

Economic Betterment (Value): Are all betterments commensurable? Can you compare your relief from less global warming with more anxiety at work? The loss of a friend? Or even money?

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Abstract: The choice theory that supports the valuation of ecological and environmental resources assumes you have a complete ranking of paths (states-of-the-world) in terms of betterment. That is, experiencing a higher-ranked path is better for you, from your perspective, than experiencing a lower-ranked path. Where: Every path for you is a conceivable life-path as it would unfold through time, including its ecological resources. Having a betterment ranking of paths requires that all of your different feelings and thoughts are commensurable in terms of how they affect your overall betterment (all types of betterments and worsements collapse onto one dimension). Even if you know in what way, and to what extent, each aspect of each conceivable path betters you, it is still a stretch to assume—which you probably do—that it is always possible to collapse all betterments onto one dimension. For example, you must be able to compare the betterment caused by dates with Alex with the betterment caused by saving gorillas, with the betterment caused by the freedom to practice your religion. In opposition to neoclassical choice theory, many people reject complete betterment-commensurability. I summarize the arguments and findings in the context of environmental and ecological resources.

Keywords: betterments and bearers-of-betterments, value, incomparable and incommensurable, a ranking based on betterment, betterment/bearer separability, neuroeconomics, the striatum, and the ventromedial prefrontal cortex

If you teach principles or intermediate Microeconomics, you likely talk about, or allude to, people having a ranking of bundles based on betterment. And, as part of that discussion, you might talk about the marginal rate of substitution (MRS) between Coke and Pepsi, or Coke and chocolate. In my class, since I am an environmental economist, I talk about the MRS between chocolate and the rate of global warming; or said another way, I talk about your willingness-to-pay (WTP) in chocolate for a reduction in the rate of global warming. Alternatively, you might think about your MRS, if you have one, between the rate of global warming and freedom to practice your religion.

1 I start by making assumptions that produce a complete ranking based in betterment
What I mean by a *path*:

A path for an individual is a conceivable life and world as it would unfold through time. It includes the goods and services they would consume through time (their consumption bundles), what they would know and not know at different points in time (their knowledge), what others would consume (other's consumption bundles), what others would know, plus the individual's relationships (social, sexual, work related), the relationships of others, and the environment (who is now and will be the future Prime Minister of England, air qualities, crime rates, etc.). Risks and uncertainties are part of every path.

If you were taking an introductory microeconomics course, your path would be defined only in terms of the amounts of each market good you would consume, and it would be called your *consumption bundle*. But most of us care about much more. Every path generates a flow of feelings and thoughts, but, as I have defined it, a path is neither. You and I might be on the same path but experience different feelings and thoughts. Each path includes risk, uncertainty, and ignorance, all of which pertain to global warming, the health effects of pollutants, and models of the environment.

Now assume:

Assumption 1: At every point in time the individual can and must be on only one path

*Assumption 2: At every point in time, the individual has a unique ranking/ordering of all conceivable paths—1st, 2nd, ..., 76th The individual has a ranking, if for all paths *j* and *k*, either Path *j* is ranked higher than Path *k*, Path *k* is ranked higher than Path *j*, or Paths *j* and *k* have the same rank.¹*

¹ A complete ordinal ranking is, by definition, transitive. Transitivity implies that if Path *j* is ranked higher than Path *c*, and Path *c* is ranked higher than Path *a*, then Path *j* is ranked higher than Path *a*.

Assumption 2 simply says that if you present an individual with any two of all the conceivable paths, the individual knows (not necessarily consciously) which path is higher in his ranking.

Assumption 2 does not imply the ranking is based on betterment.

Finally, let's throw in betterment.

Assumption 3: *Experiencing a higher-ranked path is better for the individual, from their perspective, than experiencing a lower-ranked path.*²

I consider what is required of you in terms of comparability for you to have a complete ranking of paths based on betterment.³ In parallel, I consider whether you always will have a WTP and willingness-to accept (WTA) a switch from one path to another.⁴

Note that while we often describe betterment in terms of tradeoffs, specifically in terms of a MRS, WTP, or WTA, having a complete ranking does not require that there are any paths between which you are indifferent—that is, a complete ranking does not require the existence of indifference curves, does not require marginal-rates of substitutions that are always finite, and does not require willingnesses to accept that are always finite. [An example demonstrates: consider two goods (more of each is better): chocolate and religious freedom where paths with more religious freedom are always better, independent of the amount of chocolate in each path. No two paths are ranked the same and there is never a finite MRS between the two goods, and your WTA less religious freedom is always an infinite amount of chocolate.⁵] It is important to keep in mind the distinction between a ranking of paths and measures of how much you would pay or give up to switch paths. Having a complete ranking of paths is necessary, but not sufficient, to imply that you have a finite MRS's for all levels of all pairs of all components of paths. Going the other way: if I have a complete set of MRS's—all finite—this is sufficient, but not necessary, for me to have a complete ranking of paths.

² Not all neoclassical choice-theories assume a ranking based on betterment. Often the word *preference* is used as in higher-ranked bundles are more preferred, where more preferred might, or might not, mean better. If this essay made that assumption, it would discuss *bearer-of-preference comparability* and *preference commensurability*, which is what would be required for a complete ranking of paths in terms of preferences.

³ There are many other reasons you might not have a complete ranking of paths, but those are not the topic of this essay.

⁴ Instead of the terms WTP and WTA the discussion could be framed in terms of compensating and equivalent variations (CVs and EVs). Recollect that for a higher-ranked state the CV is positive and your WTP to switch to the new state (how much money or chocolate, or whatever, would have to be subtracted from the new path to make you indifferent between the initial path and the new path with the subtraction. The CV for a lower ranked state is negative and, in absolute terms, your WTA the lower-ranked state.

⁵ Your WTP for more religious freedom would be all of the chocolate in your initial path.

I will mostly avoid the words *utility* and *preferences*: words fraught with multiple meanings and words that mean different things to different people. I will sometimes use the words *value* or *values*, but I worry about those words as well, as I will explain below. [Philosophers typically use the word “value” (Nien-hê Hsieh 2016).] Rather, I will use the terms *better off* and *worse off*. An auxiliary term is *betterment*; as in, if all else you experience remains the same, a betterment makes you better off. The plural is *betterments*: there is more than one way to be better off. Its meaning here is consistent with what is commonly meant by *better off*, and *better* is not commonly used in the economic choice literature, so has little baggage.⁶

For this essay, imagine our concern is only one individual, for example, you, a human. Betterments (and worsements) are types of feelings, sensations, and thoughts. I will assume betterment is self-assessed and that there is no difference between your betterment and your self-assessed betterment.⁷

2 Consider the distinction between different *betterments* and *bearers-of-betterments*

A *bearer-of-betterment* is a commodity, action, or situation that generates one or more types of betterment. Bearers of interest are all conceivable paths and their components. The question is whether you **can** have a complete and unique ranking of paths in terms of overall betterment. To be clear, the question is not whether you have a complete and unique ranking in terms of betterment, the question is what is required in terms of betterments and bearers-of-betterments for such a thing to even be possible.

You experience a path as a sequence/set of feelings, sensations, and thoughts. Experiencing certain sensations are types of betterment, so if two paths were to produce the same thoughts, the one with more betterment sensations is better. For example, if two paths were identical except one has more of the sensation of sweet-‘n-salty, I would be better off with that one.

Alternatively, if two paths were to generate the same sensations and feelings but I think my life more satisfying with the second path (a thought), it is better. I have identified two types

⁶ My use of *better* and *worse* is not without precedent. See Mark Schroeder (2012).

