

Theory-ladenness of Perception Arguments¹

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The theory-ladenness of perception argument is not an argument at all. It is two clusters of arguments. The first cluster is empirical. These arguments typically begin with a discussion of one or more of the following psychological phenomena: (a) the conceptual penetrability of the visual system, (b) voluntary perceptual reversal of ambiguous figures, (c) adaptation to distorting lenses, or (d) expectation effects. From this evidence, proponents of theory-ladenness typically conclude that perception is in some sense “laden” with theory. The second cluster attempts to extract deep epistemological lessons from this putative fact. Some philosophers conclude that science is not (in any traditional sense) a rational activity (Feyerabend 1975); while others conclude that we must radically reconceptualize what scientific rationality involves (Kuhn 1970; Churchland 1979).

This paper has two aims: First, to propose a framework for understanding the empirical cluster of theory-ladenness arguments; and second, to begin to assess them. Once we clearly understand the structure of these arguments—where they begin and what they must show—much conventional wisdom about the significance of the psychological data turns out to be false. In particular, the arguments from voluntary perceptual reversal, distorting lenses, and expectation effects often carry unexpected lessons for the theory-ladenness issue. The fourth empirical theory-ladenness argument, the argument from conceptual penetration, raises so many difficult issues that it cannot be adequately assessed here; however, the issues that need to be addressed in order for the argument to be evaluated are set in sharp relief.

1. The structure of empirical theory-ladenness arguments

Empirical theory-ladenness arguments typically employ some psychological phenomena to show that observations are in some sense “theory-laden.” But the claim that observation or observation reports are “theory-laden” is ambiguous. On one reading, it is trivial—it amounts to no more than that observations are inevitably made in terms of some conceptual framework or other. On another interpretation, theory-ladenness involves the less trivial claim that all observations are *in principle* defeasible since the conceptual apparatus they employ might turn out to be faulty. And proponents of the theory-ladenness of perception seem to want to mean something more radical and epistemologically charged.

The most productive step to take at this point is to put aside metaphorical talk about “theory-ladenness” and instead ask: What lesson are we supposed to extract from the above psychological phenomena? If the psychological phenomena are to be relevant to the breathtaking epistemological claims made by the parties to this debate, then they will support one or more of the following *theory-ladenness theses*.

(T) Given a case of rational theory resolution, the psychological evidence **A** the set of observations **S** employs in deciding between **B** significantly different and competing theories consists of **C** theory-neutral observations.

A: shows that inevitably, suggests that possibly

B: all possible, all actual, most actual, some actual

C: no, only some, primarily, only

Anyone wishing to take a position on the theory-ladenness issue needs to answer four questions. (A), is the psychological evidence supposed to show that the observations made by proponents of competing theories are *inevitably* neutral or non-neutral, or that there are features of our visual systems that *if* implicated in an episode of theory resolution *would* result in neutral or non-neutral observations?² (B), for what range of theories is the theory-ladenness thesis supposed to hold? (C), given that any experiment involved in the resolution of a scientific controversy always includes more than a single observation, which (if any) of these observations are (or are not) supposed to be theory-neutral? And (D), what is it for an observation to be theory-neutral?

With these questions in mind, we can formulate the various conclusions one might want to draw about the role of theory-neutral observations in the resolution of scientific controversies. For each definition of ‘theory-neutrality’ employed by the parties to this debate, there are at least 32 different possible theses they might be defending. Proponents of theory-ladenness mean to defend something close to the most radical theory-ladenness thesis, let’s call it T-1.

(T-1) Given a case of rational theory resolution, the psychological evidence *shows that inevitably* the set of observations **S** employs in deciding between *all possible* significantly different and competing theories consists of *no* theory-neutral observations.

Opponents of theory-ladenness want to defend something close to the most conservative theory-ladenness thesis, T-32.

(T-32) Given a case of rational theory resolution, the psychological evidence *shows that inevitably* the set of observations **S** employs in deciding between *all possible* significantly different and competing theories consists of *only* theory-neutral observations.

