

A Solution to the Problem of Indeterminate Desert*

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Abstract

A desert-sensitive moral theory says that whether people get what they deserve, whether they are treated as they deserve to be treated, plays a role in determining what we ought to do. Some popular forms of consequentialism are desert-sensitive. But where do facts about what people deserve come from? If someone deserves a raise, or a kiss, in virtue of what does he deserve those things? One plausible answer is that what someone deserves depends, at least in part, on how well he meets his moral requirements. The wicked deserve to suffer and the decent do not. Shelly Kagan (2006) has argued that this plausible answer is wrong. But his argument for that conclusion does not succeed. I will show how to formulate a desert-sensitive moral theory (and also a desert-sensitive version of consequentialism) on which this answer is correct.

1 A problem for desert-sensitive moral theories

Desert plays an important role in our moral thought. Something has gone off, we think, when wicked people prosper and decent people suffer. And that is because the wicked do not deserve to prosper and the decent do not deserve to suffer.¹ If

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¹John Rawls famously claimed that ‘no one deserves his place in the distribution of native endowments’ (Rawls 1971, p. 104). Some have found arguments in Rawls’ work that aim to establish that no one deserves anything (see Zaitchik 1977 and Sher 1987 (chapter 2) for discussion of these arguments). If it is true that no one deserves anything then there is no important role for facts about desert to play in moral or political theory. I shall assume that this view is false.

this is right then we should be developing desert-sensitive moral theories: moral theories that, in some way or other, allow facts about what people deserve to play a role in determining which acts are moral permissible and which are morally forbidden.² And, in fact, the development of desert-sensitive moral theories is an ongoing enterprise. Consequentialists, for example, have been developing desert-sensitive versions of consequentialism, though there is disagreement about the best way to incorporate desert into consequentialism (see, for example, Feldman 1995, Arrhenius 2006, and Hurka 2001.)

Whenever someone deserves something there is some basis for the fact that he deserves that thing. So what factors influence what someone deserves? There are many of them, but one appealing idea is that someone's moral worthiness influences his desert level. The idea is that what people deserve depends, at least in part, on how well they conform to the requirements of morality. Other things being equal, decent people, people who always do the morally right thing, deserve to prosper. They deserve to be leading good lives. Wicked people, on the other hand, people who always do the morally wrong thing, do not. (In fact, maybe wicked people do not just fail to deserve to prosper; maybe in addition they deserve to suffer.) I will call this idea 'Desert Depends on Conformity', or DDC for short.³

Can a desert-sensitive moral theory incorporate DDC? There is reason to suspect that the answer is no. The goal of this paper is to demonstrate that desert-

²One must make certain assumptions about the nature of desert for it to make sense to say that facts about what people deserve play a role in determining the moral status of acts. For example, suppose one held the view that *what it is* to deserve, say, a raise, is for it to be the case that your boss ought to give you a raise. Then it would be wrong to say that my boss ought to give me a raise because I deserve one. For the fact that I deserve a raise is, in some sense, the same fact as the fact that my boss ought to give me one. So the former fact cannot explain why the latter one obtains.

In this paper I will assume that facts about what people deserve not are definitionally tied to facts about the moral status of actions in this way, though I will not defend this assumption. Some remarks in its defence can be found in Feldman 1995 (pp. 583–5).

³Fred Feldman is one example of a philosopher who thinks that conformity to morality is among the factors that influence desert (Feldman 1995, p. 574).

sensitive moral theories *can* incorporate DDC. But let us start by looking at how the problem for theories that incorporate DDC is supposed to arise.

Other things being equal, we ought to ensure that people get what they deserve. It is almost definitional of a desert-sensitive moral theory that it incorporate this principle. (The ‘other things being equal’ clause is important here: we may end up preferring a desert-sensitive theory that says that in some situations other morally relevant factors may outweigh facts about desert, so that it is morally permissible to deny someone what he deserves.) So: a desert-sensitive moral theory that incorporates DDC will say that what I deserve depends (in part) on whether I do what I ought; and (the theory says) whether I do what I ought depends (in part) on whether I ensure that people get what they deserve. And whether those people themselves get what they deserve depends on whether they do what they ought, which (again) depends on whether they ensure that people get what they deserve. And so on. We have chains of dependencies of desert on conformity to morality, and of conformity to morality on desert.

