) is inference to the most reasonable suspicion.

Is (F2) a valid form of inference as concerns the selection of hypotheses, that is, of abductive-preference? If so, then does the transition from the (F2) premises to its conclusion harbor a sort of validity that is irreducible to deductive or inductive validity, or is the irreducibility located in the manner in which the (F2) premises are generated? Let us take up these alternatives in turn, beginning with the latter.

4. The Generation of Abductive Premises

(F2) represents a later stage of abductive thinking; before selecting a hypothesis one must first come up with the surprising fact, formulate explanatory conditionals, and assess rival explanations. Noting that Peirce took *scientific* abduction to include *all* the operations whereby theories are engendered (CP 5.590), we will first inquire whether the uniqueness of abductive reasoning is to be located in its earlier stages, specifically, in the generation of the (F2) premises.

Abductive thinking begins by juxtaposing the unfamiliar with the familiar (MSL 75: 286-7, CP 7.188). The claim that a phenomenon is *surprising* is intelligible only against a body of background expectations, for an isolated fact, not contrary to what is expected, calls for no explanation at all (CP 7.192-201). The *judgment* that a phenomenon is surprising is subsequent to the observation that it is contrary or improbable given what is expected (MS L 75: 177, CP 2.776, 7.188-200), hence, in need of explanation. But this judgment itself results from an inference to a novel proposition, viz., it represents a "discovery" with which scientific knowledge begins (CP 7.188).

What *kind* of reasoning is involved? Colligation *qua* conjoining, is deductive. Observation of what is contrary or improbable given what is expected, comes by focusing upon the relations between premises and conclusion. To "see" that P is contrary to *Q* or improbable given Q, is to realize that Q either implies or makes likely ~P, in which case the observation underlying a judgment of contrariety is exactly the sort that typifies deduction. Hence, the inference that the phenomenon is surprising, in want of explanation, appears to be deductive.

It is upon judging that the surprising fact C would be explained by a novel hypothesis H that the more familiar phase of creative thinking emerges. A breach of expectation stimulates a demand for explanation (CP 7.191) which, if successful, results in acceptance of an explanatory conditional. However, it is doubtful that Peirce held the initial *conceiving* of H *qua* antecedent to arise as a result of inference. Instead, he wrote that the abductive suggestion comes to us "like a flash," of its being an act of "instinctive insight" tending to make us guess correctly nature's laws (CP 5.604, 5.181), of abduction itself as being "neither more nor less than guessing" (MS 692: 24), and of a guessing as being an instinctive power (CP 6.491, 7.48). At the same time, he emphasized that one guesses on the basis of other information (MS 692: 27-36, 595: 37); we separate "reasonable" guesses from poor ones (MS 873.11), and given that there are "trillions" of possible hypotheses to explain given facts, we need the operation of rational constraints warding us away from idle and fruitless guesses (CP 5.172, 5.591, 7.38). Because hypotheses are not generated fortuitously, guessing is an inferential process that is under our control and, as such, is not a purely instinctive affair (MS 475:20, CP 7.48, 6.476).[8]

This tension between instinct and control was addressed again in Peirce's 1903 Pragmatism lectures where he distinguished between emergence of the novel hypothesis and inferential acceptance of its explanatory role. He claimed that the initial awareness of the hypothesis comes with the observation of the colligated whole by

means of an "uncontrolled insight" into the world of ideas, i.e., into what he called "Third-ness" as given in perception (CP 5.150-212, 7.198). The novel conceiving of any instance of premise (2) of (F2), for example, is *caused* by prior cognitions, its content is "suggested" by the facts, but not everything suggested is *inferred* from cognition of the facts:

> "There are, as I am prepared to maintain, operations of the mind which are logically exactly analogous to inferences excepting only that they are unconscious and therefore uncontrollable and therefore not subject to criticism". (CP 5.108)

However, while such operations are "associational suggestions of belief," not "inferences" (CP 5.441, MS 1134), they can still be rule-governed methods of originating hypotheses. Though Peirce offered little by way of a *logica docens* in this regard, he was very much concerned with heuristics of discovery (CP 2.105-7, NEM 4: 196), as evidenced by his account of theorematic reasoning, his insistence on the "diagrammatic" character of mathematical thinking (NEM 4:46-9), and his emphasis upon analogical thinking in the expansion of knowledge:

> Nothing unknown can ever become known except through its analogy with other things known. Therefore, do not attempt to explain phenomena isolated and disconnected with common experience (MSL 75: 286).