⁷ I ignore the likely possibility that there are betterments the individual does not self-assess as a betterment and things the individual thinks will better them but won't.

of betterment: enhanced life-satisfaction and the taste sensation sweet-'n-salty. Caramels with sea salt and bacon bits are bearers of this betterment sensation, having children that prosper might be a bearer of life-satisfaction. Daniel Kahneman and Angus Deaton (2010) refer to these two types of betterment as *emotional well-being* and *life-satisfaction well-being*.

If a political philosopher was writing this, she might use *freedom*, *equality*, and *pleasure* as examples of betterments and the Bill of Rights as a bearer of freedom and equality. If she were talking to other philosophers, she would likely use the words *values* and *bearers-of-value* rather than betterments and bearers-of-betterments; but, as noted, I am trying to avoid the *value* word. Ruth Chang (1997) is responsible for introducing the term *bearers-of-value* to keep clear the distinction between values and the things that produce/embody values.

Most people, including most economists and philosophers, are *betterment pluralists* (a philosopher would say *value pluralists*); that is, most of us believe there is more than one way to be better off. Cass Sunstein (1994) makes a rousing case for betterment pluralism. The utilitarian Jeremy Bentham was not a betterment pluralist: he was a betterment monist; he assumed the only betterment is pleasure (a unidimensional pleasure/pain continuum), and a sensation that varies only in terms of magnitude and duration.⁸ The philosopher and legal scholar Donald Regan is, I believe, a rare example of a modern monist. Quoting him (1997, 129):

In this volume I am the 'designated eccentric', appointed to take a position no one else would touch with a barge pole,...Specifically, I believe the following two propositions: (1) There is one and only one sort of value that matters to practical reason in the final analysis. This unique final value is G.E. Moore's 'good' ['good' as in approved of].⁹ (2) Given any two items (objects, experiences, states of affairs, whatever) sufficiently well specified so that it is apposite to inquire into their (intrinsic) value in the Moorean sense, then either one is better than the other, or the two are precisely equal in value.

If there is only one type of betterment, whether one can compare betterments is a non-issue.

There is no agreed list of betterments and worsements, and what might be a betterment for me might be a worsement for you. Betterment feelings and thoughts include sensual pleasures (tastes, sounds, sights, sexual), happy, content, excited, awed, calm, relaxed, prideful,

⁸ He was preceded in that belief by John Lock (1632-1704) (Locke, Book II: Chapter XX; Patricia Sheridan 2016, 19). Whether the utilitarian J.S. Mill was a betterment pluralist is a matter of debate. The philosopher Martha Nussbaum identifies him as one because he counts, for example, "music, virtue and health as major pleasures" (Nussbaum 2012, 338). In contrast, Mark Schroeder in his survey of Value Theory (2012) notes that "whether Mill properly counts as a pluralist about value depends on whether his view was that there is only one value — happiness — but two different kinds of pleasure which contribute to it, one more effectively than the other, or whether his view was that each kind of pleasure is a distinctive value."

⁹ As in the sentence, "It is good that you are here."

feeling superior, feeling free, and feeling liked and loved. So is satisfied, including with one's life; so is accomplished. For many, feeling the grace of God is a betterment. If the love of nature is a unique type of love, love-of-nature is a betterment.

Worsements can include pained, anxious, worried, depressed, hungry, thirsty, embarrassed, fearful, sad, and angry, the experience of these by others, negative thoughts, lonely, feeling discriminated against, feeling inferior, and feeling controlled. What is on the list is not the critical issue; the critical issue is that there are different ways you can be better off and different ways you can be worse off. It is important to distinguish between a betterment and the bearer of that betterment. For example, feeling accomplished is a betterment and getting tenure is one bearer of that betterment.

3 Incomparable and incommensurable:

Distinguish between comparing betterments (more freedom vs. more sexual pleasure) and comparing bearers-of-betterments. Asking whether Path k overall is better than Path h is comparing bearers-of betterments.¹⁰ For example, if Path k is identical to Path h , except that Path k has x more pandas in the wild but y fewer teachers in your daughter's school, can you determine which path is better? If two bearers-of-betterments are not comparable, philosophers use the word *incomparable* (Chang 1997). If two types of betterment are not comparable, they use *incommensurable*. The adjective betterment is implicit on both words—here we are concerned with comparing in terms of betterments.¹¹

Bearers-of-betterments h and k are incomparable if **none** of the following statements are correct: (1) h is overall better than k , (2) k is overall better than h , or (3) h and k are equal in terms of betterment.¹² They are comparable if one, and only one, of these statements is correct. Paths h and k being comparable does not imply that either is comparable with any other paths.

¹⁰ I will use lower-case letters to denote paths and specific commodities, and I will use upper-case to denote betterments.

¹¹ Paths can be comparable on many different dimensions, for example, the total weight of the food you will consume in each path, or the number of pink swans that will bite you.

¹² This is viewed by some as a *weak* notion of incomparability. Chang (1997) suggests that in addition to better than, worse than, and equally good, j and k can be "on par". *Strong* incomparability would be when none of the four conditions hold. "On par" or "roughly comparable" have been put forward as a possible solution to the problem of incomparability, but it violates transitivity of bearers (Nien-hê Hsieh (2007)). See Derik Parfit (1986), James Griffin (1986, 1997, 2000), Chang (1997), and Hsieh (2007).

Choice theory explicitly assumes all paths are comparable: if all paths are not comparable, there wouldn't be a complete ranking of paths based on betterment. By itself, comparability of paths h and k does not guarantee that there is a finite compensation that will make you indifferent between the two paths; that is, comparability of h and k does not imply your WTA to shift from one to the other is finite.

Even if paths h and k are incomparable in terms of overall betterment, they still could be comparable in terms of a specific betterment (e.g. Path k generates more happiness than h , but less life satisfaction).

Commensurability: Betterments A and B are incommensurable if you are incapable of comparing them in terms of overall betterment (David Wiggins 1997).¹³ For example, for you, personal freedom and equality are incommensurable if, at some levels of each, you cannot say which is better, more freedom and less equality or less freedom and more equality. So, commensurability requires, for example, that you can compare the sensual pleasure of music with the relief from finding out that pandas won't be going extinct. Complete commensurability means you have a complete ranking over all conceivable packages of betterments.

3.1 *Other characterizations of incomparability and incommensurability*

This section first characterizes the incomparability of commodities in terms of MRS's between pairs of commodities (equivalent to WTP and WTA for one in terms of the other). It then presents and discusses the incomparability of paths in terms of WTP and WTA. Then it presents and discusses John Boome's characterization of the incomparability of paths. It ends by characterizing the incommensurability of betterments in terms of the MRS between betterments.

3.1.1 *Characterizing the incomparability of **commodities** in terms of MRS's between pairs of commodities (equivalent to characterizations of WTP and WTA for one in terms of the other)*

I start with this characterization because we are all familiar with the MRS between commodities x and y . If commodities x and y are incomparable at some levels, the MRS_{xy} does not exist at those levels of x and y , and your WTP for more x in terms of y has no meaning. That

¹³ Note that while betterment pluralism is necessary for there to be incommensurability, it is not sufficient—all betterments might be commensurable—which is what choice theory implicitly assumes.

is, if elephant herds and the rate of global warming are incomparable, there is no WTP in terms of elephant herds for less global warming.

And, if at the specified levels of x and y , MRS_{xy} exists (an infinite or finite number), x and y are comparable at those levels. So, [x and y comparable] \leftrightarrow [MRS_{xy} exists (an infinite or finite number)]. Therefore, finite MRS is sufficient, but not necessary, for x and y to be comparable.

Graphically, a sufficient, but not necessary, case for comparability can be represented by a standard indifference curve. For example, consider two path components: the percent of the population with health care, h , and the rate of global warming, g . Picture a standard-looking indifference curve map with g on the horizontal axis and h on the vertical axis. Moving up indicates an increase in the percentage of the population with health care, a betterment for the individual represented, and moving right is a decrease in the rate of global warming, also a betterment. At the origin of the graph, no one has health care and there is a high rate of global warming.¹⁴ The individual represented by this indifference map knows, for example, how much she would be willing to increase the rate of global warming to achieve a 10% increase in health-care coverage. [If desired the figure can be added.]

