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# The Biostatistical Theory Versus the Harmful Dysfunction Analysis, Part 1: Is Part-Dysfunction a Sufficient Condition for Medical Disorder?

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*Christopher Boorse's biostatistical theory of medical disorder claims that biological part-dysfunction (i.e., failure of an internal mechanism to perform its biological function), a factual criterion, is both necessary and sufficient for disorder. Jerome Wakefield's harmful dysfunction analysis of medical disorder agrees that part-dysfunction is necessary but rejects the sufficiency claim, maintaining that disorder also requires that the part-dysfunction causes harm to the individual, a value criterion. In this paper, I present two considerations against the sufficiency claim. First, I analyze Boorse's central argument for the sufficiency claim, the "pathologist argument," which takes pathologists' intuitions about pathology as determinative of medical disorder and conclude that it begs the question and fails to support the sufficiency claim. Second, I present four counterexamples from the medical literature in which salient part-dysfunctions are considered nondisorders, including healthy disease carriers, HIV-positive status, benign mutations, and situs inversus totalis, thus falsifying the sufficiency claim and supporting the harm criterion.*

***Keywords:*** *asymptomatic disease carriers, benign disorder, biostatistical theory, concept of medical disorder, concept of mental disorder, conceptual foundations of medicine, disease, disorder, DSM, harm, harmful dysfunction, health, homosexuality, pathology, philosophy of medicine, situs inversus*

I am an unrepentant naturalist.

(Boorse, 1997, 5)

There's still time, brother.

(Final scene of "On the Beach.")

## I. INTRODUCTION

Both Christopher Boorse's biostatistical theory (BST) of medical disorder (Boorse, 1975, 1976a, 1976b, 1977, 1987, 1997, 2002, 2010, 2011, 2014) and my harmful dysfunction analysis (HDA) of medical disorder (Wakefield, 1992a, 1992b, 1993, 1997a, 1997b, 1999a, 1999b, 2000a, 2000b, 2001, 2006a, 2007, 2009a, 2011; Wakefield and First, 2003, 2013a, 2013b, 2013c) maintain that biological part-dysfunction—that is, the failure of some part of the organism to be capable of performing its biological function[1]—is a necessary condition for medical disorder. The two views also agree that the concept of biological function and dysfunction can be understood in scientific, factual biological terms independent of value judgments. These points of agreement, which I presuppose in what follows and will not reargue here, provide the BST and HDA with the ability to address three primary challenges in the philosophy of psychiatry: (1) to draw a defensible distinction between normal suffering and mental disorder, thus providing a foundation for a critique of overly expansive psychiatric diagnosis that pathologizes normal variation; (2) to rebut antipsychiatric views that hold that there is no such thing as a mental disorder; and (3) to provide a common conceptual foundation for physical and psychiatric medicine that explains why mental disorders are literally disorders in the medical sense and thus why psychiatry is legitimately part of medicine.

The factual part-dysfunction requirement for disorder provides the BST and HDA with an objective "place to stand" from which to both validate and constructively critique psychiatry as well as medicine more generally, a perspective often lacking in antipsychiatric, constructivist, and purely normativist positions. Boorse observes that a crucial advantage of the BST is that "the value-free scientific disease concept remains as a bedrock requirement to block the subversion of medicine by political rhetoric or normative eccentricity" (1997, 100), and he acknowledges that the same benefit is achieved by the HDA in making part-dysfunction necessary for disorder: "As soon as biological dysfunction is required for disorder, virtually all the BST's benefits accrue in clarifying professional and social controversies and preventing political abuse of medical vocabulary" (1997, 100).[2]

However, the BST and HDA diverge on two crucial points. First, they disagree on the fundamental issue of what constitutes a biological function and thus on what is a part-dysfunction. This dispute is set aside in this paper, to

be addressed in Part 2. Fortunately, in practice the BST and HDA overlap enough in their classification of functions and dysfunctions that for the sake of the present analysis this difference can be safely ignored.

Second, the BST and HDA are opposed on the question of how part-dysfunction is related to medical disorder and specifically whether part-dysfunction is not only necessary but also sufficient for medical disorder. The HDA maintains that part-dysfunction is not sufficient for disorder and that an additional value judgment that the part-dysfunction is causing harm to the individual is an essential component of the concept of medical disorder. The HDA is thus a hybrid fact/value account of disorder. In contrast, the BST maintains that part-dysfunction is sufficient for—indeed, constitutes—medical disorder. As Boorse succinctly states, a "biological idea, part-dysfunction, is crucial to analyses of disorder by . . . Boorse and Wakefield. For both, it is a necessary element. For Boorse, it is also sufficient" (2011, 26). I will refer to this latter BST thesis as the "sufficiency claim."

The BST thus holds that medical disorder is entirely a factual concept with no value component, contrary to common normativist intuitions about disorder. To those intuitions, Boorse replies that he is "an unrepentant naturalist" (1997, 5).

In this paper, I pursue two lines of analysis that challenge the BST's sufficiency claim. First, I formulate and evaluate what I believe to be Boorse's central line of argument for the claim, which I call the "pathologist argument." I conclude that the pathologist argument begs the question regarding the sufficiency claim and when reformulated in a sounder manner actually leads to the opposite conclusion. Second, I attempt to directly falsify the sufficiency claim by presenting counterexamples in which there is part-dysfunction but no medical disorder.

## II. TERMINOLOGICAL AND METHODOLOGICAL PRELIMINARIES

I assume that medicine is essentially concerned with "health" and "disorder" as applied to the individual. I provisionally adopt here Boorse's "part-dysfunction" terminology (as opposed to my usual use of "dysfunction") as a convenient way to indicate that the dysfunctions relevant to disorder are limited to failures of the biological functions of parts of the individual and do not include, for example, "dysfunction" based on social value judgments, as when one speaks of a dysfunctional marriage or says that one is dysfunctional at work. A caveat is that I adopt Boorse's terminology despite some uncertainty as to whether it is conceptually necessary that there literally be a specific part to which dysfunction can be attributed in all cases, or whether in principle there could be a dysfunction at a holistic organismic level that results from the interaction of normal parts. A second caveat, with which Boorse (1976a) agrees, is that "biological" in the assertion that

a part-dysfunction is a failure of a biological function does not refer to physiology per se. Consequently, this terminology should not be taken to presuppose that every psychological dysfunction is a physiological brain dysfunction.

The sufficiency claim makes for an admittedly elegant theory in which medicine is the science of biological dysfunctions. According to this conception, value judgments are excluded from the concept of medical disorder, but of course value judgments may be made about disorders in specific situations:

> [The BST] provides a theoretical, value-free concept of disease or pathological condition. But on this foundation one can build value-laden disease concepts, by adding evaluative criteria, to taste. Starting from the basic disease concept, one can define clinically evident disease, or harmful disease, or serious disease, or treatable disease, or disabling disease, or disease that should be covered by insurance, or disease that should remove civil or criminal responsibility, and so on. (Boorse, 1997, 100)

Critics of the BST object that biology is (in part) the science of biological functions and dysfunctions, and medicine is a more specific discipline. Clinicians seem to have value judgments built into their disorder judgments, rather than adding value judgments to a core concept of part-dysfunction as described in the passage above. To explain away this apparent conflict between clinicians' judgments and the BST, Boorse postulates a distinction between "theoretical" and "clinical" concepts of medical disorder. He claims that the theoretical concept is captured by the BST and is the one used by pathologists, and provides the foundational concept of medicine. The clinical concept (corresponding perhaps to "harmful dysfunction") is the value-laden concept deployed by clinicians in actual medical practice, confusingly using the same term "disorder" but actually meaning "harmful disorder."

It is of course conceivable that there is a conceptual division of labor in the medical community so that only an elite of pathologists, undistracted by clinical considerations, actually knows or properly applies the field's foundational concept. However, Boorse offers no systematic evidence for the existence and nature of the postulated conceptual bifurcation. Consequently, there is the appearance that Boorse's multiplication of conceptual entities could be an ad hoc hypothesis formulated to avoid falsification of the BST by the judgments of clinicians, who after all form the bulk of the medical community and prima facie are the most plausible target for a conceptual analysis of "medical disorder."

I will examine Boorse's claims regarding the privileged position and conceptual distinctiveness of pathologists below. However, unless or until the evidence of actual classificatory judgments demands the multiplication of concepts of disorder, I will proceed on the more Ockham-friendly provisional assumption that there is likely one concept of medical disorder that is shared by all elements of the medical community and explains the

classificatory intuitions of both clinicians and pathologists. I will examine whether the evidence supports this or the bifurcation assumption.