These 32 theses do not exhaust the potential conclusions of the theory-ladenness argument since we must include conjunctions. One might believe, for instance, that the psychological evidence suggests that some actual cases involve no theory-neutral observations, and that most of the others involve only some such observations.

Now that we have a reasonably clear account of the theory-ladenness argument’s conclusion, let us turn to the issue of what some piece of evidence would have to exhibit in order to support something close to T-1. It is not sufficient for the psychological evidence simply to show that our visual systems are malleable. If I shoot myself in the back of the head and don’t die, my visual system will be radically transformed. But this

fact can generate no epistemological magic. The defender of theory-ladenness needs to show that our visual systems are *capable of changing in such a way that lends support to his conclusion*. Ideally, the evidence would illustrate the following features:

- (a) Subject adopts a new theory, T.
- (b) Subject's visual system adapts to T.
- (c) As a result of the adaptation, Subject sees the world differently, in the sense that it is now more difficult for Subject to resolve disputes on the basis of theory-neutral observations with those who have not adopted T.

The defender of theory-ladenness needs to find some psychological data that exhibit these three desiderata. Now let us turn to the data.

2. The conceptual penetration of the visual system argument

Proponents of the theory-ladenness of perception argument often adduce cases of expert-novice differences in perception in defense of their conclusions. These cases have a characteristic structure. The expert, well ensconced in a scientific theory, and the scientific novice view a scene. Nonetheless, what they see is supposed to be different. Paul Churchland dramatically illustrates this point by imagining a group of people who have expanded their "perceptual consciousness" by mastering at a young age our most sophisticated scientific theories.

It is important for us to try to appreciate, if only dimly, the extent of the perceptual transformation here envisaged. These people do not sit on the beach and listen to steady roar of the pounding surf. They sit on the beach and listen to the aperiodic atmospheric compression waves produced as the coherent energy of the ocean waves is audibly redistributed in the chaotic turbulence of the shallows.... They do not observe the western sky redden as the Sun sets. They observe the wavelength distribution of incoming solar radiation shift towards the longer wavelengths... as the shorter are increasingly scattered away from the lengthening atmospheric path they must take as terrestrial rotation turns us slowly away from their source (1979, p. 29).

The conceptual penetration argument suggests that after a pair of individuals have mastered competing theories, the conceptual resources of their visual systems change in such a way that the observations they make are not, or perhaps cannot be, neutral between those theories. So when an individual masters completely contemporary optical theory, it is possible that she will no longer observe a red sky, but a sky that is reflecting solar radiation whose wavelength is between 650 and 700 nanometers.

In order to clarify the notion of theory-neutrality assumed here, we need at least a thumbnail sketch of the nature of scientific concepts. Let's begin with a description theory of terms, which defines a term (or a predicate) by some set of those descriptions believed true of it. More formally, it defines an expression, F, in a theory or belief-system, T, as follows (Russell 1919; Ramsey 1931; Lewis 1970).

- a. Conjoin the sentences in T that contain F.

We live on the earth, and the earth has a diameter of 7,918 miles, and the earth consists of seven continents, and the earth orbits the sun, and the earth rotates on its axis once a day, and the earth is the third planet in our solar system...

- b. Quantify existentially (first or second order) over F.

There is an x such that we live on x , and x has a diameter of 7,918 miles, and x consists of seven continents, and x revolves around the sun, and x rotates on its axis once a day, and x is the third planet in our solar system...

- c. Replace the existential quantifier with a definite description operator and define as F what satisfies the entire definite description.

The earth is defined as the unique x such that we live on x , and x has a diameter of 7,918 miles, and x consists of seven continents, and x revolves around the sun, and x rotates on its axis once a day, and x is the third planet in our solar system...