An explanatory conditional, for example, might be generated by applications of the following Newtonian rule; a surprising fact *C* is like another fact *C'* which is explained by hypothesis *H'*; thus, an *H'*-like hypothesis *H* might explain C. As with other sorts of heuristic strategies, use of this rule can stimulate novel conceptions that, in turn, spawn new inferences and the development of theories.[9]

According to this view, heuristic strategies are not rules of *inference* appropriate to controlled reasoning after novel conceptions have occurred, for inference requires seeing that the conclusion is justified (MS 293: 7-8). While they *are* rules governing transitions from one conception to another, they are typically stated in terms of what to "look for," how to "express" something (Langley et al., 1987, p.53), what to "combine" or "find" (Thagard, 1988, p.202), not what to "infer." They are aids in locating novel ideas, strategies for discovery, hence, *practical* directives, but not formulae specifying what we are entitled to accept. Nor do they correspond to principles for conferring epistemic warrant, in which case their epistemological significance is of a different order from that characterizing valid inference forms. In strict Peircean terms, the emergence of hypotheses is not a matter of *inference* and, therefore, not a matter of a

unique form of inference.[10]

As indicated above, an inference occurs only when the reasoner exercises self-control in judging that the conclusion is acceptable on the basis of the information one began with. In itself, such self-control is purely "inhibitory" and "originates nothing" (CP 5.194), that is, the creative moment lies with the instinctive observation that given what one already knows, *H* will explain C. The correlated guess, the "deliberate acceptance" (MS 451: 18), is the reasoned adoption of the explanatory conditional, hence, it is a result of inference.

The "guess" or "acceptance" of the conditional can be justified deductively; the very phrase "as a matter of course" in premise (2) indicates a degree of intuitiveness, a point underscored by the fact that explanatory conditionals convey a connection of necessity or high probability (CP 8.231 and 7.36). This claim is strengthened by Peirce's contention that once a hypothesis has been identified, it is a matter of deduction to establish further conditionals in which the hypothesis is the antecedent and predictions are the consequents (CP 7.115n and MS 473:9-10). Ideally, among these predictions will be those whose very "incredibility" makes their consequents similar to the surprising fact *C*, in which case the inferential acceptance of the explanatory conditional results by a deductive transition from the background assumptions.

Concerning the third premise of (F2), finally, several considerations must be taken into account before a hypothesis may be "chosen" for further examination (CP 7.219). Obviously, it must be explanatory if true and testable (CP 7.220), but under the heading of 'economy' Peirce also included (a) the cost (in time, money, and effort) of testing the hypothesis (CP 6.533, 7.230); (b) the instrinsic value of the hypothesis in terms of its "naturalness and "likelihood" (CP 7.223); (c) the fact that the hypothesis can be readily broken down into its elements and studied(MS 692:33); (d) the hypothesis' simplicity (i.e., that it is more readily apprehended, more facile, more natural or instinctive) (MS L75:286, CP 6.532, 6.477): (e) the breadth of the hypothesis or the scope of its predictions (MSL 75: 241; 457: 37); (f) the ease with which the hypothesis can be falsified (MSL75.-285); (g) the testability of the hypothesis by means of severe tests based on "incredible" predictions; and (h) the hypothesis' analogy with familiar knowledge (MS 873: 16).

The evaluations that emerge in generating the third premise are *comparative*,often phrased in terms of *preference*, in which case a judgment of economy is itself comparative, as already suggested (CP 7.220-231, 2.786, NEM 4: 37-8, MSL 75: 285-6, and MS 475: 37). The underlying inferences are best scrutinized by means of the

standard logic of preference in which deductive considerations abound, especially in eliminating hypotheses by means of disjunctive syllogisms (CP 7.37). But the reasoning to the premises of any such deduction are likely to be inductive, in the mode of qualitative inductions (CP 2.759, 7.209-217). How do we know, for instance, if H is more cheaply testable than *H*"? We consider the kind of hypothesis that *H* is, and based on our familiarity with past testing procedures, we reason inductively that *H* is the kind of hypothesis that could be examined more cheaply, more quickly, etc. Similar inductive considerations would permeate decisions based upon the other criteria as well.

Having argued that the reasoning used in *generating* the premises of (F2) is either deductive or inductive, there are grounds for concluding that the alleged irreducibility of abductive validity cannot be anchored in the process of abductive-discovery. Accordingly, the attempt to locate the uniqueness and irreducibility of abductive reasoning must return to the transition from the premises of (F2) to its conclusion, that is, to abductive-preference.

5. Plausibility and Abductive Preference

A more rigorous scrutiny of (F2) is needed to ascertain whether a unique kind of validity is manifested in the abductive selection of an explanatory hypothesis. What does it mean to say that "there is reason to suspect" that a hypothesis is true as the (F2)-conclusion would have it? Presumably this phase cannot be interpreted to mean that the hypothesis is highly probable, otherwise we erase the distinction between abduction and induction. If we take it as indicating "some" probability upon the conclusion given the information in the premises then we risk falling short of securing a preferential status to H over its close competitors as it is likely that some probability accrues to them as well. The same is true if "there is reason to suspect" means "there are reasons for thinking." In short, (F2) would then fail to represent the inferential mechanism for "selecting" H over its rivals.