An additional methodological point of disagreement between Boorse and me is whether, in a conceptual analysis of the concept of disorder, laypeople should be included in the linguistic community from which evidence is drawn. Boorse insists that health and disorder are technical concepts within the province of the medical profession. I hold that, to the contrary, health and disease/disorder are concepts firmly anchored in commonsense lay thinking. Indeed, when professionals themselves get it wrong in their eagerness to diagnose and treat, this is an area where journalists and laypeople correct them. Even the "Sopranos" TV show mounted an excellent dramatic critique of the excessive diagnosis of attention-deficit/hyperactivity disorder, fully understandable by the audience as an attack on the misapplication of the concept of disorder to a problem of living. No doubt diagnosis and treatment of disorder are technical matters, but not so the basic concepts of health and disorder themselves, which are expressed in widely shared judgments and intuitions. For example, research on lay and professional judgments about disorder versus nondisorder in judgments about delinquent behavior reveal that lay judgments parallel those of professionals (Wakefield, Pottick, and Kirk, 2002; Wakefield et al., 2006). This is why society can confidently sanction the medical profession to address health and medical disorder. This is also why in the run-up to the publication of the fifth edition of the American Psychiatric Association's official "Diagnostic and Statistical Manual of Mental Disorders" (DSM-5; American Psychiatric Association, 2013), newspapers and magazines were full of stories that readers understood about whether proposed changes to DSM diagnostic criteria maintained the proper boundary between disorder and normal distress.

The idea that "medical disorder" is a technical concept may be based on a confusion of conceptual analysis with substantive scientific questions. It is analogous to claiming that, because only chemists can identify $H_2O$, "water" is a technical concept that only chemists really understand. Long before the invention of chemistry, ordinary people understood the concept of water as the thirst-quenching substance in the rivers and lakes, and they were sophisticated enough about the logic of such essentialist substance concepts to reason accurately that snow and steam are forms of water. Discovering water's chemical essence allowed scientists to establish what is and is not water (e.g., there is stuff floating in the Horsehead Nebula that is water). However, the concept had to be understood before someone could discover that "water is $H_2O$." Moreover, the initial "folk concept" tends to retain conceptual priority; we could in principle discover tomorrow that we have been wrong about water being $H_2O$.

Consequently, in the analysis that follows, I will use any one's intuitions about "disorder" that seem illuminating. However, out of deference

to the need to engage productively, whenever possible I will follow Boorse and veer toward the judgments of pathologists and pathologist-like players in the healthcare system in marshaling evidence about the meaning of "medical disorder."

## III. THE PATHOLOGIST ARGUMENT

### Boorse's Shift from "Disease" to "Pathology" as His Target Concept

Boorse's most fundamental argument for the sufficiency claim is the "pathologist argument," essentially that pathologists' judgments of pathology are value-free and based on part-dysfunction and thus support the BST. The adoption of this argument is closely linked to a terminological change he made some time ago in his position. I start by examining the rationale for that change.

The original target of Boorse's analysis was the term "disease," intended very broadly to refer to the "theoretical negative idea of health in scientific medicine which is expressed by its cliché 'Health is the absence of disease,'" thus "including injuries, poisonings, environmental traumas, growth disorders, functional impairments, and so on through the vast range of conditions that medicine views as inconsistent with perfect health" (1997, 6). I use "medical disorder" to serve a similar purpose; "disorder" is a term designed to capture the entire range of health deficits that are the essential target of medicine.[3]

Boorse subsequently jettisoned "disease" as his target term. The problem is that "disease" as standardly used excludes some medical disorders such as injuries and poisonings, so was unsuitable as Boorse's target. Boorse claimed that there is a broader usage of "disease" that covers all medical disorders, but this usage is at best quite rare, and there is a question whether it exists at all other than as a convenient shorthand used in a few manuals and in the phrase "health is the absence of disease." In any event, Boorse's usage stretched the way the term is generally used, and this seemed to critics to open the way for confusing equivocations and fallacious inferences. To eliminate the ambiguity and clarify his argument, Boorse shifted his target to "pathology" as a clearer equivalent to the broad sense of "disease." This shift in terminology was assumed to leave Boorse's body of argument regarding disorder intact merely with a simple substitution of terms. However, obviously such a change can bring unexpected new confusions to the discussion.

Boorse explains this shift of conceptual target from "disease" to "pathology" as follows:

> Traditional medicine deals with a vast range of conditions that are departures from ideal health. . . . Physicians speak of defects, disorders, abnormalities, anomalies, injuries, lesions, illnesses, and handicaps. . . . Underlying this diversity, however, is

a basic theoretical conception of health as freedom from the whole range of medically abnormal conditions – or, as it is often described, freedom *from disease*. This description is accurate, however, only on an extremely broad usage of the word *disease*. . . . As a rule, the term 'disease' is used more narrowly, in such a way that many conditions listed would not be called diseases. . . . Fortunately, we can abstract from all the problems of disease classification and definition by using a more general term; *pathological*. All the conditions in the Nomenclature are correctly described as pathological, or medically abnormal, however classified or subdivided. I suggest that the distinction between normal and pathological conditions is the basic theoretical concept of Western medicine. A bodily state or process is disease, disorder, injury, lesion, defect, sickness, or illness only if it is abnormal in the sense of pathological; in other words, these are all specific kinds of pathological conditions. . . . [O]ne defines a medically ideal (and nonexistent) human being as one completely free of all pathological phenomena at every level of physiological function. (1987, 363–65)

Following the initial conclusion that "the distinction between normal and pathological conditions is the basic theoretical concept of Western medicine," the ultimate conclusion of this passage's implicit argument seems to be that the medical concept of health is the concept of being "completely free of all pathological phenomena at every level of physiological function." In other words, part-pathology is necessary and sufficient for medical disorder. However, when one examines the passage for arguments supporting this conclusion, one finds no relevant argument regarding the sufficiency of pathology for disorder. Instead, at every juncture, the passage argues only that pathology is necessary for medical disorder, that is, that all disorders are forms of pathology, a point of agreement between the BST and HDA. Thus, the passage asserts that "all the conditions in the Nomenclature are correctly described as pathological," that "a bodily state or process is disease, disorder, injury, lesion, defect, sickness, or illness *only if* it is abnormal in the sense of pathological" (emphasis added), and that "these [types of disorder] are all specific kinds of pathological conditions." These assertions are all versions of the necessity claim. The sufficiency claim is not supported with argument. It is simply assumed.

The implicit argument in the passage appears to proceed by a series of claimed necessary and sufficient equivalences:

1. Medicine's essential domain is ideal health.
2. Ideal health is complete freedom from disease (understood in a broad sense).
3. Disease (understood in a broad sense) is a pathological condition of a part.
4. Therefore, ideal health is being "completely free of all pathological phenomena at every level of physiological function."

To anticipate, I maintain that this argument goes wrong due to equivocations between a diseased or disordered individual and a diseased or pathological

or disordered part of an individual, which emerges in the move from premise 2 to premise 3. Disease constitutes medical disorder as asserted in premise 2 only if "disease" is understood in a broad sense implicitly including harm to the individual. However, a diseased or pathological part of an individual, the explicit focus of premise 3, is compatible with the individual's being completely healthy. Boorse obscures this equivocation by insisting that pathology is properly determined by pathologists, and pathologists do recognize part-dysfunction as pathology in one sense, a point to which I turn in the next section. The problem for Boorse is that although pathologists recognize pathology at every physiological level, pathologists, we shall see, do not judge that any pathology at any physiological level constitutes an individual's lack of health or medical disorder. The pathologist does not fall prey to the equivocation, so the pathologist's authority ends up going against the BST.

### Priority of the Pathologist's Judgments of Pathology

Boorse's terminological change from disease to pathology was associated with an increasing emphasis on the claim that it is "pathology" *specifically in the sense used by pathologists* that is medicine's foundational concept, synonymous with "medical disorder" or "disease" in the broad sense he had earlier intended. The notion that philosophy of medicine is best developed from the pathologist's perspective to the exclusion of the clinician's is dramatically underscored by Boorse's assertions that "my basic analysis really aims at the pathologist's, not the clinician's, concept of disease" (1997, 17), and "I am content for the BST to live or die by the considered usage of pathologists . . ." (1997, 53).

Certainly, it is plausible to consider pathologists experts on pathology, at least within the anatomical realm within which they work. However, in Boorse's series of moves that intertwines terminological change with far-reaching substantive conceptual conclusions, a crucial question seems to get lost: What is the relationship between the pathologist's concept of pathology and the concepts of health and medical disorder? More specifically, is part-pathology sufficient for medical disorder or deviation from ideal health? The failure to address this question left a gap in Boorse's argument that critics were quick to notice. Boorse's response to objections offers a test of whether he can fill in this gap in a way that supports the sufficiency claim.

### The "One-Dead-Cell" Argument

I now examine how Boorse actually deploys the pathologist argument in defending against a prototypical objection to the sufficiency claim. The objection was put forward by Lennart Nordenfelt, who argued that the BST is overly inclusive and incorrectly places trivial and harmless dysfunctions in the category of disorder. Nordenfelt took Boorse at his word that the BST

classifies any part-dysfunction in any part of an organism and at any level of physiological function as a medical disorder. He then applied that claim to the cellular level, inferring that according to the BST, one has a medical disorder even if there is a single dead cell within one's body that has no impact whatever on one's functioning:

> We shall then say that health obtains in the organism when all cells fulfill their functions. Otherwise there is at least one disease. The consequences of such a view are extremely counterintuitive. The existence of a single cell not fulfilling its function is sufficient for the existence of disease and thereby the non-health of the whole person. We all have a great number of cells which are dying or malfunctioning. Hence, we would all be ill. (Nordenfelt, 1987, 28)

Nordenfelt assumed that the conclusion he derived from the BST—that we are all ill—was so obviously false as to be a reductio ad absurdum of the BST. He went on to observe that we need a theory of disorder that is "not so subtle as to include the odd single cell. The BST has not given an account of how this is to be done" (28). Boorse acknowledged that "the BST . . . carries dysfunction all the way down to the cellular level" (1997, 85), but accepted the implication that we all suffer from disorders and that the ideally healthy person is indeed "nonexistent" (1987, 365), thus neutralizing the "we are all disordered" objection. However, Nordenfelt might well reply that even if no one is ideally healthy, the objection stands because no one thinks that each one of the millions of cells that die each second in one's body is a medical disorder.