The use of a term expresses its *complete concept* when it is defined in terms of all the descriptions believed true of it. However, it is possible to define the term using less than all the descriptions believed true of it. The use of a term expresses one of its *incomplete concepts* when it is defined in terms of some (but not all) of these descriptions. So we could define 'earth' in a way that did not run afoul of either the heliocentric or geocentric theories.

The earth is defined as the unique x such that we live on x , and x has a diameter of 7,918 miles, and x consists of seven continents...

Now we are in a position to define a theory-neutral concept.

(NC) Term F expresses concept C which is theory-neutral between $T1$ and $T2$ just in case term F is defined by descriptions that are not incompatible with either $T1$ or $T2$.

The notion of theory-neutral observation employed by proponents of the conceptual penetrability argument is this.

(NO) An observation is neutral between competing theories $T1$ and $T2$ just in case its representational content is given only by concepts that are theory-neutral between $T1$ and $T2$.

An observation is theory-laden just in case it is not theory-neutral. Notice that this definition makes an observation theory-neutral or theory-laden only relative to a set of theories. It is perfectly possible for an observation to be neutral between $T1$ and $T2$, but not neutral between $T2$ and $T3$. (This account of scientific concepts is radically incomplete; it needs, among other things, a theory of meaning. Nonetheless, it will serve our present purposes.)

A curious feature of the conceptual penetration debate is that each side has tended to stake out extreme positions. Epistemological conservatives, such as Fodor (1984) and various foundationalists, hold that there are always theory-neutral observations that play a role in cases of rational theory-choice and that are essential to the objectivity of science. Epistemological radicals, such as Kuhn, Churchland, and Feyerabend, hold that the observations made by proponents of very different competing theories are inevitably theory-laden and, as a result, observation is so infected by theory that it interferes with the objectivity of science. What should hopefully be clear by now is that there are many intermediate positions that may well deserve our allegiance.

It is reasonably clear what the proponent of the conceptual penetration argument needs in order to make his argument plausible. The conceptual penetration argument will succeed if and only if the following three views can be defended.

(1) *A theory of representational content that allows for the possibility that the proponents of substantially different scientific theories can employ very different observational concepts.* Without (1), proponents of competing theories will always share the same observational concepts. It does not follow that these observational concepts will be neutral between all possible competing theories—some theories may be incompatible with some of our ‘built-in’ observational concepts. However, scientists’ visual systems will not have the conceptual flexibility necessary to adapt to new theories. Thus, desideratum (b) (that subject’s visual system adapt to the new theory) will be unfulfilled and a radical version of the theory-ladenness thesis will remain unsupported.

(2) *A psychological account of visual perception that allows for the possibility that after the appropriate sort of training, the proponent of a novel theory can visually perceive the world in terms of the theory’s observational concepts.* Without (2), desideratum (b) cannot be satisfied because scientists’ visual systems will be incapable of adapting to new theories.

(3) *The thesis that proponents of substantially different competing theories will often (or perhaps inevitably) employ very different concepts in historical episodes of theory-choice.* Let’s suppose that the defender of the conceptual penetration argument succeeds in defending (1) and (2). He still needs to show that it is more than just a mere empirical possibility that proponents of competing scientific theories employ observations that are not theory-neutral. This case is most likely to be made on semantic, psychological, or historical grounds.

Perhaps a few (largely unsubstantiated) words are in order concerning these issues. The very best that a proponent of the conceptual penetration argument can reasonably hope to do is to support some moderate version of the theory-ladenness thesis. To see why, let’s look at each issue facing the proponent of the penetration argument.

(1) Let’s grant a theory of representational content that allows for the possibility that proponents of competing theories will employ incompatible, non-theory-neutral observational concepts. We should not, however, grant a theory that implies that proponents of competing theories must inevitably employ non-theory-neutral concepts. Such a theory fails to account for our ability to express many different concepts. For example, we can express a concept of light, or heat, or gene that is agnostic about what constitutes those things. Such concepts certainly seem to be neutral between a number of different theories about the structure of light, or heat, or genes. (For a fuller discussion of this point, see Bishop 1991.)