In any case, Peirce stressed that probability is not the quality which abduction aims at securing:

> By its very definition abduction leads to a hypothesis which is entirely foreign to the data. To assert the truth of its conclusion ever so dubiously would be too much. (MS 692: 26, and see CP 2.102)

If this is so, Peirce apparently rejected the view that either the (F2)-conclusion or the explanatory hypothesis itself terminates an abductive inference. But what other candidates for conclusion-types are there? In his later writings Peirce came to favor the

view that abductive-preference allows, at best, an inference to the *plausibility* of the hypothesis, where plausibility was explained as follows:

> By Plausible, I mean that a theory that has not yet been subjected to any test, although more or less surprising phenomena have occurred which it would explain if it were true, is in itself of such a character as to recommend it for further examination or, if it be *highly* plausible, justify us in seriously inclining toward belief in it, as long as the phenomena be inexplicable otherwise. (CP 2.662)

Thus, a hypothesis is plausible if it is both explanatory *and* to be recommended for further examination (hence, testable, though untested), allowing that plausibility comes in degrees (see also CP 8.223, 6.469, 6.480-8). Does this conception help in the search for a third type of validity?

If it is plausibility, not truth, that we mean to establish in hypothesis-preference, then the abductive conclusion should be "H is plausible" rather than what (F2) specifies (MS 652: 16, Thagard, 1981). This might do so long as the comparative nature of judgments of economy is reflected, i.e., the warranted judgment is that H has a higher degree of plausibility than its rivals, hence, more to recommend it, because it is more economical. Making this explicit yields the following form:

(F3) (1) Some surprising fact C is observed.
(2) If H were true then C would be a matter of course.
(3) H is more economical than its envisioned competitors.
Hence,
(4) H is more plausible than its envisioned competitors.[11]

Given what Peirce understood plausibility to be, and noting that the explanatory character of the hypothesis is shown in premise (2), then the conclusion of (F3) is more faithful to his view that the purpose of abduction is "to recommend a course of action" (MS 637: 5).

But it is striking that (F3) appears to be a *deductively* valid form; how could H fail to be more plausible if it is explanatory, testable, and more economical than its competitors (Achinstein, 1970, p.101)? One of Peirce's strategies for determining the presence of deductive validity is to ask whether the relevant leading principle is necessarily true. In the case of (F3), the relevant leading principle is,

(L1) If H is the most economical explanation of a surprising phenomenon C, then H is more plausible than any of its competitors.

Given Peirce's definitions, this conditional appears to be a necessary truth. That is, if H

is the most economical explanation then it is obviously explanatory, testable, and therefore–assuming considerations of economy to be the proper basis for selecting one hypothesis over others–to be recommended for further examination, at least for those who desire an explanation of C. Even when *H* has comparatively little to recommend it, if there are no better competitors we are nonetheless justified in putting it to test. In short, the judgment seems irresistible that insofar as (F3) is a valid pattern at all, it is *deductively* valid.

Iif (F3) is the canonical form of hypothesis selection we fall short of inferring the "best explanation" and risk sacrificing the irreducibility thesis. Something must give. Perhaps it is really an inference to *H* that Peirce had in mind in insisting that abductive validity is unique, so that (F3) is not quite what he envisioned as the proper form of abductive-preference after all. Perhaps what we need to acknowledge is that inference to the best explanation is not necessarily a matter of belief revision, that is, of sanctioning (and causing) a belief in the hypothesis. This possibility must now be explored.

6. Abductively Infering the Hypothesis

Peirce frequently spoke of a hypothesis *itself* being "adopted" as a result of an abduction, albeit "problematically" (CP 2.777) or "on probation" (MS 873: 22). Here he appears to be introducing a special mode of "adoption" or "acceptance"(MS 638: 5), a probationary mode that, while falling short of belief in the hypothesis (CP 5.60, 5.589), is still a favorable attitude towards it (MS 873: 23). It is the third and least assured of attitudes sanctioned by the basic types of reasoning; full belief or positive assertion is warranted in deduction (MS 473: 17-18), provisional acceptance in induction (CP 2.731; 5.591), and probational adoption in abduction. If so, then parallel to the warrant for probationally accepting a conclusion, there must be a third type of inferential linkage that anchors the irreducibility of abductive correctness. The correct pattern of abductive-preference might well be the following extension of (F3):

(F4) (1) Some surprising fact *C* is observed.
(2) If *H* were true then *C* would be a matter of course.
(3) *H* is more economical than the envisioned competitors.
Hence,
(4) *H* is more plausible than its envisioned competitors.
Hence, probationally,
(5) *H*.

Here we preserve the view that abduction is a type of inference to the best explanatory

hypothesis. The novelty is that the qualifier "probationally" indicates that justification belongs not to the sort of acceptance warranted by valid deductive or inductive reasoning, but to probational adoption only, where the latter is the acceptance that culminates the entire abductive process. That (F4) is not a valid deductive or inductive schema is also suggested by the fact that instances of the leading principle warranting the move from (4) to (5), namely,

(L2) If H is more plausible than its envisioned competitors then H.

not only lack necessity but are typically false. The same is true of any conditional linking the premises of (F4) to the probability of H, for there is no assurance of approximating truth in the long run by its means. On the surface, then, it would appear that *insofar* as (F4) is a "valid" at all, its validity is of some third sort, the elusive "abductive" validity for which we have been searching.