Alternatively, maybe for you, MRS_{gh} is infinite (there is no finite amount of health-care coverage you would be willing to sacrifice to reduce the rate of global warming). If so, h and g are also comparable for you at current levels, but your indifference curve is vertical at the point.

For an individual for which both activities are bearers-of-betterments but more health-care coverage is always better than less, independent of the rate of global warming, h and g are still comparable (there is no finite amount of health-care coverage this individual would be willing to sacrifice to reduce the rate of global warming. But for this individual, there are no h/g indifference curves (no two combinations are ranked the same).

If for me at current levels, these two bearers are not comparable, no indifference curve includes these levels, and a MRS_{gh} does not exist (not zero, not infinite, nor in between). Maybe health care coverage and global warming are incomparable for me because the existential angst I feel from knowing the planet is warming is incommensurable with the abhorrence and disgust I feel from knowing sick people are suffering unnecessarily.

¹⁴ At some point on the horizontal axis, the rate of increase goes from positive to negative, negative implying global cooling.

3.1.2 The incomparability of *paths* in terms of WTP and WTA¹⁵

If paths j and k are incomparable, the WTP and WTA for a switch from one to the other does not exist. That is, if path j has less elephant herds than path k but a lower rate of global warming, and these two paths are incomparable, then trying to estimate the compensating or equivalent variation associated with a switch from one to the other is trying to estimate something that does not exist.

3.1.3 Boome's (2001) characterization of the incommensurability of *paths*

Boome is an economist and philosopher at the University of Oxford. *Ceteris paribus*, consider whether it would be better to have 100 more prospering herds of elephants or a 7% reduction in the rate of global warming. g , as above, is the rate of global warming. Denote the initial state (e^0, g^0) . Let $e^1 = e^0 + 100$ (100 more prospering elephant herds) and take the switch from e^0 to e^1 as given. Consider Figure 1: as one moves up the number of elephant herds increases, and as one moves right the rate of global warming declines. Start by noting that (e^1, g^0) is better than (e^0, g^0) —more elephant herds and the same rate of global warming.

[Figure 1 here]

Now imagine all those amounts of g such that (e^1, g) is strictly worse than (e^1, g^0) . Denote the boundary of those bundles (e^1, g^w) . So, in my example, all the bundles on the e^1 line at and to the left of (e^1, g^w) are worse than (e^1, g^0) . Now imagine all those amounts of g such that (e^1, g) is strictly better than (e^1, g^0) . Denote the boundary of those bundles (e^1, g^b) . So, in my example, all the bundles on the e^1 line at and to the right of (e^1, g^b) are better than (e^1, g^0) .

Critically note that I have imagined g^w and g^b such that there are amounts of g on the e^1 line between (e^1, g^w) and (e^1, g^b) that are neither strictly worse nor strictly better than (e^1, g^0) . Is this possible? It depends. Back up, and assume for the moment, inconsistent with Figure 1, that there is only one level of g between (e^1, g^w) and (e^1, g^b) , and denote it g^i . If there is only one point, it must be the case the individual is indifferent between (e^0, g^0) and (e^1, g^i) .¹⁶ So, if there is only

¹⁵ We typically don't think about MRS between paths; we, instead, typically express the tradeoff between paths in terms of WTP, WTA, CV and EV.

¹⁶ Boome finds the indifference is obvious, arguing that if an infinitesimal increase (decrease) in global warming makes you worse off (better off), you must be indifferent between (e^1, g^i) and (e^0, g^0) .

one amount of g between (e^1, g^w) and (e^1, g^b) , all amounts of g are comparable to the change in e (there is comparability).

Now return to the example as represented by Figure 1, an example where there are multiple amounts of g between (e^1, g^w) and (e^1, g^b) . But now further imagine that there is at least one g in this range, g^i , that results in indifference. But now there is a contradiction: since less g is strictly worse, bundles between g^w and g^i must all be strictly worse than (e^1, g^0) and all bundles between g^i and g^b must all be strictly better, forcing the gap to collapse to a single bundle. That is, if there is an amount of g , g^i , that causes indifference between (e^0, g^0) and (e^1, g^i) it must be unique.

So, if there is more than one bundle on the e^1 line between g^w and g^b , these bundles are not strictly worse than (e^1, g^0) , nor strictly better than (e^1, g^0) , nor equal to (e^1, g^0) in terms of betterment. That is, the bundles in the gap are not comparable (cannot be ranked in terms of betterment) to (e^1, g^0) .¹⁷

Boome's characterization of bearer-of-betterment incomparability emphasizes the ranking requirement and drives home the point that incomparability does not mean you can never compare, only that comparability is not possible at some levels. For example, all the bundles on the two shaded segments are comparable to (e^0, g^0) . Taking another example, while I am not sure I could compare all possible income reductions with all possible reductions in the rate of global warming, I am able to compare ten dollars less of income with a 10% reduction in the rate of global warming; I would be better off with \$10 less income and the 10% reduction. All that is needed for incomparability is that there are some income reductions where I wouldn't be able to rank the status quo vs. a 10% reduction combined with any of those income reductions.

3.1.4 *The incommensurability of **betterments** in terms of the MRS between betterments.*

It is not a stretch of the MRS concept to think in terms of MRS between betterments, or worsements, or a worsement and a betterment. Betterments A and B are commensurable at a specific level for each, if, and only if, the MRS_{AB} at those levels is either finite or infinite. They are not commensurable if MRS_{AB} does not exist. So, as with the MRS_{xy} , MRS_{AB} being a finite number is sufficient, but not necessary for A and B to be commensurable.

¹⁷ Demonstrating incomparability is a bit more difficult to graphically show if one drops the assumption that more (or less) of each bearer is strictly better. For example, the individual could be indifferent between every bundle in the gap, and this would be an additional example of comparability.

Graphically, the sufficient, but not necessary case, can be represented by a standard-looking indifference curve but in terms of betterments rather than bearers-of-betterments. For example, consider two betterments: less grief from the loss of loved ones on the vertical axis, and less of the specific existential angst associated with a warmer planet on the horizontal axis. At the origin of the graph, the individual is experiencing much grief and much angst. [I can add the figure if desired.] For the individual represented, these two betterments are commensurable, at least at the levels on the indifference curve. At every point on the indifference curve she has a finite $MRS_{\text{AngstGrief}}$; she knows how much more grief she would accept to reduce her global-warming angst by a specific amount.

Alternatively, if at the levels graphed, your $MRS_{\text{AngstGrief}}$ is infinite (you would accept no finite increase in grief in exchange for less angst), this type of grief and this type of angst are also commensurable. Like in the comparability of commodities, an infinite $MRS_{\text{AngstGrief}}$ can be consistent with either a vertical indifference curve segment or the absence of indifference curves, but indifference curves in terms of betterments rather than bearers-of-betterments.

If at some levels of angst and grief, angst and grief are not commensurable, a $MRS_{\text{AngstGrief}}$ does not exist at these levels, and there is no betterment indifference-curve through this point.

4 The literature on whether environmental betterments are incommensurable and the literature on whether environmental bearers-of-betterments are incomparable.

I have yet to find it. There is, I suspect, a lack of literature for two reasons. Amongst economists interested in the environment, many never question whether environmental betterments and bearers-of-betterments are comparable because they “just are”. While, many others interested in the environment take as given that they are not comparable because they “just aren’t”. Researchers, like me, whose training and models are steeped in the neoclassical assumption that we all have complete ranking of paths, leave it at that. [E.g., every environmental valuation I have done assumes every individual has a complete ranking of paths.] Speaking loosely, I label members of my group *environmental economists*. Many individuals in the second group think of themselves as

ecologists. I label economists in this second group *ecological economists*.¹⁸ There is little literature because neither group is motivated to investigate a question that is already answered.