(2) There are good reasons to believe that experience and training can alter our visual systems so that we are capable of recognizing new things. Jerry Fodor (1983), no defender of the conceptual penetrability of our visual systems, offers a rough and ready test for determining whether a particular judgement about the visual surround is output by the visual system: A judgement is output by the visual system if its production is fast, mandatory, and automatic (non-voluntary). If my recognition of anything is fast, mandatory, and automatic, it is the recognition of my mother’s face. And yet this representation is not a member of most other peoples’ visual systems because they have had different experiences from my own. Consider the many things we can immediately recognize that Newton couldn’t—planes and trains and automobiles, for instance. Again, it seems very likely that these representations penetrated our visual systems, and not Newton’s, due to our constant contact with them. So it seems very possible that after lots of contact with Galapagos finches, proton traces, or Leyden jars, a scientist’s visual system could expand to include such representations.

(3) We have granted a theory of representational content and an account of the visual system that allow for the possibility that both neutral and non-neutral observational representations were often available to proponents of competing theories. Which were actually employed in a particular episode of theory-choice is an open historical question. It seems plausible to suppose that the historical evidence will not show that in *all* actual cases of theory-resolution, only neutral categories were employed or only non-neutral categories were employed. If this is correct, then the conclusion to draw from the penetration evidence will be some subset of the following theory-ladenness theses.

(T) Given a case of rational theory resolution, the psychological evidence suggests that possibly the set of observations *S* employs in deciding between *B* significantly different and competing theories consists of *C* theory-neutral observations.

B: most actual, some actual

C: no, only some, primarily, only

It seems likely that even if the defender of the conceptual penetration argument wins the semantic and psychological debates, he can, at best, establish some reasonably moderate version of the theory-ladenness thesis.

3. Perceptual reversal of ambiguous figures

Familiar examples of ambiguous figures are the necker cube (ambiguous three-dimensional figures), the old woman / young woman and the duck / rabbit figures (ambiguous forms), and the face / vase figure (figure-ground ambiguity). These figures can be readily interpreted by the visual system in two ways; for example, the face / vase figure can be interpreted as either a pair of faces or a vase. Once we have recognized the faces and the vase, we are capable of perceptually reversing these—switching from recognizing the faces to recognizing the vase (or *vice versa*)—on command.

Some evidence suggests that perceptual reversal involves shifts in attention (Gale and Findlay 1983). For example, if a subject who is capable of reversing the old woman / young woman figure is asked to attend to a certain part of the figure (around the old woman's nose or mouth), she is more likely to report perceiving the old woman, whereas if the subject is asked to attend a different part of the figure (around the young woman's nose or ear), she is more likely to report perceiving the young woman. When a subject is asked to concentrate on the old or the young woman, she will tend to focus on those same parts of the figure.

It is clear that by itself this phenomenon implies nothing about how scientific controversies are resolved and so does not directly support any version of the theory-ladenness thesis. Voluntary perceptual reversal does not exhibit desideratum (a)—the subject does not adopt a new theory. Nor does it show that a subject's visual system is capable of adapting to a new theory (b).

It appears that this evidence is supposed to be suggestive: It is supposed to exhibit features of our visual systems that if implicated in an episode of theory resolution would result in no (or only few) theory-neutral observations being employed. The argument from perceptual reversal is an argument from analogy. The different hypotheses about the ambiguous figures are supposed to be analogous to the competing theories in an episode of theory-choice. Given this analogy, there are three potential lessons one might try to draw about theory resolutions in science.



Conceptual penetration. Although there is good evidence for the conceptual penetration hypothesis (see the discussion in section 2), one might advance the phenomenon of voluntary perceptual reversal as further support. It shows that it is possible for different individuals, or a single individual at different times, to perceive different things when their perceptual mechanisms are pointed in the same direction. The problem is that this phenomenon does not show the visual system's representational resources changing appreciably. Before and after acquaintance with the ambiguous old woman / young woman figure, a subject is capable of visually perceiving old and young women. There is no increase in the visual system's conceptual resources.