Have we, then, the desired existence proof that would secure the irreducibility of abductive validity? No, not until we clarify the inferential linkage that underlies the transition from (4) to (5) and is conveyed by "hence, probationally." All we have to go on here is what Peirce says about probationally accepting a conclusion. So, just what sort of "acceptance" is probational adoption? While Peirce was reluctant to say that abduction results in *belief*, he wrote that probational adoption involves some sort of favor extended to the hypothesis. Perhaps the attitude of probational acceptance stands to plausibility as belief does to truth, i.e., it is to hold H to have, not truth, but a comparatively high degree of plausibility (CP 2.776). This is one way to interpret Peirce's claim that a hypothesis "… is accepted only problematically, that is to say, as meriting an inductive examination" (CP 2.786), or, again, the following passage:

> It is one act of inference to adopt a hypothesis on probation. Such an act may be called an *abduction*. It is an act of the same kind, when a hypothesis is merely suggested as possibly worth consideration. For even then some degree of favor is extended to it. But when, in consequence of having found that a good many predictions based on the hypothesis have been verified, a man begins to have a positive belief in it, that is an act of inference of a totally different kind: it is an induction, or reasoning from a sample (MS 873: 23).

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Given that plausbility is a normative concept, then probationally accepting a hypothesis as plausible is not to believe *it*, rather, to acknowledge that it ought to be pursued. However, if this were so, then the transition from (4) to (5) in (F4) would be redundant inasmuch as (5) merely duplicates what one is already warranted in moving to step (4),

that is, to probationally accept H is no different from believing that H ought to be examined further. Step (5) in (F4) would then be idle, and any rationale for positing a third inferential link would be eliminated. Moreover, we would not have advanced beyond (F3) and a straight-forward deductive construal of abduction.

Keeping probational adoption of *H* distinct from the beliefs that *H* that *H* is plausible, or that *H* ought to be pursued, leaves the possibility that it is a practical attitude of intending, resolve (CP 5.538), or resolution (CP 1.592) to submit *H* to further test. This would amount to a more literal reading of his previously-noted claim that the purpose of an abduction is to "recommend a course of action," that is, endorsing a recommendation to examine *H* is, just that, a "recommending," yielding a clear sense in which the abductively extended "favor" is distinct from belief. While recommending or resolving to examine *H* is to endorse a line of conduct (CP 5.538), it is also a favorable attitude towards *H* itself. It is not the "controlled and contented" disposition to act that belief in *H* would be (NEM 4.249), but a readiness to submit *H* to testing, an attitude not accorded other rejected hypotheses.

There is still a difficulty; if abductive-preference is a special type of practical reasoning, which culminates not in an acceptance of *H* per se, but in an endorsement of a course of action, then there is no distinction between *probationally adopting H and recommending further examination of H*. Whatever warrant is conferred by the premises of (F4), accordingly, reduces to the warrant for a directive, and, in strict terms, the proper conclusion is not *H*, but a claim recommending *H* for further examination, that is, an indication of a course of action to be taken. If so, abduction confers no epistemic warrant upon the assertibility of *H* itself, and (F4) turns out to be a misleading representation of the pre-testing selection of hypotheses.

This assessment of (F4) is based on the inability to find a straightforward doxastic interpretation of probational adoption within Peirce's writings, an interpretation that would sanction assertion of the hypothesis on the (F4) format. It can be supported, however, by appeal to his pragmatic criteria for identifying conceptions, for these dampen even further prospects of demarcating acceptance on probation from practical resolve. Belief in a proposition *P* establishes behavioral habits and anchors expectations about one's responses to P's presumed consequences in a way that a mere decision to test *P* does not. An investigator might have good grounds for thinking a hypothesis *H* is worth testing, yet have very good inductive grounds for being skeptical of *H's* success, hence, be justified in granting it very little favor, even to the point of believing its negation instead. Abductive-preference favors bold, though unlikely, conjectures, and

inductive warrant is no measure of the plausibility it confers.

Admittedly, because Peirce's texts are not decisive, the suggestion that abductive-preference sanctions only a course of action is itself a hypothesis as to what he might have meant. The proper conclusion might be that he lacked a clear and consistent picture of what is to be inferred in an abduction, or, for that matter, a clear distinction between belief and other practical attitudes. But let us proceed and see how a construal of abduction as practical reasoning can be carried out.

7. Abductive-preference as Practical Inference

If (F4) fails, yet (F3) offers little hope for the thesis of autonomy, what other form of abductive-preference can we look to? Perhaps Peirce's insistence that abduction aims at recommending a course of action deserves a closer look. For instance, how is a recommendation sanctioned once we have established that *H* is more plausible than its competitors? From his definition of plausibility, we would immediately have,

(a) There is reason to suppose that *H* is worth examining further.

This falls short of an explicit directive; if a plausible theory has a character to "recommend it for further examination," what is needed is something stronger than a claim that there is "some" reason, or "*prima facie*" grounds for so doing (Curd, 1980, p.214, and Achistein, 1987, p.433). To capture the sense in which the hypothesis "merits" inductive examination (CP 2.786, 8.223), a normative is more forceful:

(b) One ought, insofar as one desires an explanation of C, to examine *H* further.

or, alternatively,

(c) It is permitted, insofar as one desires an explanation of C, to examine *H* further.

Given the end of gaining truth, either of these is a proper manner of asserting justification for hypothesis pursuit, since "ought" has no meaning except relative to an end (CP 5.594).