In contrast, this essay doesn't take betterment commensurability as a given nor does it take betterment incommensurability as a given. It is about how one might think about whether two betterments or two bearers-of-betterments can be compared.

5 A complete ranking of paths based on overall betterment requires complete path comparability which, in turn, requires complete betterment-commensurability¹⁹²⁰

Said the other way: **lack** of complete betterment-commensurability is sufficient to guarantee that there is not a complete ranking of paths based on overall betterment.²¹ The joy of sweet-'n-salty must be commensurable with life-satisfaction, along with all other types of betterments.

A problem for choice theory and welfare economics is that many people, including many philosophers, reject complete betterment-commensurability. These doubters believe there are incommensurables (betterments that cannot be compared at all levels), and if they are correct

¹⁸ See Joan Martinez-Alier, Giuseppe Munda, and John O'Neill (1998). Martinez-Alier is a founder and past president of the International Society for Ecological Economics. The article, the most widely-cited economics article on environmental commensurability, simply asserts that there are many types of environmental betterments, that they are often incommensurable with each other, and incommensurable with many non-environmental betterments. Given their starting point, their question was how to make environmental decisions in such a world. They suggest "multicriteria evaluation". It's interesting that three noted ecological economists start with an assertion that crumbles a pillar of choice theory. They must take as given that choice theory is not an appropriate model for environmental decisions. This is interesting.

¹⁹ I proceed, taking as given, that if there is complete comparability of paths based on betterment, there must be complete betterment commensurability. But some philosophers do not take this as a given. They argue that there can be complete path comparability without complete betterment commensurability. Hsieh (2016; sec. 3) provides a list of their arguments, arguments that I do not find convincing. One argument is based on "strong comparability" of paths, an assumption I do not make. See Footnote 12.

²⁰ A more difficult question is whether complete betterment-commensurability is sufficient for complete path comparability. I am not sure of the answer, but for this essay the answer is secondary. Hsieh (2016, p. 13) states that even betterment monism is not sufficient for complete path comparability, but I don't follow the argument.

²¹ There can be partial rankings. For example, if all the different tastes, feelings, and thoughts produced by eating chocolate of different types and quantities are commensurable, there will a ranking over paths that vary only in terms of types and quantities of chocolate eaten. There can also be a partial ranking in the sense that while Path j is ranked higher than Path c, there are paths between them that have more betterment than c and less than j but can themselves not be ranked in terms of betterment (compared to each other they are not better than, worse than, or equal in terms of betterments).

there can be no answer to the question of what is your highest-ranked feasible path.²²²³ In which case, overall betterment and economic value are not well-defined concepts.²⁴ But as the Harvard ethics scholar Hsieh (2016) notes, betterment incommensurability is a problem for more than choice theorists and welfare economists.²⁵

The possibility of value incommensurability is thought to raise deep questions about practical reason and rational choice as well as related questions concerning topics as diverse as akrasia, moral dilemmas, the plausibility of utilitarianism, and the foundations of liberalism

Commensurability is also critical to tort law (e.g. can you be compensated with money for the loss of an arm, or loss of a cognitive ability, or loss of a loved one?).²⁶ Commensurability is also critical to assessing whether a system or economy is sustainable.

As environmental economists, we can, of course, reject all the arguments against complete commensurability, but we still should be aware of them and be able to articulate why we reject them. In addition, we should also be aware of the evidence in favor of betterment commensurability.

6 Commensurability requires that the feelings, sensations, and thoughts generated by an act or situation can be separated from that act or situation

The pleasure you get from eating chocolate must be separable from the eating, and the pride you have in your children must be separable from what they did to make you feel proud. If such separability was not the case, betterments could not be aggregated independent of the bearers of

²² They don't reject the idea that some experiences are commensurable (e.g., the pleasure of Coke vs. Pepsi), just that some betterments cannot be compared. For example, feelings produced by environmental injuries and animal extinctions might not be comparable to those produced by drinking a Coke.

²³ A distinction beyond the scope of this paper is whether one assumes an individual chooses his highest-ranked feasible path (optimization) or whether the individual chooses a feasible path that is no worse in terms of betterment than any other feasible path (maximization). The standard choice-theory assumption is that the individual optimizes. Amartya Sen (1997) and Hsieh (2007 and 2016) discuss this distinction.

²⁴ The statement, "Path *k* is overall better than Path *h*," is equivalent to "Path *k* is more valuable (embeds more value)."

²⁵ Hsieh (2007) suggests a possible solution to the rational choice problem when there are incomparable bearers-of-betterments. One could replace the choice-theory assumption that the individual chooses their highest-ranked feasible path with the assumption that the individual chooses a feasible path that is no worse (in terms of betterment) than any other feasible path.

²⁶ See, for example, the *University of Pennsylvania Law Review* symposium on commensurability (M. Adler 1998), and Sunstein (1994).

those betterments. This necessary condition is referred to as *betterment/bearer separability*—think of it as a type of consequentialism (only the consequences of the action matter, not the bearer of those consequences).

Note that complete betterment/bearer separability is necessary, but not sufficient, for commensurability—an example demonstrates: the separation of happiness from the bearers of happiness and the separation of life-satisfaction from its bearers does not imply that happiness and life-satisfaction are commensurable.

The rejection of betterment/bearer separability goes back to Aristotle.²⁷ The philosopher Martha Nussbaum (2012) explains:

Throughout his [Aristotle's] work, he insists on the tremendous importance of qualitative distinctions among the diverse constituent parts of human life; he later suggests that these distinctions affect the proper analysis of the concept of pleasure.... pleasure is something that comes along with, supervenes on, activity, "like the bloom on the cheek of a young person." In other words, it is so closely linked to the relevant activities that it cannot be pursued on its own, any more than bloom can be adequately cultivated by cosmetics. To get that bloom, you have to pursue health. Similarly, one gets the pleasure associated with an activity by doing that activity in a certain way, apparently a way that is not impeded or is complete. It would seem that what Aristotle has in mind is that pleasure is a kind of awareness of one's own activity, varying in quality with the activity to which it is so closely linked. In any case, pleasure is not a single thing, varying only in intensity and duration... It contains qualitative differences, related to the differences of the activities to which it attaches.

Nussbaum goes on to argue that J.S. Mill also rejected betterment/bearer separately. She then goes on to say that “Modern philosophical discussion of pleasure follows Aristotle and Mill” (2012, p 338). That is, she believes many modern philosophers reject betterment/bearer separability.

While this essay is about humans, I imagine that the extent to which betterments can be separated from their bearers varies greatly across species: becoming more difficult the greater the species' ability to cogitate. Humans experience feeling and sensations, consciously process them in terms of their past experiences, their knowledge, and the big picture. This cogitating then produces additional feeling and sensations to cogitate about. And while all this is going on, new actions and circumstances are producing new feeling and sensations. Contrast this with animals who experience positive and negative sensations but do not have the cognitive capacity to assess and evaluate them. In terms of dogs and worms, I conjecture that it is likely easier for my dog

²⁷ Martinez-Alier, Munda, and O'Neill (1998) provide a review of past economic debates on incommensurability, including the debates on the 1920s and 30s (Heurath, Hayek, Weber, Von Mises) on the functionality of socialism (the ability to compare values in the absence of prices generated by markets).

than for me to separate a pleasure from the activity that produced it, and easier for a worm than for my dog.