Voluntary reversal in historical episodes. The phenomenon of voluntary perceptual reversal suggests that individuals are capable of deciding which observational representations to employ in any given situation. So if a scientist has a number of different representations that she could bring to bear on an experimental situation, she can voluntarily decide which to employ. Although Churchland appears to endorse this consequence (1988, 170-1), Kuhn explicitly rejects it: "the scientist does not preserve the *gestalt* subject's freedom to switch back and forth between ways of seeing" (1970, p. 85). Why not? Why is the scientist's observational armamentarium so restricted by the theories she has mastered? No psychological evidence Kuhn adduces supports such a radically context-insensitive account of observation. In fact, voluntary reversal suggests a kind of *observational libertarianism*: many observational concepts are available to the scientist in any given experimental situation, sometimes including concepts neutral between the competing theories, and she is free to choose among them as she sees fit. This, in turn, supports the moderate conclusion we drew at the end of section 2. The psychological evidence so far examined provides no guarantee that only neutral or only non-neutral observations play a role in cases of theory-resolution; and given the availability of both types of observations, the historical evidence is not likely to be unequivocal.

The insufficiency of neutral observations. Given a complete hypothesis-neutral description of (say) the old woman / young woman (couched in geometrical terms), it is not possible to determine whether it is a figure of an old or a young woman. Therefore (one might argue) there may be analogous cases in which scientists are incapable of rationally deciding between hypotheses on the basis of theory-neutral observations alone. So even if there is a fund of observational concepts that are neutral between a pair of competing theories, such observations cannot be decisive (Kuhn 1970, p. 203). On one reading, this claim is obviously true. By themselves, observations or observation state-

ments, whether neutral or not, cannot decide between theories. Non-observational (or theoretical) vocabulary is needed just to state most competing theories, much less to decide between them. The real issue is whether neutral observations are insufficient for rational theory adjudication, and therefore whether non-neutral observations are necessary. The lesson that the proponent of theory-ladenness needs to draw from voluntary perceptual reversal is that non-neutral observations are necessary in order to make rational theory choices. But voluntary perceptual reversal does not show this. The reason it is not possible to rationally decide whether the old woman / young woman figure really represents an old woman or a young woman is that the figure doesn't provide enough information. And no one denies that there have been many historical cases in which there is not enough available information to rationally decide between a pair of theories. What voluntary perceptual reversal doesn't show, and needs to, is that in cases in which there is enough information available to decide rationally between a pair of theories, non-neutral observations must be part of that information.

4. Inverting lenses

Both Kuhn (1970, p. 112) and Churchland (1988, p. 174) offer the fascinating literature on inverting lenses as evidence for theory-ladenness. An inverting lens turns the visual field upside down while reversing left and right. Subjects typically undergo three stages: the discrepancy, adaptation, and negative aftereffect stages. In the *discrepancy stage*, a conflict is registered between visual information and proprioceptive information (information about one's felt body position). For example, suppose you were staring at a blank screen and moved your right hand from left to right across your face. Your visual system would inform you that an inverted right hand (with the forearm disappearing toward the top of your visual field) was moving from right to left in front of your face, while your proprioceptive system would inform you that your right hand was being moved from left to right across your face. Perhaps the most interesting early effect of the inverting lenses is that head movements lead to the illusion that the entire visual scene is moving in the same direction as the head but twice as fast. This produces severe disorientation and sometimes nausea. In the *adaptation stage*, the subject undergoes a change that reduces or eliminates the registered discrepancies between the relevant perceptual systems (in this case, the proprioceptive and visual systems). Notice that this does not require any change to the subject's visual system. A change to the proprioceptive system (or some other system) might account for the adaptation. Adaptation to the inverting lenses takes a few days but is impressive. The nauseating illusion of motion goes away, and subjects are capable of engaging in quite complicated tasks, such as fencing, mountain climbing, skiing, and biking in heavy traffic (Kohler 1964; Taylor 1962). In the final, *negative aftereffect stage*, the lenses are removed, and the subject tends to make the same sorts of errors she made when the lenses were first put on, but in the 'opposite' direction. The negative aftereffect almost always disappears quickly (much faster than the original adaptation).