Although normatives like (b) or (c) can be used to *support* a practical directive, e.g., a recommendation, neither is *identical* to a directive or a recommendation. To make explicit the sense in which an abduction "recommends," something like the following must be sanctioned:

(d) *H* is recommended for further examination.

or, more carefully,

(e) It is recommended, for one who desires an explanation of C, to further examine *H*.

If the abductive reasoner himself desires the explanation for C then the conclusion could take the form of an intention:

(f) I intend to examine *H* further.

Or, for a clearer first-person expression of a commitment or *resolve* to act that an intention is, the conclusion might take this format:

(g) I, to examine *H* further.[13]

Recommendations and intentions are not truth-valued declaratives (Castaneda, 1975; Belnap, 1990); in particular, (e) must not be confused with a declarative report to the effect that someone or other has recommended that *H* be further examined, and (f) is not a prediction. Again, a recommendation can be phrased interrogatively, and since Peirce often claimed that the hypothesis should be asserted only as an "interrogation," implying by this that the hypothesis merits testing (MS 692: 26), the abductive conclusion might be,

(h) Why not pursue *H*?

addressed to oneself or others. Or, phrasing the hypothesis itself interrogatively (say, through the appropriate "wh-movements" of the grammarians), practical import can also be conveyed by,

(i) *H*?

together with appropriate stress. *Each of (d)-(i) are suitable Peircean forms of practical directives*, though, adhering to the letter of what was said about the aim of scientific abduction, the schematic (e) will be treated as canonical.

A strict reading of Peirce suggests that abductive-preference requires an explicitly "practical" inferential pattern formed by adding to (F3) a second practically-oriented conclusion. What we come up with is an argument form that qualifies not as inference *to* a best explanation, but rather, as inference *from* the fact that a certain hypothesis is the best explanation to a directive:

(F5) (1) Some surprising fact *C* is observed.
(2) If *H* were true then C would be a matter of course.
(3) *H* is more economical than its envisioned competitors.
Hence, (4) *H* is more plausible than its envisioned competitors.

Hence,

(5) It is recommended, for one who desires an explanation of C, to further examine *H*.

To capture the normative aspect of plausibility, the actual chain of reasoning might also include either (b) or (c) between steps (4) and (5). Perhaps Peirce had something close to (F5) in mind when he wrote that abduction "commits us to nothing. It merely causes a hypothesis to be set down upon our docket of cases to be tried" (CP 5.602). The phrases "to be set down" and "to be tried" more closely reflect a decision concerning future action, thus, a *resolve* about how to act, and it is this attitude of resolve that is expressed by the conclusion (5) in (F5). To this extent, abductive-preference is a species of practical reasoning.[14]

8. On the Validity of (F5)

Before investigating how (F5) is valid, if at all, we must reconsider the Peirce's notion of validity. Because he defined validity in terms of *truth-productivity*, there is no obvious format for validating inferences to apparently non-truth-valued items such as recommendations, imperatives, interrogatives, and the like. One might attempt to analyze (F5)-validity by appeal to the truth-values of the performance propositions correlated to the inferred recommendations or intentions, noting that Peirce held that propositions can be questioned, commanded or recommended (NEM 4: 248). Yet, this approach affords little hope; the conclusions of *valid* ampliative inferences can be false when their premises are true, and in particular, a recommendation can be *appropriate* given the information supplied by the premises even though its corresponding performance proposition is not only false but incapable of being inductively justified.

How else might (F5) be brought within the realm of valid inferences? No doubt a generalization upon the notion of truth-productivity is required, and there are at least two ways to achieve it, neither of which require the (F5)-conclusion to be truth-valued or dependent upon the truth of a correlated proposition. The first generalizes the idea of *productivity* by relying on a strict reading of Peirce's "justification" for abductive inference. Thus, we cannot hope to attain rational explanations, reach truth, or know anything of positive fact without abduction, that is, unless we both generate hypotheses and select certain of them for further testing (CP 2.777-786, 5.603, 5.17, 7.219). The reason (F5)-inferences are valid is not that their conclusions are true if their premises are–the truth "produced" is never that of the conclusion's–but because accepting their conclusions is the only way we can uncover the truth of any of the preferred hypotheses which happen to be true.

There are two drawbacks of this approach, however. In the first place, it leaves

unanswered the question about what the semantic value of the (F5)-conclusion itself is. While directives are not truth-valued, presumably those that can be "validly" derived from true premises of the (F5) sort differ in semantic status from the undesirable recommendations of *un*explanatory or *least* economical hypotheses. Secondly, it sacrifices a uniform account of abductive validity. Abductive thinking extends beyond the search for plausible explanatory theories, indeed, every decision represents a hypothesis about what is best to do in the circumstances. Insofar as such thinking is justifiable, abductive inferences to directives having nothing to do with the search for truth must be allowed, and there seems no way to construe their validity in terms of truth production.

