Impaired awareness in Huntington disease: medical evidence in relation to the optimal expectations model

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October 15, 2013

Abstract

Neurological disorders such as Huntington disease (HD) may be accompanied by anosognosia, or impaired awareness: the patient's inability to recognize dysfunction in herself, due to damage in specific regions of the brain. Impaired awareness is thus a neurological condition, different from psychological mechanisms such as denial or wishful thinking. Economics research recently suggested the optimal expectations model as a description for why individuals at risk of HD only rarely opt to undergo predictive genetic testing and why they tend to hold overoptimistic beliefs about their health. Though this model certainly provides insights into the psychological mechanisms at play, it ignores the neurological channel. In this paper we review the medical findings on impaired awareness in HD and argue that taking account of them helps our understanding of testing avoidance and overoptimism, and improves our ability to formulate policy prescriptions and to generalize from the HD case to non-neurological settings such as HIV-AIDS and some forms of cancer, where testing is also available but taken infrequently.

In their study of the behavior of individuals at risk of developing Huntington disease (HD), Oster et al. (2013) provide compelling evidence that the emotional consequences of information and personal beliefs play an important role in decision making. The authors find that individuals at risk of HD only rarely opt for a blood DNA test that would reveal with certainty whether they carry the gene expansion that inevitably leads to the disease, and that the individuals express overly optimistic beliefs about their health. These observations, the authors argue, are well explained by an optimal expectations model in which beliefs about uncertain events are a choice variable. Accordingly, if a person at risk of HD avoids getting tested, she remains unsure about her health status and thus cannot perfectly plan her consumption; nevertheless she can choose to believe that she is healthy, thereby obtaining anticipatory utility. The resulting utility may be higher than that yielded by the alternative of choosing to get tested, whereby

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the person discovers the truth and can plan consumption perfectly, but is no longer able to hold comforting beliefs.

As Oster et al. (2013) correctly note, low testing rates have been observed in numerous other settings, including HIV testing and genetic tests for cancer markers. Thus, with their modeling of the mechanism underlying information avoidance and self-serving beliefs, and with their clean identification of a difference score between objective and perceived risk of disease, the authors make an important contribution to the economics, psychology, and medical literatures, to which they provide "a concrete answer to why individuals may avoid testing and a framework in which to think about [how to encourage medical testing and whether doing so is a good idea]." Nevertheless, the framework Oster et al. (2013) provide ignores an aspect that we consider to be of considerable significance in the HD setting: the possibility that individuals afflicted with HD avoid testing and hold overoptimistic beliefs about their health not just due to a psychological mechanism, but also due to a neurological one, as medical research on anosognosia in HD shows. Taking account of the neurological channel helps to better understand the behavior of a population at risk of HD and to produce more accurate policy prescriptions. It also helps to better understand how the HD case generalizes to settings such as populations at increased risk of HIV and certain forms of cancer, where testing is also available but the neurological aspect is entirely absent. Our goal with this note is to introduce the concept of anosognosia—or impaired awareness—in HD, and discuss its possible implications to the phenomena of information avoidance and overoptimism in HD and elsewhere, with the intention of contributing to the investigation of these issues.

I. Anosognosia in Huntington disease

The term anosognosia was coined in 1914 by French neurologist Joseph Babinski, in reference to the baffling behavior—reported multiple times since—of individuals entirely paralyzed in one side of the body due to damage in the opposite-side cerebral hemisphere and who, despite their blatant handicap, seem to be unaware of their condition. When asked if they have any problems, these individuals say they are fine and never refer to their paralysis; when asked to move the affected arm, they may remain immobile and silent, behaving as though the request is not put to them; when asked whose is that immobile hand sitting on the table, they may give bizarre answers like "Not mine, doctor. I suppose it's yours" (Sandifer, 1946). This inability to recognize hemiplegia in oneself is neurologically based, as it results only from damage to specific regions of the brain. It is telling, for example, that anosognosia in hemiplegia is observed mostly for left-side paralysis but not for right-side paralysis; similarly, left-side paralysis caused by patterns of brain damage other than those associated with anosognosia is not accompanied by unawareness (Damasio, 2005). The precise neuroanatomical correlates of the condition are not yet fully understood, though it is well established that the problem is linked to dysfunction in the basal ganglia and related frontal lobe circuitry (Flashman, 2002, and Johnson et al., 2010).