Why might it be bad for there to exist such chains of dependencies? One possibility is that a chain of dependencies goes in a circle. And these circles might generate inconsistencies: maybe there are circumstances in which, due to a circle of dependencies, a desert-sensitive moral theory says that I do what I ought if and only if I do not do what I ought. And even if a circle of dependency does not generate inconsistency, it might still result in facts about desert being ungrounded. If facts about what someone deserves depend on themselves, maybe there will be no fact of the matter about what he deserves. (Circles of dependency are not the only thing to worry about. Another possibility is that a chain of dependencies goes on forever without becoming grounded. Then again it would appear that there is no fact of the matter about what some people deserve, or whether certain people do what they ought to do.)

Shelly Kagan (2006) has argued that *any* desert-sensitive moral theory that incorporates DDC will contain pathological chains of dependencies. He claims that the existence of these chains of dependencies makes these theories ‘logically unfit’ and so false (p. 45). So, according to Kagan, no acceptable desert-sensitive moral theory can incorporate DDC. (In the next section I will discuss in more precise detail

just how circles of dependency can lead to indeterminacy, and just why Kagan finds this objectionable.)

This is a surprising method for arguing against DDC. If someone announced that he was going to argue that the wicked do not, in fact, deserve to suffer, I would perhaps expect him to say something about how the intrinsic dignity of persons makes us all worthy of love, no matter how far we stray from the path of righteousness. At the very least, I would expect his argument to contain premises articulating distinctively moral considerations. But that is not what Kagan's argument looks like. Instead, his argument is an adaptation of the kind of reasoning that we see in discussions of the liar paradox.

Since desert-sensitive moral theories can differ from one another in all sorts of way, and can be very complicated, it is hard to figure out whether every single one of them that incorporates DDC is 'logically unfit'. In light of this fact, Kagan's strategy is to discuss several simplified 'model' desert-sensitive moral theories and argue that each of them must be rejected. This does not *prove* that no desert-sensitive theory can incorporate DDC. But it does provide evidence that all such theories are false: the models he discusses are diverse enough that one might reasonably think that any other desert-sensitive moral theory that incorporates DDC will fail for the same reason that one of Kagan's models fails.

Still, again, Kagan has not given us a proof. There may be a theory that he has not considered that is not logically unfit. What I will do in this paper is present two such theories, and thereby defend DDC. The first theory I will present resembles one that Kagan considers; the main difference from Kagan's, and the reason why it succeeds, is that it is more mathematically sophisticated. But this theory is not, on its face, a version of consequentialism. Since I am especially interested in whether there can be a desert-sensitive version of consequentialism that incorporates DDC, I will also present a version of consequentialism that escapes Kagan's arguments.

2 Kagan's argument

To appreciate what Kagan means when he calls a moral theory 'logically unfit' let us go through Kagan's reasons for rejecting one of the simple desert-sensitive moral

theories he discusses. This will also help us see what a desert-sensitive moral theory must do to avoid Kagan's arguments.

As we will see, Kagan's simplest desert-sensitive moral theory is ridiculously simple. It is far too simple to be taken seriously as a candidate for the true moral theory. But for our purposes its simplicity is a virtue, because it allows us to reason clearly about the chains of dependency of desert on conformity and conformity on desert and to see exactly why a theory that contains such chains might be a bad theory.

Here is the theory. There is only one moral requirement: to give others what they deserve. Someone is good (let us say) if he conforms to the requirements of morality, and bad if he does not. (This is a stipulative definition of 'good'. It may not match the meaning the word has in ordinary usage.) There are only two things that people can deserve: love and hate. Each person must either love or hate each person (and cannot do both). Finally, desert depends on conformity to morality in the simplest way: someone deserves love if and only if they are good (and so deserves hate if and only if they are bad). That is all there is to the theory.