The second interpretation restricts relevant production to the (F5)-conclusion while preserving a uniform perspective on abductive correctness. It does so by generalizing the idea of validity yet retaining Peirce's formula that an inference is valid "if it possesses the sort of strength that it professes and tends toward the establishment of the conclusion in the way in which it pretends to do this" (CP 5.192). Thus, a method can also be valid if it has the virtue of *establishing* conceptions having a (semantic) value other than truth. Let us say that a question, recommendation, or intention is *legitimate* or *appropriate* given the information in the premises, and just as "*P*" follows necessarily from "*P* is true," so a recommendation "*R*" follows necessarily from the claim that "*R* is appropriate." A condition fixing appropriateness is as follows:

(AR) A recommendation to further examine *H* is *appropriate* for one who desires an explanation of *C* iff one is permitted (or, one ought), so far as an explanation for *C* is desired, to examine *H* further.

That is, truth of a qualified normative necessarily determines the appropriateness of a corresponding directive and, consequently, supports the directive itself. Considerations about which recommendation is appropriate *all things being considered* might yield a different judgment if overriding normatives sanction a different recommendation; examining H might be appropriate given certain ends but not other, even higher, ends.[15] Also, the workability of (AR) requires that there be some means of determining when a normative is true and when one is overriding, illustrating that a scrutiny of scientific methods cannot be separated from normative and practical concerns. Peirce's teleological basis for normative truth yields a rough, though flexible, formula for fixing both normative truth and overridingness, and it preserves the realist assumption that whether *H* ought to be examined further is an objective matter insofar as *H* advances the pursuit of truth. Retained is the distinction among the three sorts of validity;

deductive validity guarantees passage from truth to a "preferred" semantic value, whether truth or appropriateness, inductive validity yields the preferred value in the long run, while abductive validity secures the preferred value if anything does.

I am claiming that a uniform treatment of abductive reasoning requires the broadened conception of validity characterized in this second interpretation. But it carries a big price from the point of view of Peircean scholarship. The very problem that plagued (F3) resurfaces: why isn't (F5) *deductively* valid? If *H* is the most plausible hypothesis, there can be no doubt but that one who desires an explanation of *C* is permitted, *qua* investigator, to examine it further, for the move from step (4) to (5) in (F5) seems an iron-clad guarantee of securing the preferred semantic value of appropriateness. This follows directly from (AR) and the normative component in Peirce's construal of plausibility. Through their combined effect, (4) necessitates the claim that the recommendation to further examine *H* is appropriate, and from this, in turn, the recommendation itself necessarily follows. By transitivity of the deductive linkage, therefore, the inference from (4) to (5) is deductively valid since the relevant leading principle, namely,

(L3) If a hypothesis *H* is more plausible explanation of C than its envisioned competitors then it is recommended for one who desires an explanation of C to further examine *H*.

is a necessary truth. But given that (5) just is the ultimate conclusion of (F5), then (F5) is a deductively valid form. Accordingly, if (F5) is the canonical form of abductive-preference, then all hope of securing the irreducibility of abductive validity collapses.

9. Conclusion

I have argued that Peirce's later writings develop the view that abduction is a form of practical inference culminating in a *directive*, that is, in either a recommendation or an intention to further examine a given hypothesis. If this interpretation is accurate, then abduction is neither "inference to the best explanation" nor a process of "belief revision." Moreover, good abductive arguments do not harbor an irreducibly third type of inferential correctness distinct from deductive validity and inductive strength. These results by no means deny the significance of Peirce's discussion nor undermine the unique role of abductive reasoning in scientific inquiry. The proper assessment is that the value of Peirce's account does not derive from the irreducibility claim, but rather, from its emphasis upon the overtly practical phases of scientific reasoning.

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Footnotes

1. See CP 5.146 where the claim of irreducibility is made. Peirce denied that there was any need to recognize a fourth category of reasoning. In 1911 he wrote,
"I have constantly been on the alert for a fourth kind of reasoning, and have yet never found the least vestige of any… I think myself entitled to presume, for the present, that there is no such fourth form" (MS 856:6-9).
He stressed that argument by analogy is a mixture of the three elementary kinds (CF2.733, 7.98) while other familiar types of argumentation, e.g., statistical deduction or qualitative

induction, are species of deduction and induction respectively. ↵

2. Focus will be upon Peirce's post-1900 writings on abduction, for in 1898 he acknowledged that he had previously confused abduction (also called 'hypothesis," "retroduction" and "presumption" with a species of probable inference (NEM 4:183 and see CP 2.102), and in 1910 wrote, "... the division of the elementary kinds of reasoning into three heads was made by me in my first lectures and was published in 1869 in Harris's Journal of Speculative Philosophy. I still consider that it had a sound basis. Only in almost everything I printed before the beginning of the this century I more or less mixed up Hypothesis and Induction."(CP 8.227) ↵

3. See also, CP 7.536, 2.444, 2.773, 4.53-5, 7.459, and MS L231:56). Every inference involves an acceptance of a conclusion that is both rule-governed despite being caused by an acceptance of the premises together with the reasoner's application of a general method or inference pattern. The rule, in turn, is correlated to a leading principle of the inference (CP 2.588-9) forming part of an agent's logica utens (CP 2.186, 5.108, 5.130). For Peirce, a belief is a habit according to which one would act certain ways in given circumstances, specifically, according to the expected logical consequences of the proposition believed. Moreover, a belief is described as a habit one is aware of, satisfied with, does not struggle against, and which can be acquired merely by imagining situations and the behavior they call for (MS 873:24-26). See CP 5.538-45 where the connection to expectations is emphasized, and CP 1.645-6 where the relation to action is explicit. Peirce also distinguished practical from theoretical belief, then classified the latter as a species of the former (CP 5.538-9). ↵