Related to the above conjecture is my conjecture that there are fewer dog betterments than human betterments, and fewer worm betterments than dog betterments. Consider, as an example, your ability to separate a simple sensation such as pain from the activity or circumstance that produced it. The same chest pain could be because you just ran your best marathon, because you are getting divorced, because you are having a heart attack, or because you just reached the top of Mt. Everest. Whether the pain is a betterment or worsement, and of what sort, depends on whether you chose it, whether you think it will be gone in the morning, what you imagine is causing it, and whether experiencing it helped you achieve an important goal. Since humans think about the causes of their sensations, this suggests difficulty in separating the feeling from its cause. Most other animals can't cogitate about their sensations.

In thinking about bearer/betterment separability in terms of the environment, first distinguish between environment-specific betterments and bearers of those betterments. More wilderness, less global warming, and saving a species from extinction are examples of bearers of environmental betterments, not betterments. The first question about environmental betterments is are there such things? That is, are there betterments that only the natural environment can provide? This is not a question I am going to fully answer, but many people believe there are environment-specific betterments. Examples include the special freedom that only being in the wilderness can provide, environmental self-reliance, experiencing animals and plants in their natural state, experiencing the unity of the natural world, including our place in it, and the wonder and awe evoked by sights such as lightening at night illuminating ragged mountain peaks.²⁸²⁹

The issue is whether everyone can separate these betterments from their bearers. Sunstein (1994) says people cannot. For example, he discusses how the *awe* produced by viewing a mountain is different from the awe produced by viewing a skyscraper, which is different from

²⁸ In contrast, there are betterments that are often experienced in natural settings such as the thrill of going fast on skis, a bike, or a snowmobile that are, arguably, not environmental-specific betterments. For example, when I was young, I got similar thrills from going fast in cars.

²⁹ It is important to contrast an environmental betterment—something that makes a human better off in way that can only be generated by environmental resources—and other reasons for preserving environmental resources such as inherent value (environmental resources are valuable for their own sake, independent of their effect on humans), they have a right to exist, independent of mankind, and humans have a responsibility towards other species given our position in the pecking order.

the awe produced by a remarkable musical or athletic performance, and since these awes cannot, in his view, be separated from their bearers, they are incommensurable. And, in addition, they are incommensurable with the betterments produced by the consumption of conventional goods and services.

Many environmental bearers generate betterments and worsements that are public in nature in that everyone experiences the existence of the bearer (if the rate of global warming is reduced for you it is reduced for everyone, same for saving a species from extinction). This raises the issue of whether it is more (or possibly less) difficult for you to separate a public betterment from its bearer than separating a bearer you only experience (e.g. eating an ice cream cone) from the betterments produced. I don't have a good answer. A related issue is whether one has the right to compare public and private bearers. This is discussed below.

I have sympathy for betterment/bearer inseparability, but suspect it depends a lot on the specific bearer and the specific betterment, and the extent to which the betterment has a significant cognitive component. In our referendum CVM surveys, instead of simply asking whether the respondents are better off with Option I or II, might we include a third option? "I can't make this comparison." (See Section 7.5)

7 Other arguments against complete commensurability include:

7.1 You cannot compare certain betterments because it would be morally unacceptable to even imagine such tradeoffs

Consider the question of how much money you would have to be paid to push the button that would forever eliminate elephants from the earth, or the button that would open the pipe and dump a million tons of PCBs in Lake Michigan, or the button that would eliminate equal rights. Many normal people—but not economists—would find it off-putting and wrong to even consider such tradeoffs. That is, if it is wrong to make certain comparisons, they are not made.

Inability to compare because of moral or cultural sanctions is likely to vary drastically by culture and religion. Research suggests that high socioeconomic-status secular Westerners (Europeans and North Americans) are more likely to make certain comparisons than are non-Westerners and Western religious conservatives (see, for example, Jonathan Haidt and Jesse Graham (2007) and Graham, Haidt and Brian Nosek (2009)). The two latter groups, but not the

first group, morally require in-group/loyalty, authority/respect, and purity/sanctity, making it difficult for them to compare violations of these sanctions with money. While I do not know of a specific study demonstrating this, for many North-American First Peoples, the betterments born by their culture and natural surrounding are likely incommensurable, on moral grounds, with betterments resulting from market goods and services.³⁰

Even among secular Westerners, there are many who believe that we have a moral obligation to the environment, a preservation ethic. Consider, the famous quote by Aldo Leopold in his 1940's essay "The Land Ethic",³¹

A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.

Summarizing his land ethic, humans do not stand alone but are part of the community of plants, animals, lands, and waters (collectively, the "land"), and, as members of that community, humans must respect the community's other members. These other members have the right to exist and prosper, and it is our responsibility to see that they prosper—we play the role of the parents to the community's other member. And, parental responsibility is inconsistent with sacrificing one's children for money.³²

7.2 *Two betterments are incommensurable if comparing them is incompatible with experiencing one or both of those betterments*

The argument is that experiencing some betterments is inconsistent with you being willing to give them up for money or goods. Consider companionship (Joseph Raz 1986). Raz

³⁰ Indian tribes are often trustees in NRDA cases. To cite an extreme example, consider the "water pollution, soil contamination, deforestation, and cultural upheaval" (Wikipedia: Lago Agrio oil field) resulting from oil exploration and extraction in the Sucumbíos Province of Ecuador caused by Texaco (now owned by Chevron) and its effect on the indigenous tribes who, arguably, lost a large part of their culture and way of life. Chevron and Ecuador battled over damages in both the U.S. and Ecuadorian courts. If their culture and money are, in fact, incomparable, damages are undefined.

³¹ Leopold's *Sand County Almanac* was published by his son in 1949 (shortly after Leopold's death). It is a collection of essays: essays about the land in Wisconsin where he had a farm (the part of Wisconsin with sandy soil), essays about other regions, essays about his personal experiences in nature, and essays that sketch an environmental ethic. The "Land Ethic" is the last essay in the book. The book was mostly unknown until the 1970's. It, along with Rachel Carson's *Silent Spring* (1962) are foundations of the environmental movement in the U.S.

³² There are differing views on views on how Leopold's might have applied his land ethic in specific situations, so I suspect there would be disagreement amongst environmental ethicists as to whether Leopold believed the betterments humans get from the land are incommensurable with other betterments. That said, many environmentalists say they are incommensurable and view Leopold as a father of their views.

argues—in my words not his—that you cannot have a MRS between meaningful companionship and money, because being in a meaningful relationship with someone requires that neither you nor your partner has a MRS between your relationship and money. Of course, some people do have a MRS between companionship and money, but they are then not in a meaningful relationship, or so the argument goes. Consider the Grace-of-God. God is unlikely to shed his graces on you if you have a MRS between the Grace-of-God and money—at least I wouldn't if I were God.³³

This argument is compelling for religious betterments and personal-relationship betterments (romantic love, friendship, love of family, etc.). If this argument is correct for you, you have incommensurables in that you wouldn't be able to rank all bundles that varied in terms of religious, personal, and environmental betterments, or that varied in terms of religious, personal, and betterments associated with market goods.

But can this argument be applied specifically to environmental betterments? That is, are there environmental betterments with the property that experiencing them is incompatible with being willing to give them up for money or goods? Unlike bearers of friendship, love of family, and sexual relationships, bearers of environmental betterments are mostly not human,³⁴ nor even alive. Plants and wild animals are the exceptions. At first blush, it would seem you cannot have a human-type relationship with most bearers of environmental betterments. (The view of a mountain might cause me to experience awe, but the mountain is incapable of feeling my awe—so won't react to it).

Valuation of an environment betterment in dollars is negated if, for you, a willingness to trade the environmental betterment for market-goods betterments negates your ability to experience that environmental benefit. If that something within you is that it would be morally wrong to trade environmental betterments for market-goods betterments, it is the previous argument, not this argument, but these two arguments for incommensurability often overlap.