Boorse offers the caveat that one dead cell is not pathology if it occurs "in tissues like skin and mucosa whose normal function entails constant death and regeneration" (50). However, individual cells die regularly throughout our bodily systems for all sorts of reasons other than programmed regeneration, including environmental wear and tear, limitations to number of replications, and programmed cell death (apoptosis) triggered by various intracellular dysfunctions. Nordenfelt can safely assert that such single-cell deaths in situations other than programmed regeneration are not necessarily considered medical disorders. Consequently, Boorse's caveat does not neutralize Nordenfelt's objection.

The one-dead-cell objection is clearly aimed at the sufficiency claim. Nordenfelt started from two assumptions that Boorse can share: that the one dead cell is part-pathology and that it is harmless (I take the denial of "illness" as implying the denial of harm). Such a condition, Nordenfelt claimed, is not considered a medical disorder or health deficit, contrary to the BST's prediction.

Relying on the pathologist argument, Boorse vigorously defended against the one-dead-cell objection to the sufficiency claim, arguing that an individual with even one dead cell does indeed thereby necessarily have a medical disorder, even if the dead cell is harmless:

> [T]o the pathologist no one is normal. . . . At the pathologist's level of description, there is no paradox in calling one dead cell pathological. . . . One dead cell is just the ultimate focal necrosis, one of pathology's most common findings. Why would one dead neuron not be pathological? Is a dead neuron a normal neuron? Do dead neurons function normally? Since the neuron is a body part, in a tissue whose physiological function does not feature regular regeneration, it is not much more mysterious that its death is pathological than that the whole organism's death is pathological. Of course, one dead neuron is a trivial piece of pathology. But to call a condition pathological implies nothing about its importance. To think otherwise is to confuse theoretical and clinical normality. Judgments of importance belong to clinical practice, not to basic theory of normality. . . . Of course we are not all ill, but we do all contain some pathology, of which one dead cell is just a trivial example. If microbial attackers have destroyed a large number of cells, no pathologist would hesitate to call that pathological. So we have clear dysfunction. (1997, 50, 85–86)

Boorse's reply to Nordenfelt repeats in varied wording the point that the dead cell in question is pathological (not normal, not functioning normally, pathology we all contain, clear dysfunction). This point is a non sequitur. No doubt a dead cell is not a normally functioning cell, to the pathologist or to anyone else for that matter. But Nordenfelt is not challenging the pathological status of the cell. His argument *starts* from the shared premise that the dead cell is pathological, and questions whether on that basis we would judge that the individual has a medical disorder. He is thus precisely targeting his objection to a gap in Boorse's argument; although Boorse is correct that the pathologist would label the dead cell pathological, Boorse does not show that the pathologist would judge that pathology to constitute the individual's deviation from ideal health. The fact that an individual contains a part that is pathological does not in and of itself imply that the individual is pathological in a sense that implies medical disorder, any more than the fact that the individual contains red blood implies that the individual is red.

From the way the passage proceeds, it is as if Boorse assumes that the thesis that part-pathology equals medical disorder is so manifest that it cannot be challenged. Thus, when he makes the point that harmlessness is compatible with part-dysfunction (with which Nordenfelt agrees), he then thinks he can rest his case that harmlessness is compatible with medical disorder. Consequently, the passage ends at the point that the real argument (as to whether part-dysfunction without harm is medical disorder) should begin. This perhaps explains why Boorse repeats in so many different ways that the dead cell is a pathological cell; he mistakenly thinks this is sufficient to secure his point that the dead cell is a medical disorder.

The passage provides the beginnings of a reason to be suspicious of Boorse's "theoretical/clinical" distinction. The argument that the one dead cell is pathological is framed as taking place "at the pathologist's level of description," as if this makes a difference. Yet, Nordenfelt accepts the judgment that the one dead cell is pathological; thus, from his presumably clinician's perspective he

agrees with the pathologist, as indeed everyone would, including laypeople. So far, there is no distinctive pathologist's level of description that diverges from what clinicians would say; the cell is pathological. Then, in response to Nordenfelt's denial that the pathological cell is a medical disorder, Boorse accuses Nordenfelt of confusing the pathologist's theoretical concept of disorder with clinical normality. In other words, in reply to the question raised by Nordenfelt as to whether part-dysfunction implies health decrement, Boorse deploys the theoretical/clinical distinction to dismiss the question as confused, even though it is an entirely legitimate—indeed, the essential—question. Given the general agreement among pathologists and nonpathologists on part-pathology, the existence of a theoretical/clinical distinction in concepts of health would emerge only in the answer to this further question.

The closest Boorse comes in the above passage to providing an argument in response to the one-dead-cell objection is the following, immediately following Boorse's observation that one dead cell is a trivial pathology: "But to call a condition pathological implies nothing about its importance. To think otherwise is to confuse theoretical and clinical normality. Judgments of importance belong to clinical practice, not to basic theory of normality."

We can all agree with Boorse's point that to call a cell pathological implies nothing about its importance to the individual (I take "importance" to be a stand-in for harm). However, Nordenfelt is not asserting that because it is harmless, the dead cell is not pathological. Rather, Nordenfelt is asserting that because it is harmless, the pathological cell is not a medical disorder. Nordenfelt's question, rather than reflecting a confusion between theoretical and clinical concepts of normality, is best understood as suggesting that the evidence challenges Boorse's unargued assumption that his theoretical concept corresponds to pathologists' intuitions about health. In response, Boorse offers only the circular argument that if the individual's cell is pathological, then the individual must be disordered in the theoretical sense. Consequently, Boorse's view is in danger of becoming a nonfalsifiable ad hoc theory.

## Rethinking the "One-Dead-Cell" Argument: The Univocality of "Medical Disorder"

I now step back from the critique of Boorse's response to Nordenfelt to examine what happens if one rethinks Boorse's reply and reworks it to fix its problems. The main problem, we saw, is that the argument is question begging. The question is whether the BST's notion of pathology is a sufficient criterion for medical disorder and health deficit. Adopting Boorse's methodology, the question is approached from the perspective of the pathologist. The gap in Boorse's analysis was the lack of any demonstration that the pathologist judges the one dead cell to be not just a form of part-pathology but also a medical disorder. Boorse's argument, stripped to its essentials, is as follows:

P1. The pathologist judges one dead cell to be pathology inside the person (= part-dysfunction).

C. Therefore, one dead cell is a medical disorder.

This enthymeme needs filling out. Granting Boorse his methodological principle of the primacy of the pathologist's judgment when it comes to both pathology and medical disorder judgments yields the following premise:

P2. The pathologist's judgment of pathology determines what is pathology, and the pathologist's judgment of medical disorder determines what is medical disorder.

There is still a crucial missing premise needed to make this argument valid as a defense of the sufficiency claim, namely, that the pathologist judges the one dead cell to be a medical disorder of the individual, or put generally:

P3. What the pathologist judges to be pathology the pathologist also judges to be a medical disorder.

Boorse appears to ignore the need for P3 and instead attempts to fill the gap in the argument's premises by assuming:

P4. What the pathologist judges to be pathology is medical disorder.

However, P4 manifestly begs the question raised by Nordenfelt, namely, whether part-dysfunction is sufficient for medical disorder. Premise P3, on the other hand, which is the non-question-begging way of trying to fill out the argument, is plainly false. Just as any pathologist would judge the one dead cell to be a form of pathology (of the cell), no pathologist would classify the one dead cell—assuming per hypothesis that it has no harmful impact on an individual—as a medical disorder of the individual or as implying that the patient is not healthy. For example, pathologists assessing the reproductive health of males routinely notice individual sperm cells with tail malfunctions or other dysfunctions that limit normal motility, a clear part-dysfunction in the individual. In light of this common part-dysfunction, the sperm cell is unable to make its biologically designed species-typical contribution to reproduction. Nonetheless, such dysfunction generally exists at a frequency that has no impact on reproductive potential. Under these conditions, pathologists would report no reproductive disorder, and healthy reproductive functioning to the physician.

Consequently, the pathologist argument as applied to the one-dead-cell objection, when put into non-question-begging form, is unsound. The pathologist test fails to rebut Nordenfelt's one-dead-cell objection and would fail to rebut other examples of harmless dysfunction. (Some evidence that pathologists actually do think this way is contained in the counterexamples presented in a later section.)

Boorse's pathologist argument in nonvacuous and valid form would run as follows:

P1. The pathologist judges one dead cell to be pathology inside the person (= part-dysfunction).

P2. The pathologist's judgment of pathology determines what is pathology, and the pathologist's judgment of medical disorder determines what is medical disorder.

P3. The pathologist judges that one dead cell is not (necessarily) a medical disorder and is compatible with the complete health of the patient.