Now consider the following situation. Suppose that there are two people, Frank and Stella. Suppose that Frank and Stella love each other. What does Frank deserve — love or hate? What about Stella? These questions do not have answers. Our moral theory, together with all the morally relevant facts about who loves whom, do not determine what Frank and Stella deserve. For it is consistent with all that has been said so far to suppose that both deserve love. If Frank deserves love, then since Stella loves him, Stella gives him what he deserves, so Stella is good. Since she is good, she deserves love, which is what Frank gives her; so Frank is good, and therefore deserves love. Consistent. But it is also consistent with all that has been said so far to suppose that both deserve hate. For if Frank deserves hate, then Stella does not give him what he deserves, so Stella is bad. Since Frank loves Stella, he does not give her what she deserves, so he also is bad, and therefore deserves hate. This is also consistent.

So if this theory is the true and complete moral theory it is *indeterminate* whether Frank deserves love or hate (and similarly for Stella). This is the problem of indeterminate desert.

It may not be surprising that this theory suffers from indeterminacy. But Kagan thinks that a similar form of reasoning can be used to show that *every* desert-sensitive moral theory that incorporates DDC suffers from indeterminacy — even more complicated, more realistic theories, including theories in which desert does not depend just on conformity and theories in which conformity does not depend just on whether one gives others what they deserve. (I will look at both of these kinds of theories as we proceed.) And that *is* surprising.

Kagan claims that any moral theory that contains this kind of indeterminacy is ‘logically unfit’ and so false. But he does not tell us much about why this kind of indeterminacy is unacceptable. He only explicitly gives one reason for thinking this: he says that if it is indeterminate whether Frank deserves love or hate, then it is indeterminate how Frank is to be treated. The idea, I suppose, is that *that* is certainly unacceptable. But this does not seem obvious to me. Why is it unacceptable for a moral theory to say it is indeterminate how someone ought to be treated? Is it not, in fact, easy to describe situations in which it is indeterminate how someone ought to be treated? Suppose I promise to bring you a red rose and the rose I bring, while determinately either red or orange, is not determinately red. Then, it seems, it is indeterminate whether I kept my promise, and (so?) indeterminate how you ought to treat me.

Maybe the best thing to say in defence of Kagan’s claim is that it is unacceptable for indeterminacy to arise in a moral theory in the particular way it does in our example: through the ungroundedness of facts about whether Frank or Stella is good or bad. And even if one does not agree that all moral theories in which facts about desert are sometimes indeterminate must be false, one should still think that it would be better to have a desert-sensitive moral theory that avoids the problem of indeterminate desert.

Besides the problem of indeterminate desert, desert-sensitive moral theories also face (what I think is) a more pressing problem. There are situations that such a theory must say are paradoxical. Consider a situation in which Frank loves Stella and Stella hates Frank. Here the problem is not that there are too many consistent suppositions about what Frank and Stella deserve; instead, there are *no* consistent suppositions. (If Stella deserves love, then Frank is doing what he ought, so he

deserves love, so Stella does not do what she ought, so Stella deserves hate: a contradiction. Similarly, if Stella deserves hate, we can show that she deserves love. This is an analogue of the version of the liar paradox in which sentence *L1* says that *L2* is true, and *L2* says that *L1* is false.) So if this moral theory is true, then it is *impossible* for Frank to love Stella and Stella to hate Frank. But such a situation is obviously possible. So this moral theory is false.

Kagan does discuss this problem of inconsistency, but he is more worried about the problem of indeterminacy. Although I think the problem of inconsistency is a bigger problem, I am going to go along with Kagan and insist that an acceptable desert-sensitive moral theory must avoid both problems. (I will also, like Kagan, focus most of my discussion on the problem of indeterminacy.) So an acceptable desert-sensitive moral theory that incorporates DDC must determine a unique answer to the questions ‘How well does S conform to the requirements of morality?’, and ‘What does S deserve?’, for each person S in each possible situation. And it must do so without saying that situations that appear possible, like the situation in which Frank loves Stella and Stella hates Frank, are really impossible.⁴ That is what the theories I am going to describe will do.