Like the argument from perceptual reversal, the argument from inverting lenses does not satisfy the first two desiderata on a theory-ladenness argument—the subject does not adopt a new theory, nor does her visual system adapt to a new theory. The argument from inverting lenses is an argument from analogy. Donning the lenses is supposed to be akin to adopting a new theory. When the new theory is adopted but not mastered, the subject's observations are not yet supposed to be theory-laden. Churchland makes this point forcefully.

Who ever claimed that the character of a scientist's perception is changed simply and directly by his embracing a novel belief?... [Defenders of theory-ladenness have] emphasized the importance of long familiarity with the novel idiom,

of repeated practical applications of its principles, and of socialization within a like-minded group of researchers (1988, p. 175).

Adapting to the lenses is supposed to be analogous to mastering the theory. Let's look into the nature of the adaptation. Kuhn and Churchland argue that the lensed subject's behavioral adaptation is subserved by the adaptation of her visual system: the visual fields of subjects flip over some time during the adaptation stage. Contrary to conventional wisdom, this finding should not give hope to the defender of theory-ladenness. It shows that after doing extreme violence to the visual system's input, *it adapts by going back to representing the world exactly as it did before*. The adapted lensed individual and the non-lensed individual will agree just as much as they ever did about the external world. Taking the analogy seriously, this outcome suggests that after a pair of subjects have mastered their competing theories, their visual systems have the profoundly conservative tendency to represent the world as they did before the adoption of those theories. It is hard to imagine a more damaging result for the proponent of theory-ladenness.

This point is striking when we ask what is supposed to be the analog of a theory-laden observation in the lens experiments. If adapting to the lenses is analogous to mastering a new theory, and the subject's visual field flips, where are the theory-laden observations? There aren't any. The subject now sees the world exactly as she did before donning the lenses.

As a matter of fact, the psychological data offer very good reasons to suppose that the visual fields of lensed subjects never flip over. Subjects who have adapted to the lenses often report that the world looks "normal," but reports that the visual world looks "upright" almost never survive close inspection and comparison with (memories of) pre-goggle perception (Dolezal 1982, pp. 227-8). Furthermore, the hypotheses that the visual field rights itself makes false predictions about the inverting lenses' negative aftereffects (Dolezal 1982, pp. 234-5).³

Regardless of what cognitive or motor mechanisms account for the inverting lens adaptation, it cannot lend support to the proponents of theory-ladenness. Recall the final desideratum on data that was supposed to support a radical theory-ladenness thesis.

(c) As a result of the (visual system) adaptation, Subject sees the world differently, in the sense that it is now more difficult for Subject to resolve disputes on the basis of theory-neutral observations with those who have not adopted T.

When we take the proposed analogy seriously, the inverting lens data does not even exhibit this final feature. Proponents of theory-ladenness need to adduce visual system *adaptations* that increase observational disagreement between subjects. And although *donning* the distorting lenses increases observational disagreement (at least in the short run), the *subject's adaptations* to those lenses do not increase observational disagreement.

5. Expectation effects

How do expectations influence perception? Consider the findings of the Bruner-Postman card experiment (1949). On very short exposures, subjects identified anomalous playing cards (e.g., a red spade) as normal ones (a black spade or red heart) without apparent hesitation or doubt. However, most subjects were eventually capable of correctly identifying the anomalous cards on longer exposures. The Bruner-Postman card experiment (along with other experiments that demonstrate expectation effects, e.g., Warren 1970) suggests that there are circumstances in which an individual ex-

pects to see (or perceive) X, and when X does not occur, the individual will report having seen X nonetheless. Sidestepping the touchy issue of whether the individual actually saw X, it is clear that this phenomenon possibly could play an important role in the resolution of theory disputes in science. Can expectation effects give comfort to defenders of theory-ladenness?