C1. Judged by the BST's "pathologist" test, pathology/part-dysfunction is not sufficient for medical disorder or health deficit of the individual.

One might add the following for good measure:

P4. If the pathologist discerns that the one dead cell causes harm to the individual, then the pathologist judges that the one dead cell is a medical disorder and that the patient is not completely healthy.

C2. By inference to the best explanation, the HDA is a more plausible account of medical disorder than is the BST, using the BST's own "pathologist" criterion.

Just as Boorse held there was a broad and narrow meaning of "disease," there appear to be broad and narrow meanings of "pathology." The broad meaning refers to "biologically pathological," a concept within biology that covers all part-dysfunction. The narrow meaning refers to "medical pathology" in the sense of medical disorder. Unfortunately, turning to the term "pathology" did not enable Boorse to escape the problem of ambiguity he faced with "disease," and equivocation remains a problem with Boorse's argument. Philosophy of biology cannot be assumed to be philosophy of medicine; Boorse's claim that biological dysfunction is sufficient for medical disorder requires proof that is not forthcoming.

This analysis suggests that the claimed distinction between the pathologist's and the clinician's concepts of disorder does not exist. Boorse claims that the pathologist uses the theoretical sense of disorder, which equals part-pathology, whereas the clinician uses a different clinical concept of disorder that requires a value judgment. However, once the pathologist argument is placed in non-question-begging form, we see that both concepts—part-pathology and medical disorder—are understood in the same way by pathologists and clinicians (and, I would claim, laypeople). The entire reconstructed argument P1 through C2 is equally sound if "pathologist" is replaced by "clinician." If asked the right questions, the pathologist and the clinician agree that something has gone wrong with the cell, but that the individual is perfectly healthy. The pathologist does *not* judge that the individual with one dead cell has a medical disorder in some theoretical pathologist's sense, but instead answers by applying the same concept of disorder as the clinician, because that is the only concept of medical disorder that there is.

## Can Boorse Deny That One Dead Cell is a Part-Dysfunction?

Nordenfelt's one-dead-cell argument starts from the fact, emphasized repeatedly by Boorse in the above passage, that a dead cell is obviously a

pathological part-dysfunction. However, a Boorsean intent on saving the BST from the one-dead-cell argument might ask why Boorse can't simply deny that there is any part-dysfunction, given that the dead cell has no discernible impact on the individual's broader functioning or survival or reproduction?

Boorse is quite explicit that, although the species-typical effects of a kind of part are integral to judging the part's function, one must not look to such broader effects to decide whether a part-dysfunction exists in a particular case, because that is not how pathologists judge pathology. Pathologists recognize microdysfunctions as pathological independent of immediate organismic impact, which may not be significant even in obvious cases of part-dysfunction:

> [J]ust as physiologists trace this fine-structure down to tissue, cell, organelle, and genetic levels, so pathologists also recognize microdysfunctions as pathological. . . [A] biological function of a trait need only make its bearers marginally more likely to survive and reproduce. However, an effect manifest on evolutionary time scales may be all but invisible in an individual lifetime. If one further recognizes the overcapacity and redundancy in biological designs--large livers, two kidneys, multiple biochemical pathways and regulatory systems--one can see that any necessary relation of local pathology to overt illness is so weak as to be almost useless for defining disease. (1997, 49)

I claim that when a microdysfunction has no significant harmful impact on an organism, we do not judge there to be a medical disorder, whereas Boorse holds that the part-dysfunction itself is sufficient to imply a decrease in health. However, we agree that the presence of part-dysfunction is evaluated on grounds independent of the impact of that specific condition on the organism. This agreement provides the grounds for a fruitful disagreement about what the presence of part-dysfunction implies.

For example, absence of one kidney is a manifest part-dysfunction. However, removing a kidney from a healthy donor appears to be entirely harmless over the ensuing decades, with life expectancy (Ibrahim et al., 2009b; Segev et al., 2011), reproductive success (Ibrahim et al., 2009a), and even overall kidney function (Fehrman-Ekholm et al., 2011) unaffected when compared to matched cohorts, so harm is lacking. If Boorse used broader functional impact as the criterion for part-dysfunction, then he would hold that there is no dysfunction in absence of a kidney after donation. This would make nonsense of the intuitive idea of part-dysfunction, casting doubt on the cogency of the BST as a conceptual analysis. Instead, Boorse says that even if such individuals have no other medical abnormalities and do not need treatment, "of course surgically removing a kidney creates a pathological condition" (1997, 49), and infers disorder. I agree that there is a part-dysfunction when a kidney is missing, but I believe that if there really is no significant harm, then physicians are literally correct when they reassure potential donors that kidney donation does not compromise health or cause disorder.

Denying that a dead cell is a part-dysfunction would self-defeatingly cost Boorse the pathologist argument because, as Boorse repeatedly observes, any pathologist would identify a dead cell as a pathological cell. Adhering to the pathologist's judgments is the only way Boorse can defend his divergence from value-laden clinical intuitions and dismiss proposed value components of "disorder" as ignoring the theoretical/clinical distinction. This is the basis for Boorse's dismissal of the HDA's harm component: "[B]oth Wakefield and Spitzer ignore the distinction between pathological and clinical concepts, and that is why Wakefield feels he must supplement dysfunction with a harm clause" (1997, 49). Boorse is, after all, engaging in a conceptual analysis, and this requires anchoring the BST in how concepts are actually deployed. If, rather than living or dying by the pathologist's intuitions as promised, Boorse were to second-guess the pathologist's judgments when they pose any awkwardness for the BST, for instance by declaring that when there is no harm then there is functional equivalence and thus no part-dysfunction irrespective of what the pathologist says, then his position would devolve into an ad hoc exercise. Denying that a dead cell is an instance of part-dysfunction is not a viable option for Boorse without a radical makeover of his position.

## IV. FOUR COUNTEREXAMPLES TO THE BST'S SUFFICIENCY CLAIM: HEALTHY DISEASE CARRIERS, HIV-POSITIVE STATUS, BENIGN MUTATIONS, AND SITUS INVERSUS TOTALIS

Do pathologists—or others of their ilk, such as researchers and nosologists—actually think in the way Boorse portrays them as thinking, where part-dysfunction is taken as sufficient for medical disorder? Or do they, as I have argued, distinguish part-dysfunction from medical disorder and require additionally that there is harm from the part-dysfunction to justify attribution of disorder? In clarifying his "analytic methodology," Boorse declares: "I was the first philosopher . . . to emphasize the importance of matching the stock of diseases recognized by medical usage. . . . I am content for the BST to live or die by the considered usage of pathologists . . ." (1997, 53). Within these conceptual-analytic constraints, Boorse does allow for a certain amount of linguistic revision in the quest for overall reflective equilibrium. That caveat acknowledged, I take him at his word and examine whether the BST matches considered medical usage, or whether there are compelling prima facie counterexamples to the BST's sufficiency claim, especially among Boorse's preferred linguistic community of pathologists, nosologists, and researchers.

If the goal is to examine the concept of disorder actually deployed by the medical community, then one would ideally prefer evidence of explicit statements by the experts about the presence of health and disease rather

than one's own counterfactuals about "what they would say if." This poses a challenge because no one in medicine actually discusses the disorder status of, say, one harmless dead cell, and salient dysfunctions discussed by medical professionals are almost always harmful. To test the BST versus the HDA using medical linguistic intuitions, one needs to identify those unusual cases in which there is dysfunction (thus disorder according to the BST) but no harm (thus no disorder according to the HDA), and yet in which medical professionals have taken an interest and expressed classificatory judgments. I present four such examples below.

### Counterexample 1: Asymptomatic Disease Carriers

If there is one medical phenomenon that is a compelling "natural experiment" that tests the BST's sufficiency claim, it is asymptomatic carriers of infectious diseases. The classic example is the infamous Mary Mallon of New York (1869–1938), better known as Typhoid Mary. She was the first widely recognized symptomless carrier of typhoid fever, and her work in food preparation led to the infection of many and the deaths of several individuals, even though Mary herself apparently never experienced any symptoms. Indeed, she insisted to the end that she had no connection to the cases of typhoid that emerged wherever she worked. Mary was quarantined in an isolated cabin on a small island in New York's East River that was home to a mental asylum. When she was eventually let out of isolation by a kindly public health official based on her promise not to return to being a cook, she changed her name, went back to her old profession, and promptly sickened and killed yet more people, until she was again apprehended and permanently quarantined. Fecal specimens as well as investigation upon autopsy determined that live typhoid bacteria were actively replicating within her.

Medical and lay judgments about Typhoid Mary offer a test of the conceptual relationship between part-dysfunction and medical disorder or disease. According to the BST, infection with the typhoid bacillus and the associated replicative processes is a clear part-dysfunction, and no additional requirement for symptoms or other harms must be met to qualify the carrier's condition as a disease. According to the HDA, the lack of direct harm to carriers from the internal dysfunction means that carriers may be judged to be nondisordered.