3 Breaking the circle

Let us look again, in more abstract terms, at how the problem of indeterminate desert arises in our simple theory. We start with certain facts that are given: we are given whether Frank and Stella love each other, and we are given what the moral requirements are. Then we begin with some supposition about what Frank and Stella deserve. From this supposition, we can compute how well each conforms to the moral requirements, and then from that compute what each of them deserves. We have gone in a circle from a supposition about what they deserve to a conclusion about what they deserve. The supposition we started with is consistent if the level of desert we get after we go around the circle is the same as the level we supposed to

⁴A desert-sensitive theory might also avoid the problems of indeterminacy and inconsistency by incorporating DDC only partially. It could say that people’s desert levels depend on their conformity to morality only in situations where there is no threat of indeterminacy or inconsistency. But this solution is ad hoc.

obtain at the beginning. The problem is that there are many consistent suppositions.

The first theory we have looked at is, I said, ridiculously simple. Maybe less simple and more realistic theories will not suffer from indeterminacy. Kagan discusses several ways to make the theory less simple and more realistic (and argues that they all suffer from indeterminacy). I want to look at one of these less simple theories, because the solution to the problem of indeterminate desert that I will propose builds on one of its ideas.

The first theory said that there is just one moral requirement: to give other people what they deserve. Our second theory will say that there are other moral requirements as well. It does not matter much what they are; what matters is that those requirements say nothing about desert. (A general requirement to do no harm, or to be benevolent, would fit the bill.) When does someone deserve love, according to this theory? Let us suppose that the theory says that someone deserves love if and only if he conforms to *all* of the moral requirements (and so deserves hate if and only if he fails to conform to at least one of the moral requirements). This theory looks like it might not suffer from indeterminacy: now whether someone meets all of his obligations is only *partly* a matter of whether he gives others what they deserve. The desert-independent moral requirements can serve as independent facts that constrain what assignments of desert are consistent, narrowing down the number of consistent assignments (hopefully) to just one.

But this theory does not, in fact, succeed. It still contains indeterminacy. Suppose that Frank and Stella have both met all of their desert-independent moral obligations, and that (as before) Frank and Stella love each other. Is it still consistent to assume that Frank and Stella both deserve love, and also consistent to assume that Frank and Stella both deserve hate.

Even though this theory still suffers from indeterminacy, it points the way to a theory that does not. Here, in outline, is my strategy for solving the problem of indeterminate desert (and the problem of inconsistency). I will take this theory and expand the number of possible levels of conformity to morality, and the number of possible levels of desert, that Frank and Stella can have. This has the effect of *expanding* the number of starting points there are for going around the circle. Still, the net effect of doing this and also including desert-independent moral requirements

is that exactly one consistent supposition about Frank and Stella's levels of desert remains.

In my theory there are *infinitely* many levels of conformity to morality and infinitely many levels of desert. And those levels form a continuum (like the real numbers and unlike the rational numbers). To see why the theory requires levels of conformity and levels of desert that behave like this, let us see why it is not enough merely to allow more than two levels of desert. So suppose that there are more than two desert levels and that we can list them all (d_1, d_2, d_3, \dots) so that desert levels that appear earlier on the list are desert levels of less deserving people. (It does not matter whether the list is finite or infinite.) The theory says that someone with an intermediate level of desert deserves an intermediate amount of love. Now consider a situation in which Frank and Stella have satisfied enough of their desert-independent moral requirements so that the following is true: if, in addition, Frank perfectly satisfies the requirement to love those who deserve it, then his desert level is d_{i+1} ; but if he does not perfectly satisfy that requirement then his desert level is d_i . Frank is at a 'desert-level threshold'. A similar claim is true for Stella. Now if the amount of love Frank and Stella have for each other is the amount owed to someone at desert level d_{i+1} , then it is consistent to suppose that each have that desert level, and also consistent to suppose that they each have desert level d_i .

This argument works by looking at a situation in which Frank and Stella have met enough moral requirements well enough so that, if they perfectly meet just one more, they will be at the *next* level of desert. But in my theory the infinitely many levels of conformity and of desert form a continuum; there is never a next level. So this argument does not work against my theory.⁵ (Of course, we cannot yet conclude that my theory *avoids* the problem of indeterminate desert; I am going to prove below that the theory does avoid it.)