³³ Sunstein (1994): “Suppose that [Adam] Smith has arranged to have lunch with a friend today, but that he has become very busy and perhaps would like to cancel. Suppose Smith thinks in this way: if he cancels, his friend will be disappointed, because he would like Smith's company, and also a bit insulted, because it is cavalier and disrespectful to cancel lunch at the last minute. Maybe Smith should make it up to him, or provide compensation, by offering a nontrivial cash payment...[but] A cash payment would be inconsistent with *the way* that someone values a friend. Even if the friend would prefer \$1, or \$10, or \$100, or \$100 to lunch with Smith—the offer of cash would be perceived as an insult rather than a compensation. In this context, the difference in kinds of valuation [betterments] means that a financial exchange would be inappropriate.”

³⁴ An exception might be groups of indigenous Amazonian groups with little or no contact with modern humans.

What if my relationship with environmental bearers is religious, spiritual, personal, or some combination of the three? Start with the religious and spiritual (I am not sure where to draw the line between them): There is a long, and continuing, human history of believing features of the environment are sacred (specific species, specific geographical features and places). Many secular Westerners poo-poo sacredness, but such beliefs are common elsewhere and in other groups. Even among Westerners, there are many individuals who believe nature has sacred components. A synonym for “sacred” is “inviolable”—“secure from assault or trespass”—Merriam-Webster. Sacred is a belief, and if one believes a component of the environment is sacred, its existence evokes a feeling of reverential awe, a type of betterment. The argument here for incommensurability is that an individual who is capable of sacrificing some component of the environment for monetary betterments is incapable of feeling reverential awe for that component: if you are willing to sell it for money, it can’t be sacred to you, or so the argument goes. For people for which nothing is sacred—I won’t mention any famous names—this argument for incommensurability can’t apply.

What if you love nature—you have a “love of nature”. Consider two types of love. (1) First imagine that I love the bears in the woods, and I believe they love me. As with a meaningful relationship with a human, loving the bears and their loving me is inconsistent with either of us sacrificing the other for a jar of honey. (2) I love the bears but understand that, while they like my garbage, they don’t love me. A willingness on my part to sell their hides means that I am incapable of loving them, so cannot experience bear-love betterment. Or said the other way, for me, money betterment and bear-love betterment are incommensurable.

While this essay is not about animal welfare, wild animals suffer at our expense, and animals are a big part of nature. All animals are, arguably, capable of pain and pleasure. For some people, animal suffering causes them to suffer, and this type of human suffering is a worsement).³⁵ In terms of this section, the argument would be that if I am willing to sell animal suffering for money, I do not have the ability to experience the type of worsement caused by animal suffering. Why might this be true for some of us: our relationship with animals is

³⁵ The animal suffering is the bearer.

Of course, there are many people who have a MRS between reducing animal suffering and market goods (zero, finite, or infinite). For all these people, the suffering produced by animal suffering and the betterments produced by market goods are commensurable. In addition, for some humans, animal suffering is a comparable bearer-of-betterments: they get pleasure from the suffering of animals.

fundamentally different from our relationship with goods and services that are not animal based? A similar incommensurability argument could be made for the betterment (or worsement) you would get from lessening the pain of other humans.

7.3 You might not have complete betterment-commensurability if you have no ability to control how much of a betterment you experience (its level is fixed from your perspective), so you do not compare it with other betterments.

Put simply, you do not sweat what you cannot influence. Elizabeth Anderson (1997) articulates this argument more generally by saying there is often no reason to think about how you would trade one betterment for another, and besides it being a waste of your time, it would, for many, be something to avoid. Economists, in contrast, assume you have a complete ranking over all conceivable paths so reject the idea that a ranking is created when needed. Economists, like me, who value in dollars environmental resources assume you have a well-defined MRS between money and the betterment from less global warming (e.g. your WTP for the betterment from less global warming) even before you see your first global-warming CVM survey. Economists of my ilk would say that a CVM survey is simply a way for the surveyor to find out your WTP to reduce global warming (less global warming is the bearer). In contrast, Anderson would say that you don't show up at the survey center with a WTP for panda-preservation because it never crossed your mind that you could buy panda-preservation. And, you wouldn't create it during the survey unless you were convinced by the survey that it was for sale. Those of us in the actual business of creating and using CVM surveys to value environmental resources have sympathy for her point, but not enough to reject the commensurability of money-betterments and less global-warming betterments.

Most of us have no ability to control pollution levels or amounts of environmental preservation, so don't compare them with bearers-of-betterments whose levels we can influence.

7.4 Inadequate processing skills

Imagine I have full information about two paths in that I know the specifics of each, so my ignorance is not an issue. However, the paths have more moving parts than a human can cognitively process, making it impossible to rank them in terms of betterment. I mention this possible cause of incommensurability, but don't want to make too much of it because this inability causes more than just incommensurability issues for choice theory.

You might want to counter that this is an example of inability to compare because of ignorance and not a real example in incommensurability of betterments. It is ignorance in the sense that I am ignorant of the betterment effects of each path, but I am not ignorant of the properties of each path, so it isn't ignorance of the world in the conventional sense of knowledge.

7.5 *Saying A and B are incommensurable (or commensurable) does not make it true*

As pointed out by Judge Richard Posner (1998), an incorrect argument for the existence of incommensurables is that people often assert that they can't compare some betterments. The problem with the argument is that we often have an incentive to say we can't make the comparison, when we could have. We might not want to put in the cognitive effort; we might not want to convey that we are of the sort who can compare the betterment from saving polar bears with the betterment from beer, even if we are of that sort. Admitting to your partner that the pleasure of their love is commensurable with your pleasure from sex outside of your partnership would likely reduce their love for you, so you lie. Saying you would accept much more global warming to save a few coal jobs, might not go over well with your environmental friends, but something you might say to your Trump friends.

If you think you can compare apples and oranges in terms of betterment simply because you ate the orange rather than the apple, you are wrong. Eating the orange does not imply you "chose" the orange: you had to eat something (Edward Morey 2019).³⁶ More generally just because you think you can compare two bearers, or two betterments, does not mean you can.

7.6 *Incommensurability is sometimes mandated by law.*

E.g., U.S. Federal laws forbid the comparison of some environmental bearers-of-betterments. Consider, *The Endangered Species Act*. Saving a particular species is, for most of

³⁶ The flip side of Posner's point: a common, but illogical, argument made for both complete comparability and complete commensurability is that people make choices, and given that most people are betterment pluralists they must be making tradeoffs between all the betterments associated with each alternative (having and calculating all the MRS's). This argument is circular. Make a distinction between behavior, a choice, and the correct choice. Economists make two assumptions: most behaviors are chosen (you drank Coke rather than Pepsi because you chose Coke over Pepsi), and it was the best choice (Coke was the best alternative given your options). If you start by assuming that people make choices and those choice are based on overall betterment, then betterment commensurability is assumed. See Morey (2019) for a review of the psychological and neurological research on these assumptions.

us, a bearer of an environmental betterment, but so would be saving a different species. Commensurability of these bearers would imply that it might sometimes be best to extinct one species to save two from extinction, but the Act, with few exceptions, forbids this: implying saving one species is incommensurable with saving another. “To the same, the Delaney Clause forbids an entry of carcinogenic substances onto the market, banning tradeoffs of any sort” (Sunstein 1994, p.835). And, the U.S. Federal Courts have ruled that even if dollar damages from the degrading of an environmental resource is less than the cost of restoring the resource, the destroyer is responsible for the higher restoration costs, implying betterments obtained by spending the dollar damages on other things is not commensurable with the betterments produced by the resource in its initial state (the Courts interpretation of the view of Congress).

7.7 Your betterment (or worsement) from learning more about an environmental process is incommensurable with the betterment associated with a change in the level or extent of that process.