Actual historical and contemporary judgments about Typhoid Mary fall decidedly on the side of the HDA and falsify the BST's understanding of disorder/disease. Medicine standardly describes asymptomatic carriers as not diseased. Medical and lay descriptions simultaneously recognize the internal bacteriological pathology of her infection—indeed, there could not be a clearer case of internal dysfunction than Mary's, with bacteria utilizing her gall bladder as a spawning ground—and yet judge her to be healthy and free from disease, describing Mary as a "healthy disease carrier" who never

had typhoid fever and who is apparently immune from getting the disease ("Typhoid Mary Must Stay," 1909, 3).

In the initial report on Mary in JAMA, public health doctor William Park (1908) carefully referred to Mary and her ilk not as diseased but as "chronic bacilli carriers" that include both those who have never had the disease and those who have recovered from it. Dr. John Meakins (1911) observed in the *Canadian Medical Association Journal* that "there are numerous typhoid carriers who never had typhoid fever, but through contact with infection became bacilli carriers" (711). Dr. George Soper (not a physician but a sanitary engineer working in public health who played a prominent role in Mary's case) stated as explicitly as possible that Mary's condition "is not a disease" ("Typhoid Mary has reappeared: Human culture tube, herself immune, spreads the disease wherever she goes," 1915). *The New York Times* reported that Mary was "a walking repository of typhoid germs . . . although immune from the disease herself" ("Typhoid Mary Must Stay," 1909, 3), that "although she has never had typhoid fever herself, she is infected with typhoid germs," and that she is "a healthy carrier who has never suffered from the disease" ("Typhoid Carriers," 1912, 8). As to Mary herself, she stated in a letter, "I never had typhoid in my life, and have always been healthy" (Rosenberg, 2014). As the HDA predicts, both professional and lay judgments indicate that infection and complete health are not incompatible when the infection causes no symptomatic harm.

Moreover, in the tenth revision of the World Health Organization's "International Statistical Classification of Diseases and Related Health Problems" (ICD-10; World Health Organization, 1992), Mary's condition falls not under "Typhoid Fever" (A01.0) but under the nondisorder category Z22.0, "Carrier of Typhoid," within chapter XXI, "Factors Influencing Health Status and Contact with Health Services," in the section of "Potential Health Hazards Related to Communicable Diseases," which is reserved for conditions that are not themselves diseases. In earlier ICD editions Mary also fell under the "V Codes" used for nondisordered targets of medical intervention. The nondisorders section of ICD-10 contains a long list of healthy carrier diagnoses for a great variety of infectious diseases. The divergence from the BST prediction could not be clearer.

The asymptomatic carrier example reveals two important insights about the concept of disorder. First, it falsifies the BST's sufficiency claim because clear dysfunction does not imply disorder or disease. Second, regarding the HDA, it resolves a potential ambiguity: the harm that qualifies a dysfunction as a medical disorder must be direct harm to the individual, not just harm to society or other people. Mary's carrier status led to several deaths, yet that harm did not qualify her dysfunction as a medical disorder. The healthy carrier example therefore suggests the need for further clarification of the "harm" component of the HDA.

## Potential Replies to the Healthy Carrier Counterexample

I consider two possible replies to the "healthy carrier" counterexample.

### *Mary had no dysfunction*

Might Boorse save the BST from the "asymptomatic carrier" counterexample by simply denying that Typhoid Mary had any part-dysfunction? All observers are united in characterizing Mary as infected with the replicating typhoid bacillus, so Boorse would have to argue that ongoing replication of a pathogen within the body is not a part-dysfunction in the BST-relevant sense. However, leaving the implausibility of such a claim aside, Boorse cannot deny the presence of a part-dysfunction in the healthy carrier without falling into contradiction. This is because both he and I have responded to another frequent objection to our accounts by insisting that such internal pathogen replication is a dysfunction.

The objection in question is that a cold's or other virus's symptoms can consist entirely of species-typical naturally selected defensive responses, such as sneezing, coughing, a fever, and mucus production. Thus, the critics argue, here we have a consensually judged disease without any biological dysfunction. Critics then draw the conclusion that part-dysfunction is not necessary for disorder and that evaluative criteria can wholly determine disorder attribution:

> In fact, the infectious disease can be seen as the species-typical reaction to the circumstance of a certain microbial invasion. But this, then, becomes paradoxical. A typical disease can be seen, on the BST, as a species-typical reaction, i.e. as a healthy response to a difficult environment. . . . [I]nfectious diseases as well as some other "defensive" diseases can be identified only if their relation to illness and disability is taken into account. (Nordenfelt, 1987, 29)

Boorse and I respond to this objection that dysfunction is not necessary for disorder by pointing out that there is a dysfunction underlying the symptoms that triggers the symptomatic defenses. The dysfunction consists of the infection of the cell by the pathogen, the co-opting of the cell's mechanisms for the virus's purposes of replication, and the injury or destruction of the cell as the pathogen reproduces within it and moves on to infect other cells. As Boorse says,

> If microbial attackers have destroyed a large number of cells, no pathologist would hesitate to call that pathological. So we have clear dysfunction. Defense mechanisms simply belong to a class of functions triggered by dysfunctions. (1997, 85; cf. Wakefield, 1999a, 2011)[4]

Thus, Boorse cannot deny that the asymptomatic carrier's infection, in which the pathogen reproduces within the individual's cells, is a genuine dysfunction. To do so would be to allow the BST to be falsified by the "disease as designed defense mechanisms" objection.

*Distinguish theoretical versus clinical concepts of disorder*

Can Boorse's distinction between theoretical and clinical concepts of disorder help him respond to the "healthy carrier" counterexample? He would have to maintain that the medical observers were confused and were misled in their judgments that Mary has no disease by the fact that the infection was clinically irrelevant. The strategy of declaring classifiers as conceptually confused was one way that Boorse attempted to escape the one-dead-cell objection. Might it work here?

In Typhoid Mary's case, this alternative explanation of judgments about Mary's disease status can be rejected based on the realities of the case. Mary's condition was not only important and highly clinically relevant but appropriately treated, so, unlike the one-dead-cell case, any supposed "clinical concept of disorder" that took account of pragmatic considerations would have unquestionably classified her dysfunction as a disorder. Mary's dysfunction was in urgent need of treatment to prevent harm to others, so extensive efforts were made to cure Mary of her carrier status, including administering various antiseptics and even consideration of an operation to remove her gall bladder (a primary site of bacillus replication). Research was conducted not only in the United States but in England and Germany to try to determine how best to treat healthy carriers of typhoid, with no immediate results either because treatments were insufficiently effective over time (the gall bladder operation was rejected partly on these grounds, because there were other sites of bacillus replication) or effective but too dangerous to the carrier. George Soper, the public health official, is quoted in one Times article as saying, "The condition—it is not a disease—is of such a nature that it has thus far resisted medical treatment," and the Times goes on to explain:

> Medical treatment has thus far proved ineffective at ridding the gall bladder of its infection, for if you put into the gall bladder a disinfectant strong enough to destroy the germs, it will also destroy the patient. While quarantined by the Board of Health, Mary Mallon was treated in accordance with the most skilled practice of the day . . . ("Typhoid Mary Has Reappeared; Human Culture Tube, Herself Immune, Spreads the Disease Wherever She Goes," 1915)

So, contrary to the notion that Mary's condition was mistaken for a nondisorder because it had no clinical or treatment relevance, Mary's condition was highly clinically relevant and demanded treatment, yet was firmly classified as a nondisorder by everyone involved. Boorse's postulation of two concepts of disorder cannot save the BST from the healthy carrier counterexample.

## Counterexample 2: HIV Disease Versus Asymptomatic HIV Infection

An equally clear counterexample to the BST, and one that is closely related to the carrier example, is the way that HIV infection is classified in the ICD-10.

The BST predicts that HIV infection, being a part-dysfunction, is a disease irrespective of manifest symptoms. But the ICD-10 does not see it this way.

As one would expect, in the ICD-10's "Infectious Disease" chapter, there is a set of ICD-10 codes for various manifestations of "Human Immunodeficiency Virus (HIV) Disease" (i.e., AIDS). The 26 different HIV disease codes range from "B20.2. HIV disease resulting in cytomegaloviral disease" through "B21.0. HIV disease resulting in Kaposi sarcoma" to "B23.2. HIV disease resulting in haematological and immunological abnormalities, not elsewhere classified."

However, there is one HIV-infection-related condition that is singled out and explicitly excluded from the "infectious disease" list, namely, asymptomatic HIV infection. That condition appears instead in the ICD-10 chapter devoted to Z-coded nondisordered conditions, "Chapter XXI. Factors influencing health status and contact with health services (Z00-Z99)," as "Z21. Asymptomatic human immunodeficiency virus [HIV] infection status." The ICD-10 explicitly specifies that this nondisorder category includes "HIV positive NOS" ("NOS" just means "not otherwise specified" under any other code). HIV-positive status is certainly a part-pathology. Nevertheless, according to the ICD's perspective, HIV-positive status does not in and of itself compromise health, is not in and of itself a disease (even in the broad sense used in ICD-10), and is not a pathology in the sense that implies that the individual has a medical disorder.