5.1. The strong expectation argument

From the fact that subjects saw normal cards because they expected to see normal cards, one might suppose that what one sees is completely determined (or very nearly so) by one's theoretical expectations. So when a person masters a theory, he expects to see, and therefore does see, the predictions made by that theory. Define a theory-neutral observation as follows: *An observation is neutral between a pair of theories if and only if it is consistent with the predictions of both theories; otherwise, it is theory-laden.* (This is not the notion of theory-neutrality assumed in other empirical theory-ladenness arguments.) Given this interpretation of the Bruner-Postman card experiment, proponents of competing scientific theories cannot possibly adjudicate their differences on the basis of theory-neutral observations because their observations never conflict with the dictates of their theories. A very radical version of the theory-ladenness thesis follows from this interpretation of the data: For all possible cases of rational theory resolution, the psychological evidence shows that inevitably the set of observations S employs in making her choice consists of no observations that are theory-neutral.

Although the strong version of this argument supports the most radical version of the theory-ladenness thesis, it is demonstrably unsound. As a historical matter of fact, proponents of many theories have been surprised to see their expectations foiled. There is no psychological experiment that supports the thesis that theoretical expectations completely determine what one sees. In the case of the Bruner-Postman card experiment, just the opposite since most subjects were capable of identifying the anomalous cards on longer exposures.

No defender of the theory-ladenness argument, when thinking and expressing himself clearly, has defended the strong expectation argument. In fact, the existence of anomalies (perceived failures of expectations) is a fundamental tenet of Kuhn's philosophy of science. It is nevertheless important to be clear about the strong expectation argument. Foes of theory-ladenness have taken it to *be* the theory-ladenness argument and peremptorily rejected it as absurd. Consider the following critique of theory-ladenness by Jerry Fodor.

[W]orking scientists indulge in every conceivable form of fudging, smoothing over, brow beating, false advertising, self-deception, and outright rat painting—all the intellectual ills that flesh is heir to... Nevertheless, it is perfectly obviously true that scientific observations often turn up unexpected and unwelcome facts, that experiments often fail and are often seen to do so... (1984, p. 42).

Fodor's argument is beside the point. The fact that experiments often violate expectations does not undermine any sane version of the theory-ladenness of perception argument.

5.2. The weak expectation argument

The weak expectation argument deploys the Bruner-Postman card experiment, and other experiments of the same vintage, to show that our perceptual judgments are sometimes determined by our theoretical expectations. So in the hurly-burly of scien-

tific practice, theory adjudication on the basis of theory-neutral observation may be less common than usually supposed. Here then is a psychological phenomenon that, if at work in actual cases of theory resolution, makes it difficult for proponents of competing theories to resolve their differences on the basis of theory-neutral observations.

But we must be careful. What would an episode that exhibited expectation effects look like? Suppose S1 is a proponent of T1, and S2 is a proponent of T2, and T1 and T2 make incompatible observational predictions. Assuming S1 were experiencing expectation effects, he would not believe that his theory was in any observational trouble because he would perceive, or at least report that he was perceiving, what his theory predicted. Given this situation, what motivation would S1 have to reject his theory in favor of S2's theory (or *vice versa*)? After all, S2's theory makes predictions that conflict with what S1 is seeing, or reporting that he sees, and *vice versa*. So any time expectation effects are at work, it is very unlikely that either party will be motivated to resolve conflicts of theory, at least on the basis of those observations. Given that the presence of expectation effects in an historical episode undermines the likelihood of any resolution of theory conflict, it also undermines the likelihood of finding a case of theory resolution that has the extra property of not having been based on theory-neutral observations. Kuhn recognizes this point. He is not a proponent of the weak expectation argument. Kuhn employs the Bruner-Postman card experiment not to argue that theoretical disagreements are adjudicated on some basis other than theory-neutral observations, but to argue that in science "novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation" (1970, p. 64).