This argument resonates with me. Consider the acquisition of knowledge and information, particularly knowledge about the environment and the natural world. If you are living without full information, one way to make yourself better off, or worse off, is to allocate time and money to education. For example, consider learning about global warming (the process and its effects). I chose global warming as my example because it is a global public process and is, arguably, a process that could make many people a lot worse off. I also chose it because many people are ignorant about the process of global warming and its effects and seem to want to stay that way.

Education leads to knowledge and knowledge can be a type of betterment (of course more might be better for you, while less might be better for me). Education (reading, studying, and listening) is the bearer. The question at hand is whether knowledge betterment is commensurable with other types of betterments. Knowledge, once acquired, can't be traded away. You can sell your house and car, but you can't unlearn things, even if what you learned made your worse off.³⁷ Another aspect of knowledge is that before you acquire it you are

³⁷ In a recent study, Ananda Ganguly and Joshua Tasoff (2016) found that 16% of the university students sampled were willing to forego a payment of \$10 to avoid learning whether they had genital herpes. David Eli and Justin Rao (2011) have found that people will pay to not learn about their IQ or how attractive others find them.

ignorant, so cannot have a good prior as whether its acquisition will make you better or worse off. These two aspects of knowledge suggest that it might be difficult to compare education with other bearers of betterments.

Return to Figure 1 and now let e be my education level with respect to global warming. A path now consists of a certain level of education about global warming and a certain rate of global warming. Can I compare these two bearers-of-betterments? I am not sure; there are inherent difficulties. To keep things simple, assume that everyone agrees that a lower rate of global warming is better, but because I am uneducated on the topic, I don't know how much better off a lower rate will make me. Further imagine that my uneducated prior is while global warming is a bad, it is not much of a bad.³⁸ Given all this, how would I determine whether I would be better off in a world where I am more educated about the effects of global warming and there is a different rate of global warming? I don't know that I could make all such comparisons. Now flip the example, and imagine I am already educated about global warming (so know how it works and its effects). Then I am asked to decide whether I would be better off if I were more ignorant and there was some different rate of global warming. How do I assess not knowing what I already know?

In summary, many people are ignorant about physics, chemistry, and biology, in particular in terms of the environmental sciences, ecosystem dynamics, and the health effects of chemicals in the environment. And the betterments, or worsements, we experience when our environment changes (species go extinct, the rate of global warming changes, there is less (or more) PCB contamination) are a function of our personal level of knowledge—ignorance is often bliss. But once knowledge is acquired it is not freely disposable, suggesting that comparing environmental betterments with knowledge about the environment is difficult, causing me to imagine I am incapable of ranking some paths in terms of their environmental effects and my knowledge about those effects.³⁹

7.8 *A few additional qualms about the commensurability of environmental betterments:*

³⁸ Also think through the example imagining that in my ignorance I imagine global warming is worse than it actually is.

³⁹ Consider some other similar types of tradeoffs: a medical test that will inform you as to whether the black mole on your toe is a cancer vs. the treatments that exist for toe cancer; educating yourself on the research on the benefits and costs of immunizing your children vs. immunization rates; and knowing the actual probability that you will be killed in a terrorist attack vs. how much is spent on fighting terrorism.

The fact that many environmental amenities are public commodities (non-congestible and nonexcludable) makes some people incapable of comparing the personal betterment they would get from different amounts of private goods with the worsenments everyone would get from dirtier air or more global warming—they feel they do not have the **right** to make such comparisons, so they don't.

Or, imagine comparing betterment relief from less global warming and the betterment resulting from being less anxious. Making such comparisons is complicated by the fact that being more anxious will influence how much relief you get from a given change in the rate of global warming. One could test this in the lab by invoking anxiety before the start of a CVM survey or choice experiment. The design would vary the amounts of both the hypothetical changes in the rates of global warming and the amounts of anxiety invoked in the subjects.⁴⁰

Personal responsibilities and personal commitments can also complicate commensurability. [Contrast personal responsibilities and commitments with those placed on everyone by religious or cultural mores.] Consider, for example, a western rancher whose ranch has been in the family for generations. Typically, such ranches provide wild-life habitat which is a bearer of environmental betterment for many ranchers, and others.⁴¹ In addition, many of these ranchers are committed to, and feel responsible for, both maintaining the ranch in its current state and keeping it in the family (both of these responsibilities motivating conservation easements). It wouldn't be surprising that some of these ranchers would have difficulty comparing the betterment associated with maintaining the ranch habitat with the betterment obtained by retiring to a condo in Florida.

One final complaint about a world of complete commensurability and complete comparability: most the richness and variety of life would be beside the point. No one would care, at the end of the day, what caused their betterments and worsenments (another way to define

⁴⁰ Anxiety levels can be manipulated with, for example, computer simulations and by varying the environment. Listening to this 911 call with make you anxious (<http://clipp.instruct.de/player/data/db/video/106672.mov>) It is disturbing. Rajagopal Raghunathan and Michel Pham (1999) is an example of a study that evoked anxiety. For examples of modeling choices as a function of personality and emotions see Solinō and Farizo (2014) and Morey and Mara Thiene (2017).

⁴¹ Ranches where I live north of Steamboat CO, in addition to grazing cattle and sheep, provide habitat for elk, deer, moose, mountain lions, trout and many other animals. There are conservation easements on many of these properties, even though obtaining the easement reduced the market value of the ranch.

commensurability).⁴² Many people would hope they do not live in such a world, but this does not prove they do or don't.

8 Some neurological research on betterment commensurability

Contrasting with the above philosophical arguments that some betterments are not commensurable are recent research findings on the neurobiology of choice. Based on a meta-analysis of MRI data, Dino Levy and Paul Glimcher (2012),

Neuroimaging studies in humans have recently begun to suggest the existence of a small group of specific brain sites [the striatum and portions of the ventromedial prefrontal cortex] that appear to encode the subjective values of different types of rewards on a neural common scale, almost exactly as predicted by theory [economic choice theory].

Quoting Levy and Glimcher (2012) further, “But what happens in the brain when we need to choose between a large amount of water and a single apple? Or a small amount of water and two apples?” The brain needs to assess both “reward type” and the quantities of each type.

Indeed, there is now broad consensus in the neuroscience of the decision-making community that reward magnitude is represented in a small number of well-identified areas. Here we conduct a meta-analysis using evidence from human functional magnetic resonance imaging (fMRI) studies conducted over just the past few years that suggest that one of these reward magnitude encoding areas, the ventromedial prefrontal cortex/orbital frontal cortex (vmPFC/OFC), can be thought of as representing the value of nearly all reward-types on a common scale that predicts behaviorally observed comparison and choice.

The striatum and the ventromedial prefrontal cortex together are your *valuation circuit* (Glimcher 2014).⁴³

Imagine the valuation circuit as a two-dimensional topographical map of neurons, where each alternative in the current choice set (e.g. an apple and an orange) is a different point on the map.⁴⁴ The value of an alternative is represented by the firing rate of the neurons at the point on the map that represents that alternative.

⁴² Consider how hedonic price and wage studies critically depend on betterment commensurability: in equilibrium, living in Pittsburgh is equal to living in Aspen in terms of overall betterment.

⁴³ In contrast, there is another part of your brain called the *choice circuit*. The choice circuit is the part of your brain that initiates you saying “Yes, I will pay \$5 to reduce global warming by 10%.” because paying \$5 is associated with a higher firing rate than saying “no”. See, for example, Glimcher (2014) for a discussion of the choice circuit and its relationship to the value circuit.

⁴⁴ “We know that most classes of information recorded in the cerebral cortex are topographically encoded on anatomically two-dimensional ‘maps’.” The cortex is made of dozens of these small topographical maps” (Glimcher (2014)).