In attempting to reach reflective equilibrium in a conceptual analysis of "medical disorder," it is one thing to claim in the BST's defense that medicine often does not bother to explicitly label asymptomatic part-dysfunction conditions as diseases because there is no pragmatic clinical reason to attend to such conditions at all, but still they are in fact medical disorders. That line of argument may be defensible as an approach to cases, like the one-dead-cell case, in which nothing much is said by medical professionals about a condition in the medical literature, so one can project one's view onto the example. However, this defense of the BST does not effectively address salient much-discussed examples like HIV-positive status, in which medical nosologists—who know full well about the part-patholgy involved in HIV-positive status—formally and affirmatively assert that this clear part-dysfunction is not a form of disease and is in fact compatible with health. The BST's inconsistency with such considered classificatory judgments makes the achievement of reflective equilibrium between the BST and common medical judgments an elusive goal. Nor, as we have seen, can the BST bite the bullet and accept that asymptomatic infections are not part-dysfunctions and thereby not BST medical disorders, because then the BST falls to the "infectious disease as a set of biologically designed defensive reactions" objection.

### Counterexample 3: Mutations—Neutral, Risky, or Benign

Although any mutation in a gene that has a function is likely to be a dysfunction, most genetic mutations are not considered disorders. This is true

for virtually all mutations that do not cause direct harm and thus are not considered genetic diseases. In some cases, the mutation poses a higher risk of developing a disorder (as in the BRCA1 and BRCA2 mutations) but the mutation, though a dysfunction, is not directly harmful and so is not itself considered a disorder. Indeed, as a group of medical faculty (Temple et al., 2001) make explicit in their analysis of genomic disease, "Until a mutation is shown to demonstrate a defined risk of developing adverse consequences, individuals carrying that mutation should not be considered diseased" (808).

Even among mutations that do pose risks, medicine routinely differentiates between mutations that are disorders in themselves due to direct harm and mutations that pose risks of developing disorders but are not themselves disorders. For example, in both ICD-9-CM and the 2014 version of ICD-10-CM, the BRCA1 and BRCA2 mutations that increase the risk of developing other mutations that give rise to breast cancer are coded as nondisorders, namely, "V84.1 Genetic susceptibility to malignant neoplasm, breast" and "Z15.01 Genetic susceptibility to malignant neoplasm of breast," respectively. It appears that the BST cannot make this distinction because according to the BST a dysfunction is by definition a disorder.

Sometimes a mutation in a gene is harmless because of redundancy of function, and rarely a mutation is beneficial due to some surprising protection it offers against some disease. Such mutations are not described as disorders or as diminutions in health in the scientific literature. For example, recent research indicates that "we all carry 100–200 new mutations in our DNA. . . . Fortunately, most of these are harmless and have no apparent effect on our health . . ." (Science Daily, 2009). If dysfunctions were disorders, then even a harmless mutation would have an "effect on our health."

Examples of beneficial mutations include, for example, an immune system-related gene that when mutated and thereby "defective" (Genes That Protect Against AIDS, 1996) confers protection against HIV infection progressing to AIDS, about which a *New York Times* article says, "Those with a double dose of the mutant gene also fail to produce a protein that helps relay chemical messages between cells. However, they are healthy . . ." (Altman, 1996); and a mutation that destroys a gene normally involved in insulin regulation, but where the mutation protects against type 2 diabetes even in people who are overweight: "Now the researchers are asking whether the mutation has any bad health effects. So far, . . . none has been found" (Kolata, 2014).

These mutations are not labeled as disorders despite being dysfunctions because they are harmless. So, they are not instances of Boorse's frequent example of a "beneficial disease," such as when cowpox is useful to protect against smallpox. Cowpox is a directly harmful condition that is a clear disorder manifesting in skin lesions and other symptoms, but it may be considered overall beneficial due to the protection it confers

against smallpox. The harm in harmful dysfunction need only be prima facie significant harm that can be overridden by other considerations so as not to be harmful on balance. However, the protective mutation examples entail no prima facie significant harm. Thus, as the HDA predicts, unlike cowpox, they are considered true nondisorders, not on-balance desirable disorders.

### Counterexample 4: Situs Inversus Totalis

Situs inversus, a fascinating medical anomaly first described by Aristotle in animals and Fabricius in humans (Tayeb, Khan, and Rauf, 2011), consists of reversal of the positions of the internal thoracic and abdominal organs along the left–right bodily axis so that, for example, the heart is on the right rather than the left side of the chest cavity. Complete reversal in all details is sometimes referred to as *situs inversus totalis*. I focus on a historically pivotal account of situs inversus to excavate what it reveals about the concept of disorder.

Situs inversus was introduced to the modern medical literature by Scottish physician and pathologist Matthew Baillie, after his medical students opened up a cadaver to discover a systematic transposition of internal organs. Baillie's letter reporting on the phenomenon, filled with brilliant speculation about the meaning of the discovery for a broader understanding of animal development, was published in the Royal Society of London's journal in 1788 (Baillie, 1788). Given that Boorse ties the BST's fate to the judgments of pathologists, it is worth noting that Baillie was one of the great pathologists of all time, with his 1793 book, *The Morbid Anatomy of Some of the Most Important Parts of the Human Body*, generally considered the first great work on medical pathology written in English.

Baillie began his report by noting that in seeking to understand nature's wisdom and power by investigating the structure of animals, "we there find a most wonderful delicacy of mechanism, and exquisitely adapted to a variety of purposes." He noted, however, that rather than "following nature in her common tract," much can be learned "by observing her wanderings" (1788, 351), that is, her deviations from the natural. Baillie described the observed phenomenon as "a complete transposition in the human subject of the thoracic and abdominal viscera to the opposite side from what is natural" and "removed from the ordinary plans of nature" (351), a "singular lusus naturae" (i.e., freak of nature) and "monstrosity" (352), and a "great deviation in nature" (361). These various characterizations indicate that Baillie considered the observed organ reversal to be due to a failure of natural biologically designed functioning. That is, he attributed the phenomenon to what Boorse and I would call a dysfunction.

Yet, not once in the course of his lengthy report did Baillie describe the organ reversal as a disorder or disease. Toward the end of his letter,

Baillie explicitly addressed whether the condition was a medical disorder that compromised the individual's health. Baillie asserted that "his health could not be affected by such a change of situation in his viscera; nor could there arise from it any peculiar symptoms of disease" (359) because "in such a change it does not appear, that the functions can be affected" (361). Baillie argued that anatomical structure can vary while function is preserved (e.g., blood vessels can vary in their course as long as tissues are adequately served), and the isomorphic structural relationships in the observed transformation would yield identical performance of functions despite the dramatic divergence from the normal. Baillie goes so far as to speculate that the observed deviant pattern might equally well have been nature's plan, in which case "what is now called the natural situation of the parts would have been as singular as the present phenomenon" (362), thus provocatively implying that there is an arbitrariness in nature's plan.[5]

In sum, Baillie believed that the observed systematic positional transformation of the organs is clearly a dysfunction, yet one from which there is no harm. On this basis, he concluded that the condition cannot have any impact on the individual's health. For Baillie, an eminent pathologist, dysfunction that causes no harm is not a medical disorder.

The contemporary medical literature follows Baillie's general approach. Like Baillie, contemporary sources indicate that situs inversus is due to some kind of dysfunction, with various medical dictionaries and research reports referring to situs inversus as "abnormal," "a defect," "incorrect," " an "anomaly," "opposite of normal," "reversal of normal," "mirror image of the normal arrangement," and a "malformation" that occurs when the left–right axis specification process "goes awry during embryogenesis." Indeed, it is now known that situs inversus is caused by a dysfunction that reverses or blocks the rotation of specific cilia, the motion of which determines development of the body's axis of left–right orientation early in embryogenesis. Additionally, like Baillie, many contemporary sources indicate the likely harmlessness of situs inversus, indicating that patients are generally asymptomatic and have normal life spans. Consequently, contemporary pathologists appear to agree with Baillie that situs inversus itself does not impact health. Almost never in the contemporary literature is situs inversus called a "disorder" or "disease." Instead, it is neutrally referred to as a "condition" and seen as compatible with health, and its disease status denied: "Situs inversus totalis is not a structural heart disease" (Cohen et al., 2013, 29).

Situs inversus totalis falsifies the BST's sufficiency claim and supports the HDA. It is a clear case of dysfunction that causes no harm, and it is not in itself considered a disorder.

## Potential Replies to the Situs Inversus Counterexample

I consider two possible replies to the "situs inversus" counterexample.

### *ICD-10 has a code for situs inversus*

A possible counterargument is that ICD-10 has a diagnostic code for situs inversus, which is classified under "Other congenital malformations" in the chapter "Congenital malformations, deformations and chromosomal abnormalities." However, there is an explanation of this coding that is consistent with Baillie's and contemporary views that situs inversus totalis in itself is not a disorder.[6]

The ICD-10 code reflects not the status of situs inversus totalis in itself but other medical issues that may accompany situs inversus. There are two kinds of deviations from the pure cases of inversion considered above, in both of which situs inversus is associated with harm and true disorder. The first occurs when the transposition is not perfect in every detail, and major harmful defects of heart structure and other disorders can result (Cohen et al., 2013). Thus, if situs inversus is detected in a fetus, this must be followed up with further diagnostic tests because there is a significant probability that serious heart problems exist (Carvalho and Kyle, 1997), and this requires a code. The second kind of problem occurs when the dysfunction in cilia motility that causes the condition is part of a broader ciliary disorder, primary ciliary dyskinesia (PCD). PCD affects all the sites in the body where cilia and flagella are important for functioning (e.g., respiratory tract, inner ear, Fallopian tube) and is typically associated with the triad of sinusitis, bronchiectasis, and situs inversus, in which case it is known as Kartagener's syndrome. Due to their close association, Kartagener's syndrome, which comprises perhaps 25% of situs inversus cases, is diagnosed under the ICD-10 code for situs inversus. Unlike situs inversus itself, Kartagener's syndrome and PCD are clear disorders.[7]

### *There is no dysfunction in situs inversus*

A second possible counterargument is that the situs inversus example is a non sequitur because Boorse need not agree that situs inversus involves part-dysfunction. The basis for this counterargument is that, as Baillie explicitly asserts, bodily functions are unaffected by organ reversal. Thus, it could be claimed that, despite all the talk about freaks of nature and the unnatural, situs inversus involves no dysfunction because nothing goes wrong with the individual's functioning.