The scope of the term anosognosia has expanded over time, and now encompasses similar unawareness of neurological/neuropsychological dysfunction following various conditions other than paralysis and that results directly from brain damage (Prigatano, 2010). One such condition is Huntington disease, whose medical literature frequently notes that patients systematically underreport the severity of their deficits (Mendez et al., 1989). And because HD disrupts the

basal ganglia and related frontal cortex systems (Peinemann et al., 2005), it is possible that part of the unawareness in HD patients is neurologically based—i.e., a direct result of the disease—rather than psychologically motivated.

This hypothesis was first investigated by Deckel and Morrison (1996), who asked a group of HD patients (the majority of whom already presented HD symptoms) and a control group of patients with various non-HD neurological conditions to rate themselves on their ability to perform different motor and cognitive tasks. The investigators compared self-ratings to ratings given by clinic staff members, and found that HD patients overestimated their abilities to a larger extent than the control group did, suggesting that HD patients had poorer awareness of their impairments than non-HD patients. Subsequently, the investigators administered a series of neuropsychological tests to the HD patients and found that performance on these tests was significantly worse for those whose unawareness was larger, a finding that provided increased evidence that the unawareness observed could have a neurological origin related to damage caused by HD.

Succeeding studies have given further insight into the complexity and subtlety of the phenomenon of anosognosia in HD. Notable are Ho et al. (2006) and Hoth et al. (2007), who (again) showed that HD patients consistently underestimate the degree of their deficit across a range of abilities, but nevertheless are perfectly capable of rating accurately the performance of other individuals on these abilities. This important finding reveals that anosognosia is a disability to recognize a problem in oneself, rather than a disability to recognize the problem per se. More recently, Duff et al. (2010) reported executive disability and apathy in individuals known to carry the HD genetic expansion but who did not yet show significant motor signs to warrant a diagnosis of the disease (most of them were as early as 10 or more years from diagnosis). In addition, the authors found a negative relation between awareness of handicap and probability of diagnosis in the next five years (as determined by a genetic test), which suggests that lack of awareness occurs even in pre-diagnosed individuals and increases with proximity to motor diagnosis. Finally, McCusker and colleagues (2013) studied for a number of years individuals who knew they carried the HD gene expansion but who did not meet criteria for diagnosis of HD at study entry, and found that half of those who developed visible HD symptoms in the duration of the study were unaware of symptoms at their onset. Importantly, unaware individuals were also less likely to report depression than symptomatic individuals who did recognize their symptoms. The authors concluded that self-reports may be increasingly inaccurate in premanifest HD as they progress toward manifest disease.

II. Implications in relation to optimal expectations

If the goal is to characterize behavior and inform policymakers in the HD setting and elsewhere, then a discussion of the possibility of impaired awareness in HD is necessary. The phenomenon, well documented in the medical literature, has direct implications for the accuracy of the optimal expectations model, for the policy prescriptions that can be derived from it, and for the generalizability of the findings and implications to domains other than HD.

In discussing these points, it is important to note that the population studied by Oster et al. (2013) comprises individuals at risk of HD. Naturally, some participants did not have the HD gene mutation, others had it but were premanifest, and others had it and showed

clear symptoms of HD at some point in the study. Oster et al. (2013) propose the optimal expectations model to explain testing avoidance and overoptimism in all three subpopulations. Yet, the evidence reviewed here indicates that doing so may be only partly correct. The model is an apt description of the psychological mechanism that may be at play, particularly for the behavior of those individuals who do not carry the HD gene expansion and thus are unlikely to be neurologically impaired. But for the unfortunate subset of participants in the study who do carry the HD gene expansion and who are in either a premanifest or a manifest stage, information avoidance and overoptimism may be the combined result of a psychological mechanism and a neurological mechanism.

If neurological dysfunction partly underlies the optimism exhibited by individuals at risk of HD, then, contrary to the optimal expectations model, the distortion in beliefs about one's own health may persist even after the individual learns unequivocally that she carries the HD gene expansion. The studies here reviewed support this idea, as they provide repeated evidence of unawareness of deficits among HD patients who know they carry the HD mutation. Not only may the individual's beliefs about her own health not correspond to reality after testing, but also her consumption decisions—decisions about work, marriage, education, etc.—may fail to correspond to her actual state even after testing, much in disagreement with the optimal expectations model.