4. See also CP 2.153, 5.191, 7.444, MS 692: 5, MS 628: 4. In places, Peirce distinguished validity from strength (CP 5.192, 2.780) allowing that one argument can be stronger than another though both are valid, e.g., an induction based on more instances, a deduction with a more probable conclusion, or an abduction whose hypothesis has fewer competitors. In CP 5.192, he defined validity in terms of strength, writing that an argument is valid "if it possesses the sort of strength it professes and tends toward the establishment of the conclusion in the way in which it pretends to do this." However, he did not define strength, and in subsequent discussions the indicated measure of abductive strength is built into the proper form of abductively selecting hypotheses. ↵

5. Peirce also argued that the three types of reasoning are differently justified, where justification has to do with the process of inferring and not with the connection between premises and conclusion. He maintained that "we are always justified in presuming, for the purposes of conduct, that our sole end may be reached" (MS L75:271 and compare MS 634:9-10). Justification for inferring by way of a valid deductive method is due to the fact

that one is never led away from truth, and use of a valid inductive method is justified because its conclusion "is reached by a method which, steadily persisted in, must lead to true knowledge in the long run of cases of its application" (CP7.207, 2.725-40). Peirce offered at least three distinct yet related justifications of abduction: (a) The human mind, having evolved under the influence of natural laws, has a "natural tendency" (instinct) to think as nature is (MS 876:5). Man's mind is attuned to the truth of things in order to discover what he has discovered (CP 6.476). (b) By sampling many abductions, we see that the results of reasoning abductively are beneficial (MS 637: 6-9, CP 2.270; 2.786), for humans would not have survived without having knowledge and this requires abductive thinking (CP 5.603, NEM 4:320). (c) Abduction is the only hope of attaining a rational explanation (CP 2.777, 5.145), of regulating future conduct rationally (CP2.270), of attaining our purposes of reaching truth (CP 2.786) or of comprehending the universe (MS L75: 272). In other words, unless we reason abductively we cannot know anything of positive fact (MS 475:43,CP 5.603, 5.171, 7.219). At one point Peirce argued that all justification rests on deduction, insofar as abductive procedures can be justified inductively (CP 2.786) and inductive procedures rest upon deduction (CP5.170). Here, it is the practice of abductive reasoning that depends on inductive and deductive justifications, not abductive validity. ↵

6. See CP 5.189-191. Conclusion indicators like "hence," "therefore," etc. must be understood as having both a causal and normative force in depicting inferences, indicating not only a transition from some acceptings (beliefs) to another, but that the speaker finds the inference permissible. In displaying inference forms, however, they serve only the latter function. See Harman 1986, 1-10, for more on the distinction between reasoning and argument. Pattern (Fl) is the focus of concern in Hanson 1958, 85-90, and has tended to dominate the discussion of Peircean abduction ever since. It is significant that by 1911, Peirce wrote; "I do not, at present, feel quite convinced that any logical form can be assigned that will cover all "Retroductions." For what I mean by a Retroduction is simply a conjecture which arises in the mind." (MS L231: 55) ↵

7. This is especially apparent given that a reasoner could not legitimately accept the premise (3) it without a considerable familiarity with the hypothesis. In other words, (F2) cannot be viewed as an originative mode of inference. In considering a form similar to (F2), Peter Achinstein asks us to consider a thought that one might have to the effect that a hypothesis H is plausible because H provides an explanation given evidence and background information. It is possible, he writes, that I have this thought without having been previously acquainted with H, hence, that I first became acquainted with it in the course of making an inference to its plausibility (Achinstein, 1970, p.98, and see Blachowicz, 1989,

pp.450-451 who concurs with Achinstein). The latter clause is correct, but the former violates Peirce's vision that we are reasoning to the plausibility of H from information about H, namely, that H not only explains what we want explained, but is a more economical explanation than its competitors. Hence, while it may be true to say that we first come to be acquainted withH "in the course of making an inference" toH's plausibility, it does not follow that the first acquaintance with H results from an inferential transition. Instead, the inference presupposes our acceptance of various attributions to H. Addressing this issue, Douglas Anderson cautions against confusing "logical" with "temporal" priority: while the conditional premise containing H is logically prior to the conclusion, this does not mean that it is arrived at temporally prior to the conclusion, for the premise and conclusion may be "simultaneously arrived at." Thus, Peirce's canonical form in which the hypothesis already appears in the premises of abductive inferences does not preclude the latter from being "insightful and originative" (Anderson, 1986: 157). Anderson adds that "Peirce does not hold the ideas of insight and inference to be mutually exclusive with respect to abduction," citing the fact that Peirce described abduction as both instinctual and inferential within the span of a single lecture (p. 155). The hypothesis is not arrived at independently of its explanatory role, but as I argue in Kapitan 1990, Anderson overlooks Peirce's view that inference generates acceptance of the conclusion only if there is a causal andtemporal relation in the movement from premise to conclusion.