This objection confusingly looks for the inferred dysfunction in the *effects* of situs inversus rather than in its *cause*. As Baillie stated, symmetry considerations as well as the history of actual cases lead to the conclusion that total systematic organ reversal causes no dysfunction whatever either within the involved organs taken individually or in other organs causally linked to them. The inferred dysfunction—unknown to Baillie in its specifics but

identified and elaborated by contemporary science—lies instead in the reorientation's cause. The assumption is that there exists some mechanism that has the function of determining the usual orientation of the abdominal and thoracic organs, and in situs inversus this mechanism has failed to perform its species-typical function. Baillie, like more recent accounts, assumes that standard orientation is biologically designed and infers the existence of a part-dysfunction in the responsible mechanisms. However, he judges the dysfunction to be a nondisorder because there is no subsequent harm to the organism.

Nonetheless, ciliary complexities notwithstanding, Boorse in his paper in this issue appears to reply that situs inversus involves no part-dysfunction: "My analysis recognizes normal variants, *i.e.* variants of equal functional capacity. I myself cited blood type as a normal polymorphism (Boorse, 1977, 558). *Situs inversus*, without cardiac pathology, is also a normal variant for the same reason" (2014).

In calling situs inversus a normal variant, Boorse appears to deny that there is a part-dysfunction. Yet, situs inversus is not on its face analogous to blood type. No pathologist sees standard variations in blood type as part-dysfunctions, whereas virtually all scientific observers starting with Baillie concluded that situs inversus involves something going wrong in some part. We don't know why one consistent species-typical orientation rather than random orientation was naturally selected, but it appears that it was. Consequently, we implicitly reason that some part must have the species-typical contribution to our ultimate goals of producing standard orientation, and situs inversus must reflect a failure of that part to be capable of its species-typical contribution, hence there is a part-dysfunction. (If standard species-coordinated orientation continues to have some small long-run impact on fitness despite there being no significant harm to the deviating individual, then this reasoning would apply whether one adopts Boorse's or my view of function and dysfunction; see Part 2.)

Boorse's assertion that situs inversus is a normal variant does not clearly address the challenge raised by situs inversus because it fails to differentiate two senses of "normal variant." One sense refers to variations that are normal in the sense that they are all healthy, that is, free from disorder. Situs inversus is a normal variant in this sense; it yields a normal (i.e., healthy) person. The other sense refers to variation in which there is no part-dysfunction; the implicit reasoning above suggests that situs inversus is not a normal variant in this sense. In collapsing these two senses into one statement about normal variants, Boorse begs the question of whether situs inversus is, as Baillie claimed, an example of part-dysfunction without disorder, that is, an abnormal variant in the "part-dysfunction" sense but a normal variant in the "health" sense. As to the strategy of denying that situs inversus involves a part-dysfunction because it is functionally equivalent

to standard orientation, we saw earlier that this approach to defending the BST leads to serious problems in maintaining the pathologist argument that is at the root of Boorse's defense of the BST. Similar reasoning leaves dead cells, missing kidneys, and a host of other manifest dysfunctions according to the pathologist to be labeled as normal variants because of their innocuous effects.

## V. FURTHER CONSIDERATIONS: "BENIGN" DISORDERS, APPLICATION OF DISORDER TO LOWER ORGANISMS, AND THE HOMOSEXUALITY DEBATE

### Where Did All the Benign Disorders Go?

Could the counterexamples be only part of the story? The above examples show that there are part-dysfunctions that are not considered disorders, thus falsifying the BST's sufficiency claim. However, medicine also recognizes "benign disorders." Does this category conflict with the HDA's harm requirement?

The description "benign" is indeed used of many disorders. However, the way this expression is used supports neither the BST nor rejection of the HDA's harm criterion. Although usage varies somewhat, the crucial element in the attribution of benign disorder is not harmlessness but a less harmful prognosis when compared to some baseline class of disorders. The most common usage pertains to benign versus malignant tumors, but "benign" can be used in a more general sense: "Benign diseases are generally without complications, and a good prognosis (outcome) is usual" (Encyclopedia Britannica, 2014). For example, an article that disputes the benign nature of lower back pain focuses not on the obvious harm but on prognosis: "Low back pain is considered to be a benign disorder with a good prognosis. However, the results of recent reviews suggest that the long-term course on pain or functional recovery is not so favorable and that low back pain does not usually resolve spontaneously when ignored" (Bekkering et al., 2005, 1881).

In other areas, the prognostic comparison primarily has to do with the difference between cancer and less prognostically ominous diseases:

> The presence of benign breast diseases should be diagnosed prior to cosmetic breast surgery . . . to determine whether benign disease is present, and if so, what needs to be done to treat it. Benign diseases of the breast include rash, nipple discharge, mass, calcifications, and some syndromes, such as Cowden's disease, which carries a risk of breast cancer, and Weber–Christian syndrome, with benign subcutaneous masses that evolve into depressions. (Shiffman, 2009, 63)

Similarly, "Benign vulvar disorders are a significant issue for patients. These disorders include vulvar atrophy, benign tumors, hamartomas and cysts,

infectious disorders, and nonneoplastic epithelial disorders" (Schwartz et al., 2013). In the area of blood diseases, familial eosinophilia is considered to have a more "benign clinical course" as compared to nonfamilial forms, yet "Familial eosinophilia (FE) is an autosomal dominant disorder characterized by marked eosinophilia and progression to end organ damage in some, but not all, affected family members" (Klion et al., 2004, 4050).

In psychiatry, when it is noticed that some presentation listed in the DSM is harmless, generally it is reclassified as a nondisorder. For example, early criteria for stereotypical movement disorder covered both harmful (e.g., head-banging) and harmless (e.g., rocking back and forth when going to sleep) behaviors. Such stereotypic movements occur in intellectual disability disorders and are presumed to be caused by a dysfunction, but sometimes occur on their own. The criteria were eventually adjusted to require some form of harm and to eliminate harmless conditions from diagnosis. The "clinical significance criterion" requiring that symptoms cause significant distress or role impairment was added to many diagnostic criteria sets in DSM-IV and retained in DSM-5 precisely to ensure that an adequate degree of harm was associated with each diagnosis to "separate normal and pathological symptom expressions" and to prevent diagnosis of "individuals for whom a diagnosis of 'mental disorder' would be inappropriate." (American Psychiatric Association, 2013, 21). Although much confusion surrounds the clinical significance criterion (Wakefield, 1996, 2009b; Spitzer and Wakefield, 1999; Wakefield, Schmitz, and Baer, 2010), it is basically a manifestation of the intuition that disorder requires harm.

## Application of "Disorder" to Lower Organisms

Boorse puts forward an objection to the HDA's harm criterion based on the fact that disorders are commonly attributed to lower organisms. He objects that the HDA's harm criterion is difficult or impossible to apply to lower organisms, both because it is unclear whether or in what sense lower organisms can suffer harm, and because the HDA's harm component is (I have asserted) defined in terms of social rather than individual values, so how can it be applied to lower organisms who have no social definition of harm? Unfortunately, responding to this objection requires exploring the nature of harm across species and would take me too far afield given the limits of this paper and must await another opportunity.

However, it is worth noting that transposing the discussion to lower organisms does not save the BST from any of the objections lodged here to the sufficiency criterion. The BST runs into the very same problems in applying the sufficiency claim to lower organisms as it does when applying it to humans. A fly with one harmlessly dead cell, a dog that is an asymptomatic carrier of a dog disease, a cow with situs inversus totalis, and a fish with some dysfunctional sperm that do not affect its fertility all have part-dysfunctions

without being disordered. Something more than part-dysfunction is needed for disorder in lower organisms as well as humans.

## BST's Misunderstanding of the Homosexuality Debate

By defining medical disorder as a vast set of mostly harmless dysfunctions and relocating all value judgments externally to "disorder," the BST offers a framework quite different from the HDA's for interpreting debates about what is and is not a disorder. Perhaps the most salient example is the debate over the elimination of homosexuality from the DSM-III (American Psychiatric Association, 1980) and the nature of Robert Spitzer's arguments for elimination. A detailed analysis of this debate is beyond the scope of this paper, but a brief comment may be useful.