Bearing in mind the literature on anosognosia in HD may illuminate features of Oster et al. (2013) data that are otherwise at variance with the predictions of the optimal expectations model. For instance, the model predicts that as symptoms of HD become more visible and the objective probability of HD rises, the individual will eventually revise upward her subjective belief of having the disease. Nevertheless, on average, subjects in Oster et al. (2013) update only very minimally as symptoms worsen, which leads to an increased discrepancy between risk of HD as perceived by the individual and objective risk of HD based on observations by the examiner, as symptoms become more noticeable (see Figure 4 of their paper). This pattern is, on the other hand, entirely consistent with Duff et al's (2010) and McCusker et al's (2013) conclusions that unawareness may occur in premanifest HD patients and may increase as they progress toward manifest disease. Striking is also the fact that a nontrivial proportion of the participants in Oster et al. (2013) appear to be so utterly unaware of their deficits as to report 0 percent risk of HD when in fact their objective risk of HD is at or above 99 percent, and that the share of participants indicating a 0-percent risk is highest for individuals with most visible symptoms (again, see Figure 4 of their paper). This latter finding is inconsistent with the optimal expectations model,[1] and suggestive of impaired awareness.

Policy recommendations regarding whether we should encourage or not testing for HD may also vary given the possibility of impaired awareness. Oster et al. (2013) suggest that if the emotional toll of knowing the truth is potentially very large, then we should be wary of inadvertent revelation of genetic status. McCusker et al. (2013) perhaps lend some credence to this view when they find that unawareness of symptoms is associated with lower levels of

[1] In the section 'Theory: Optimal Expectations,' Oster et al. (2013) denote the individual's perceived risk of HD by $\pi \in [0, 1]$ and the objective risk of HD by $p \in [0, 1]$. Their proof of Proposition 1 (p. 820) obtains that $\pi = 0$ for $p \in [0, p^*]$, and π equals some number greater than zero for $p \in (p^*, 1]$, where p^* is some positive number. Therefore, the model predicts that perceived risk of HD be revised upward given a high enough objective risk of HD, which in turn implies that the proportion of agents whose subjective belief is 0 can never increase as the objective likelihood of HD rises.

depression. At the same time, though, genetic testing of an individual who may become unable to acknowledge her condition and to provide reliable self-assessment may prove particularly valuable to the individual's caregivers and relatives. Designing effective treatment for such an individual, and in general managing the progression of her disease, is obviously a rather difficult task, which may be facilitated by early testing. In the words of McCusker et al. (2013): "Unawareness has major implications for better defining the disease process, time of presentation for diagnosis and assistance, measures of progression, the impact of impaired function in daily activities including driving and in the workplace, as well as perception of possible discrimination and caregiver burden. Treatment, when available or for symptomatic disease features, could be delayed if the person fails to notice the changes taking place and to present for care." Moreover, an intervention such as educating potential patients and their relatives about the phenomenon of impaired awareness may change their attitudes toward testing.

Considerable work is still needed before we can understand the workings of impaired awareness in HD. But it seems clear that, because of the neurological nature of the condition, whatever effects it has on attitudes toward testing and on the accuracy of assessment of one's own health we can expect not to observe them in settings such as HIV and various cancers, where neurological impairment is absent. Generalizations from the HD population to these other domains must not be made without taking into consideration the phenomenon of anosognosia. It may for instance be the case that the reluctance of participants in Oster et al. (2013) to update their perceived likelihood of having the disease in the face of increasing symptoms will replicate to a lesser extent in nonneurological settings. Similarly, conclusions about the benefits of encouraging early testing, and about the weight that should be given to the individual's self-assessment for making important life decisions versus that put on the judgment of her relatives and caregivers are not readily extendable from the HD population to the HIV and cancer populations. Neither should we directly extend the optimal expectations model to explain behavior (for example denial of illness or refusal to take medication) of individuals with other brain disorders for which impaired awareness is common, such as schizophrenia, movement disorders, and traumatic brain injury (Prigatano, 2010).

These are questions of great significance for the welfare of the parties involved. What we can learn from the behavior of individuals at risk of HD, and what we can in turn say about behavior in other domains, is not fully appreciated without a discussion of impaired awareness. We hope that our note further contributes to the understanding of the phenomena of testing avoidance and overoptimism, and to the design of correct policies in response.

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