6. Final words

The framework offered here for understanding theory-ladenness arguments allows us to see that there are many different arguments that can justly be called 'the theory-ladenness of perception argument'. Further, because the parties to this debate have not made clear what the evidence needs to show in order to prove their respective points, they have not always understood the significance of the psychological phenomena they advance. As a result, opponents of theory-ladenness rightly reject an argument that no one believes (the strong expectation argument), and proponents of theory-ladenness champion an argument that undermines their conclusions (the inverting lens argument).

The framework for understanding theory-ladenness advanced here should also make us wary of the extreme positions so often defended. For example, there are numerous moderate positions to take on the conceptual penetration issue. It may well be that scientists often have both theory-neutral and theory-laden observational concepts available to them, and which they employed in a particular episode of theory-choice is an open empirical question. If this is right, historians, sociologists and philosophers of science should not begin a study of an episode of theory-choice with the conviction that proponents of the competing theories must (or must not) employ theory-neutral observations. Doing so will likely keep closed what is, in fact, a very open and very interesting question.

Notes

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²Kuhn recognizes that the theory-ladenness of perception arguments must deploy both psychological and historical evidence. The psychological evidence, alone, will not support a theory-ladenness thesis.

[T]hough psychological experiments are suggestive, they cannot, in the nature of the case, be more than that. They do display characteristics of perception that could be central to scientific development, but they do not demonstrate that the careful and controlled observation exercised by the research scientist at all partakes of those characteristics. Furthermore, the very nature of these experiments makes any direct demonstration of that point impossible. If historical example is to make these psychological experiments seem relevant, we must first notice the sorts of evidence that we may and may not expect history to provide (1970, 113-4)

³Suppose the visual field had righted itself. When the subject removed the lenses, we would expect the visual field to (again) appear upside down and for the subject to (again) fall victim to the motion illusion. So when the subject moves her goggle-free head to the right, the world should appear to move in the same direction as her head. But this does not happen. In fact, the world appears to move in the opposite direction of her head motion (Dolezal 1982, p. 234-5).

References

- Bishop, M.A. (1991), "Why the Semantic Incommensurability Thesis is Self-Defeating", *Philosophical Studies* 63: 343-356.
- Bruner, J.S., and Postman, L. (1949), "On the Perception of Incongruity: A Paradigm", *Journal of Personality* 18: 206-223.
- Churchland, P.M. (1979), *Scientific Realism and the Plasticity of Mind*. Cambridge, England: Cambridge University Press.
- (1988), "Perceptual Plasticity and Theoretical Neutrality: A Reply to Jerry Fodor", *Philosophy of Science* 55: p. 167-187.
- Dolezal, H. (1982), *Living in a World Transformed: Perceptual and Performatory Adaptation to Visual Distortion*. New York: Academic Press.
- Feyerabend, P. (1975), *Against Method*. London: New Left Books.
- Fodor, J. (1983), *The Modularity of Mind*. Cambridge: MIT Press.
- (1984), "Observation Reconsidered", *Philosophy of Science* 51: 23-43.
- Gale, A.G. and Findlay, J.M. (1983), "Eye Movement Patterns in Viewing Ambiguous Figures", in Groner (et. al.) *Eye Movements and Psychological Functions: International Views*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, pp. 145-168.
- Kohler, I. (1964), "The Formation and Transformation of the Perceptual World", *Psychological Issues* 3: 1-173.

Kuhn, T.S. (1970), *The Structure of Scientific Revolutions*. Chicago: The University of Chicago Press.

Taylor, J.G. (1962), *The Behavioral Basis of Perception*. New Haven: Yale University Press.

Warren, R. (1970), "Perceptual Restoration of Missing Speech Sounds", *Science* 167: 392-3.