Boorse (1987) properly takes to task some faulty and ad hoc arguments and inconsistencies in Spitzer's arguments for eliminating homosexuality from the DSM (e.g., Spitzer takes the painful consequences of social disapproval or illegality of other paraphilias to be relevant forms of harm for supporting a disorder judgment when there is a dysfunction but ignores such forms of harm in the case of homosexuality) (Spitzer and Endicott, 1978; Bayer, 1981; Bayer and Spitzer, 1982). However, amidst the confusions, there is a consistent central thread that is inconsistent with the BST but perfectly coherent according to the HDA.

Spitzer was quite aware of the difference between factual and value judgments as part of disorder attributions and distinguished these in the debate over homosexuality. Spitzer himself eventually asserted that "what is at issue is a value judgment about heterosexuality, rather than a factual dispute about homosexuality" (Spitzer, 1981, 210). Forcing the debate over homosexuality into the Procrustean bed of the BST that insists "disorder" is value-free, Boorse must reject Spitzer's understanding of the issue as conceptually confused. Pointing to what seems to him a conceptual failure on Spitzer's part, Boorse rhetorically asks, "Why must normal sexuality be 'interpersonal', so that homosexuals but not fetishists or bestialists can be normal?" (1987, 380–81). The BST does not allow Boorse to see what Spitzer saw, that the homosexuality debate was in the end largely about whether the "harm" component of disorder is satisfied by homosexuality.

The judgment that homosexuality should be eliminated from DSM based on value grounds that it does not cause significant harm and thus is not a disorder should be distinguished from the value judgment that although homosexuality is a disorder, it should nonetheless be eliminated from DSM because of the substantial harm to homosexual individuals that occurs because of its official pathological status. No doubt some psychiatrists voted to eliminate the category on the latter nonconceptual grounds, despite believing that some forms of homosexuality are disorders. However, both publicly and in correspondence, this frankly political approach was not Spitzer's claimed reasoning. His reasoning was instead that whether or not homosexuality

is caused by a dysfunction (an issue on which he never came to a settled opinion, either publicly or in correspondence), in the contemporary context of overpopulation and widespread birth control among heterosexuals, the highest generally accepted normative goal of sexual-love relationships in our society is (or is increasingly becoming) not reproduction per se but mutual interpersonal and sexual satisfaction. Thus, except for social oppression, no harm as judged by evolving social values need occur to the homosexual individual based sheerly on the choice of a same-sex love object. It is this reasoning that allowed Spitzer to consistently argue for eliminating homosexuality but retaining the other paraphilia categories, all of which can be argued (admittedly with varying levels of plausibility) to represent various kinds of failures of the ability for full mutually loving relationships with another individual.

No matter how one ultimately judges the soundness of Spitzer's reasoning, his approach is conceptually coherent on an HDA account but conceptually incoherent on a BST account. Boorse and I agree that we are attempting to analyze the concept of medical disorder as it is actually used rather than prescribe some new concept we prefer. To that extent it is a strike against the BST that it must see the considered reflections of the leading psychiatric nosologist of our time about the reasoning involved in this pivotal moment in psychiatric history as based entirely on conceptual confusion rather than revealing something about how the concept of disorder actually works in medicine. In my view, Spitzer brilliantly exploited the "harm" criterion to finesse the homosexuality debate to a conclusion without foundering on the shoals of the hopelessly controversial question of whether as a matter of scientific fact some forms of homosexuality are caused by an as-yet-unknown part-dysfunction.

## Could Some Additional Factual Criterion be Substituted for Harm?

If one accepts that biological dysfunction is a necessary criterion for disorder but concludes that the BST's sufficiency claim must be rejected, that does not by itself imply that what is needed in addition is the HDA's harm criterion. The harm criterion does explain the intuitions in the examples considered throughout this paper. However, it has sometimes been suggested that if something more than part-dysfunction is required for disorder, then the additional requirement might not be harm or any value component, but rather some further factual criterion correlated with harm, perhaps concerning the part-dysfunction's overall impact on the organism.

Seriously addressing this suggestion must await another occasion. However, I venture to speculate that any such alternative to a value criterion will run into trouble for the same reason that the BST runs into trouble. Whatever factual criterion one puts forward for disorder, it will fail to correspond to our intuitive classificatory judgments when the factual criterion does not have

any meaningful harmful implications for the individual. The idea that one can "complete" the concept of disorder by adding a further factual criterion to part-dysfunction suffers from a kind of naturalistic fallacy, always subject to the objection: But what if this fact has no harmful effects whatever on the individual? In such cases, I claim—and the examples presented throughout this paper suggest—pathologists and physicians and laypeople would conclude that although there is an abnormality, there is no decrease in the individual's heath. The intellectual appeal of a purely scientific conception of disorder notwithstanding, the failure of the BST's sufficiency claim may be an instance of a general principle that value-ladenness is the price one pays for analyzing the foundations of a practical activity or profession like medicine versus a pure science.

## VI. CONCLUSION

Conceptual analyses, like scientific theories, must be judged in large part by explanatory power. The search for reflective equilibrium allows some flexibility in how one interprets the evidence and resolves anomalies, but it quickly turns into the rationale for ad hoc theory-preserving if explanatory power regarding intuitively clear cases does not retain central stage. On explanatory power grounds, I believe the above discussion provides good reasons for rejecting the BST's central claim that part-dysfunction is sufficient for medical disorder and for accepting the HDA's claim that harm is additionally necessary for disorder. Even if one accepts Boorse's claimed conceptual authority of pathologists over clinicians, pathologists' intuitions about health and medical disorder would not seem to support Boorse's proposed bifurcation of disorder concepts. Instead, pathologists and clinicians appear to have univocal concepts about pathology in the part-dysfunction sense on the one hand, and concepts of medical disorder, disease, and loss of health on the other, and they understand the difference in a way that appears to be consistent with the HDA. The counterexamples and other arguments and evidence presented here suggest that Boorse's aspiration to embrace the BST's sufficiency claim and still attain Rawlsian reflective equilibrium about medical disorder judgmentsis not achievable.

One might object: given two different closely linked concepts, biological dysfunction and medical disorder, how do we tell which is the "basic theoretical concept of Western medicine"? Isn't it arbitrary whether we call one biological and the other medical, or place both within the medical domain as theoretical and clinical disorder concepts? Boorse himself has implicitly offered the answer to this question over the course of his brilliant work on the concept of disorder. The indisputable touchstone for entering the medical domain is direct implications for judging the health of an individual. Boorse's pathologist test, properly applied, as well as the above

counterexamples, reveals that pathology in itself—in the broad sense of any biologically dysfunctional mechanism—does not imply a health deficit in the individual and so does not provide a sufficient warrant for crossing into the medical conceptual domain.

## NOTES

1. Failure of function can be partial or full incapacity. Boorse looks to statistical deviation from species-typical levels of functioning as the test of failure, whereas I look to evolutionary considerations as the test of failure. My phrasing is intended to be compatible with both possible formulations.

2. I note the caveat that in Part 2 of this comparison of the BST and HDA I will argue that the BST's potential usefulness in addressing the noted issues may be weakened by the BST's analysis of dysfunction, especially Boorse's Cummins-type view of functions as current contributions to goals and his statistical approach to judging proper functioning.

3. Of course, medicine addresses many problems that lie outside its essential domain of medical disorder, such as contraception, relief of normal pain, and cosmetic surgery. I have distinguished the tasks of a profession that are part of the profession's essential mission from the additional tasks it is mandated to undertake due to its unique technical skills, which I label "essential" versus "derived" professional tasks, respectively (Wakefield, 1988a, 1988b). I also note that, although I accept here the standard view that medicine is essentially concerned with the health of individuals, I have argued elsewhere that "disorder" might literally apply to some systems of organisms, such as parent–child dyads, in which there can be systems-level harmful dysfunctions (Wakefield, 2006b, 2006c).

4. The assertion that defenses are triggered by dysfunctions applies to the case at hand but is an overstatement if taken as a generalization (as I am sure Boorse would agree). Defenses are not always triggered by dysfunctions. Sneezing is a defense often triggered by dust or other environmental threats that have not yet become dysfunctions. Consistent with the HDA and BST position that dysfunction is necessary for disorder, in cases in which there is no dysfunction underlying the defense, we do not judge the defensive "symptom" to indicate disorder, as in sneezing in a dusty environment.

5. An amusing ontological conundrum raised by Baillie's report was: although the testicles are normally symmetrical and thus in situs inversus appear entirely identical to the normal condition, is it still the case that in situs inversus totalis the left testicle is in fact the transposed right testicle?

6. The ICD for a variety of reasons tends to place few conditions in the nondisorder category even when plainly they are nondisorders. For example, the ICD-10's "O-codes" in chapter XV include disorders related to "pregnancy, childbirth, and the puerperium" but also include such nondisordered conditions as "O80. Single spontaneous delivery" that explicitly states that it "includes delivery in a completely normal case," "O80.0. Spontaneous vertex delivery" (i.e., a completely normal unaided head-first delivery) and "O04.9. Medical abortion, complete without complication."

7. Situs inversus's code is also useful because the condition requires the physician to alter the procedure for performing some diagnostic tests and procedures. For example, EEG leads and defibrillator pads must be positioned in reversed positions, appendicitis must be diagnosed with the pain on the opposite side from the usual, and organ transplantation poses challenges in fitting normally oriented organs to the patient's inverted structure.

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