[Figure 2 here]

Figure 2 is a cartoon showing the two peaks associated with a choice set with two alternatives, the higher peak indicating that the neurons at this position are firing faster than the neurons positioned at the lower peak. The alternative that achieves the highest peak will be the alternative chosen. The process is somewhat stochastic, as in a random-utility model: there are random components to the fluctuations in neuron firing-rates, causing the height of each peak to have a random component. While these random fluctuations are occurring, if the firing rate of a neuron increases, it tends to increase the firing rates of neurons in its vicinity while inhibiting the firing rates of more distant neurons, including those associated with the other peaks: the peaks are fighting it out: each peak is acting to make itself higher and the other peaks shorter. Eventually, one peak dominates, and the alternative associated with that peak is chosen.

Getting ahead of the studies I discuss next, it seems that (1) the final selection of an alternative (at least for the sorts of sets of alternatives studied in neuroscience labs) always takes place in the valuation circuit, and (2) the variation in firing rates across the neurons in this area determines/predicts which alternative will be selected.

This suggests, at least for the alternatives studied, that, at the end of the day, each alternative is compared on a scale of one dimension (the firing rate of the neurons associated with each alternative), with the alternative associated with the highest firing rate winning. These findings are consistent with (they don't contradict) complete betterment-commensurability and complete bearer-of-benefits comparability

In the studies reviewed by Levy and Glimcher (2012), male subjects were asked to choose between different alternatives or simply viewed different alternatives, both while an fMRI machine scanned their brain to see what lit up and what did not light up (where energy was being expended). The researcher can see which brain regions light up when the subject is presented with different amounts of the same reward, when presented with different reward types, and when presented with a choice where the alternatives differ by reward type and magnitude. Alternatives included money (magnitude, and when it would be delivered), college trinkets (hats, etc.) pain, pictures of females that varied in attractiveness, and, of course, snack

It is a map of the alternatives on the table. No neuroscientist is suggesting that this region stores a complete ranking of all possible paths. Neuroscientists do not imagine there is such a place, so are not looking for it.

foods. It should be noted that in all of the studies that involved choosing—not all did—money was one of the alternatives.⁴⁵

Put simply, the reviewed studies show that no matter what options were presented, the valuation circuit was always activated. What is suggested and what is implied? These findings imply/suggest that what happens in this region of the brain always affects what the individual does (the alternative they indicate). But this does not imply that the region converts everything onto the same betterment (value) scale; it also doesn't imply the individual identifies (chooses) the alternative with the most betterment. E.g., maybe this part of the brain determines that you go with the alternative you most desire at that moment, or the alternative that makes you least anxious.⁴⁶

Put simply, the findings are consistent with betterment and bearer comparability but do not prove it. Making an analogy, observing a ship sink below the horizon as it travels out to sea is consistent with the earth being a sphere, but it does not prove it.

Further support for the conjecture that this area converts all the alternatives onto the same scale is that there is a correlation between how a subject says they would trade one alternative for the other and the activation of different parts of this region (see, in particular, D.V. Smith *et al.* (2010) and Levy and Glimcher (2011)).

So, and summarizing, the neuro-imaging research surveyed by Levy and Glimcher is consistent with the hypothesis that individuals can convert, for the money and commodities studied, different sorts of betterments onto the same betterment scale. That is, the research does not contradict betterment commensurability. I don't think many of those who reject complete betterment-commensurability would be surprised by this finding or disagree with it. Rather, they might say that the likelihood of betterment commensurability between money and snacks, or money and pain, does not imply complete betterment-commensurability.

If I had to question Levy and Glimcher's assessment of the data, as economists, they were looking for a spot in the brain where betterment commensurability takes place, and they found a likely candidate. However, and repeating my earlier point, just because you did x rather

⁴⁵ In some of the studies, the subject is presented with a set of alternatives, examines the alternatives and then chooses one. In other studies, the subject only examines the alternatives. In all the studies, the process is unfolding while the subject is in an fMRI machine which is recording in terms of energy expenditures the firing rates of neurons.

⁴⁶ For a discussion of desires/wants vs. likes, see Morey (2019).

than y does not imply that you chose to do x rather than y , and if you did choose to do x rather than y , it does not imply you are better off doing x rather than y .

9 Conclusions:

The foundation of economic choice theory is complete path-comparability in terms of overall betterment, which requires complete betterment-commensurability. The intent of this essay isn't to claim that there is or isn't complete betterment-commensurability (I have doubts about complete) but to review the issues and arguments and present the relevant theory and research.

While choice theory was originally only about estimating the demand functions for market goods, its span has been leaping and creeping wider—which is why I define a ranking over paths rather than only bundles of market goods. Environmental economists have widened the scope of a bundle to include environmental, ecological, and nature-based recreational resources, many of which provide both use and non-benefits (or damages). Pushing back against the notion of putting economic values on the environment are ecologists, environmentalists, and environmental ethicists who question whether and why environmental resources are comparable to goods and services in terms of the betterments they provide.⁴⁷

If I had been working for British Petroleum on the legal case to assess the dollar damages from the 2010 oil spill in the Gulf of Mexico,⁴⁸ and if my intent had been to reduce, or eliminate, their liability, I would have introduced the argument that environmental betterments are, for many, incommensurable with the sorts of betterments generated by spending on private goods, meaning it impossible for many to trade-off environmental injuries for money. Arguing this would, at a minimum, have forced the Trustees to hire some philosophers or neuroscientists to defend betterment commensurability (the philosophers probably could have used the extra income).

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⁴⁷ In the last few decades, there is been an inclination/move by Federal U.S. government agencies to compensate for environmental injuries with in-kind replacement. For example, the responsible party compensates for their destruction of wetlands by being required to create or enhance comparable wetlands (e.g. replace dead ducks and degraded duck habitat with ducks and great duck habitat). This inclination is motivated, in part, by concerns about the commensurability of environmental betterments with the betterments produced by market goods and services.

⁴⁸ I worked on the other side.

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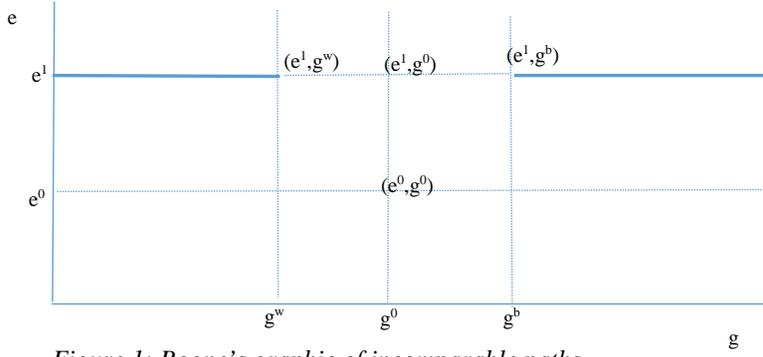


Figure 1: Boone's graphic of incomparable paths

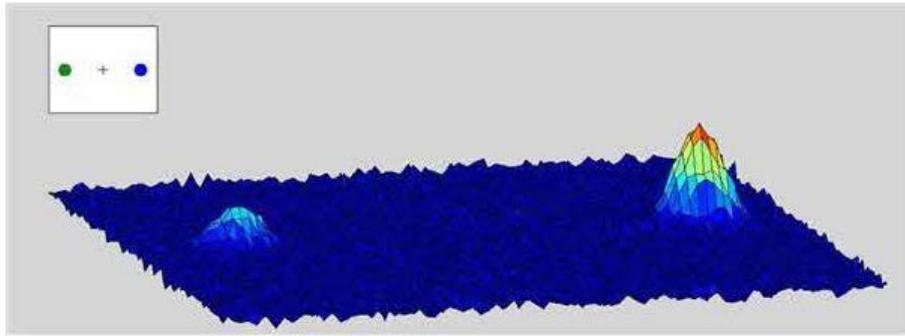


Figure 2: Cartoon of the valuation circuit with two alternatives (courtesy Ryan Webb)