"An inference is a passage from one belief to another: but not every such passage is an inference... In inference one belief not only follows after another, but follows *from* it." (CP4.53, Peirce's emphasis)

The plausibility of claiming "simultaneous" awareness of premises and conclusion fades even more dramatically when it is understood that a judgment of comparative economy must itself be based upon a fairly extensive acquaintance with the hypothesis' merits (CP7.218-232). Hence, if H occurs as an antecedent of a premise of an (F2)-inference, then that inference cannot be the causal process that generated the first thought of H. The more reasonable conjecture, therefore, is that (F2) is the canonical form for abductive-preference alone, and sheds no light on the thought-processes involved in discovery. ↵

8. In discussing his paradigm example of abduction, Kepler's discovery of elliptical orbits, Peirce suggested that accepting the conditional premise that contains the novel hypothesis is itself the product of inference(CP 2.96,1.72-4). ↵

9. Not every case of belief causing belief is inference, even if it occurs by following a rule (CP .53, MS 293:7-8), e.g., the inference-like "associational suggestions of belief." See also CP 7.202, 2.776, and 5.171. In discussing the Associational psychologists Peirce wrote:

"The action by which, an association having once been established, that act by which in

accordance with it, one idea calls up another they called suggestion. I shall use this terminology ... (MS 318: 38)."

Suggestion is treated as a genus of which inference is only a species (CP 7.443, 1.606), and it must be noted that he defined "abduction" as the first adoption of a novel hypothesis (CP 7.202, 6.525), not as the first conceiving of it. While every inference is tacitly rule-governed, the agent's initial "irresistible" acceptance of it may be tempered by subsequent evaluation of it by the norms of reasoning one accepts (CP1.606) Thus, we can distinguish among (i) initially conceiving that one might reason in a certain manner (the creative observation), (ii) actually inferring in that manner (guessing), and (iii) evaluating the reconstructed inference (cf., Achinstein, 1980, p.121 and Curd, 1980, p.203). I have also discussed these issues in Kapitan 1990. ↵

10. Langley et al 1987, 14, classifies the heuristic procedures of hypothesis generation as "inductive" since thev search for general theories from finite data, though it points out that Newton's derivation of the inverse square law of universal gravitation was a deductive process that utilized an algebraic heuristic (pp. 54-7). Zahar 1983 champions the deductivist approach to hypothesis discovery, viewing the theoretical innovations of Maxwell, Einstein, and Newton as embodying deductive processes. Pera (1980, 1987), on the other hand. finds the invention of hypotheses to be inductive, though, equating inductive with ampliative, he does not view discovery in terms of establishing an explanatory conditional. Inductive systems of discovery are also discussed in Zytkow and Simon (1988). Achinstein (1980) distinguishes between rules codifying heuristic strategies and inference rules in terms of generating and justifying rules (p. 121). ↵

11. See Achinstein 1970, p.93-4 and Curd 1980, p.214 for analogous forms. The notion of plausibility has been variously interpreted. According to Thagard 1981, p.249, Thomas Goudge felt the conclusion of an abduction to be a statement of the form "it is plausible to entertain H" with plausibility being a mode of acceptance (CP 8.222). Thagard, however, finds plausibility to be a property of propositions, a reading more solidly grounded in the texts CP 8.223, 2.662, 6.469-476 and MS 652:16. ↵

12. See Frankfurt 1958, p. 595 who similarly talks of "adopting" hypotheses inasmuch as they are taken to deserve further consideration. ↵

13. See Castaneda 1975, which gives a detailed justification for the introduction of practical thought contents ("practitions") to account for what is inferred in instances of practical reasoning. Practitions include first-person intentions–each taking the form "I, to (do) A," where A is an action-type–as well as second-person prescriptions and recommendations. ↵

14. This reading is closer to the interpretation offered in Hanson 1965, p. 64, and Curd 1980, p. 214, which take the abductive conclusion to be something like (a). It is also analogous to

the independent account of retroduction developed in Achinstein 1987, which, nonetheless, shares the common understanding of Peirce's view. Achinstein claims that a "more guarded" claim, viz., that a theory T is worth considering further, is the sort of conclusion sanctioned by the mere explanatory success of 7" (pp. 423-425), and cites James Clerk Maxwell as a precursor of this view (p. 412). With the conclusion of (F5), we move a step beyond the evaluative mode represented by (a) to the more practical inference patterns culminating in directives, familiar in studies of practical reasoning (see Castaneda 1975 and the papers in Raz 1978). ↵

15. A thorough discussion of the deductive character of practical reasoning and of the rationale and grounds for assigning semantic values to imperatives, intentions and the like, is offered in Castaneda 1975. His method of assigning semantic values to practical directives is more complicated than what (L2) conveys, though it can be suitably adapted to the reasoning involved in abductive-preference. I have expressed misgivings about his explication of overridingness however (Kapitan 1984). ↵