I am just about ready to explain my solution in detail. But first I want to emphasize that, like the theories Kagan discusses, the theory I will present is a sim-

⁵Strictly speaking, to evade the argument it is enough that the desert and conformity levels be densely ordered. The rational numbers are densely ordered, but I require the levels to have more structure (they need to be complete the way the real numbers are). The mathematical theorem I will use requires this extra structure.

plified, toy theory. The purpose of discussing it is to show, in a simplified setting, how to avoid the problem of indeterminate desert. I am confident that more realistic theories can avoid the problem in the same way.

I will begin by presenting a scheme for representing the continuum of conformity levels and of desert levels. Each person has a degree of conformity to the requirements of morality, which I will represent with numbers: 1 is perfectly saintly, someone who always does what he ought, and 0 is completely vile, someone who never gets it right. But I want to allow any degree of conformity between these. For scenarios with two people, like Frank and Stella, the joint state of conformity to moral requirements will be a pair of real numbers (x_1, x_2) , each between 0 and 1. Let M be the set of conformity states $[0, 1] \times [0, 1]$.

Not just conformity to the moral requirements, but also love, comes in degrees. We need a convention for representing degrees of love. I will say that love of degree 1 is perfect love, while ‘love’ of degree 0 is perfect hatred. Love of degree $1/2$, then, is complete indifference. (I am using ‘love’ in a technical sense here, but it is related to the ordinary sense. I love someone to some degree in the ordinary sense if the degree to which I love them in this technical sense is greater than $1/2$. If we say that a number y is the opposite of x just in case $y = 1 - x$, then in this scheme love is the opposite of hate.)

Each person also has a degree to which he deserves to be loved. In light of what degrees of love can be, the set of desert states is easy to characterize: the set E of desert states is also $[0, 1] \times [0, 1]$. An ordered pair (f, s) in this space represents a state in which Frank deserves to be loved to degree f and Stella deserves to be loved to degree s .

This is to be a theory that says that what people deserve depends on how well they conform to the requirements of morality. So somehow facts about how much love Frank and Stella deserve are determined by the facts about how well they conform to morality.⁶ I will represent this dependence of desert on conformity

⁶This is one place (among many) where I am simplifying things. In reality, someone’s degree of conformity *influences* but does not *determine* their desert level. It may be, for example, that those who must work harder to conform to morality to a certain degree deserve more love than those who find it easy to conform to that

by a function h from M to E . So h works like this:

$$h(\text{degree of conformity}) = (\text{degree of love deserved}).$$

If, for example, Frank's degree of conformity is .7, and Stella's is .2; and if in virtue of this Frank deserves to be loved to degree .9, and Stella to degree .5, then we write $h(.7, .2) = (.9, .5)$. What is the function h ? In my theory it is the identity function: the degree to which someone deserves to be loved is just equal to their degree of conformity. Those who always act rightly deserve perfect love, those who sometimes get it right deserve some love, and the absolutely vile who always do the wrong thing deserve complete hatred.

That is the story about how desert is determined by conformity to morality. So what determines the degree to which someone conforms to morality? Our theory has several moral requirements: a requirement to love others iff they deserve it, and several desert-independent requirements. Let us start by looking just at the requirement to love those who deserve it. You conform to this requirement perfectly (to degree 1) when you love someone to just the degree to which they deserve to be loved. What about the case where you do not love someone to the appropriate degree? We know, qualitatively, what must happen: the greater the difference between the degree to which you love someone and the degree to which they deserve to be loved, the lower the degree to which you conform to morality. But there are lots of quantitative measures of degree of conformity that meet the qualitative constraint.

The measure my theory uses is very simple and is best explained using a diagram. Figure 1 is a graph of that measure. The horizontal axis represents the degree to which someone (say, Frank) loves someone else (say, Stella). The point marked ' D ' is the degree to which Stella deserves to be loved. And the vertical axis represents the degree to which Frank conforms to the requirement to love, as a function of D and of the degree to which he loves Stella. The rule for generating the graph is as follows. Frank is able to love Stella to any degree between 0 and 1. When he loves Stella to degree D , Frank is doing exactly what he ought to. In

degree. The consequentialist theory I present later does not ignore other influences on desert.

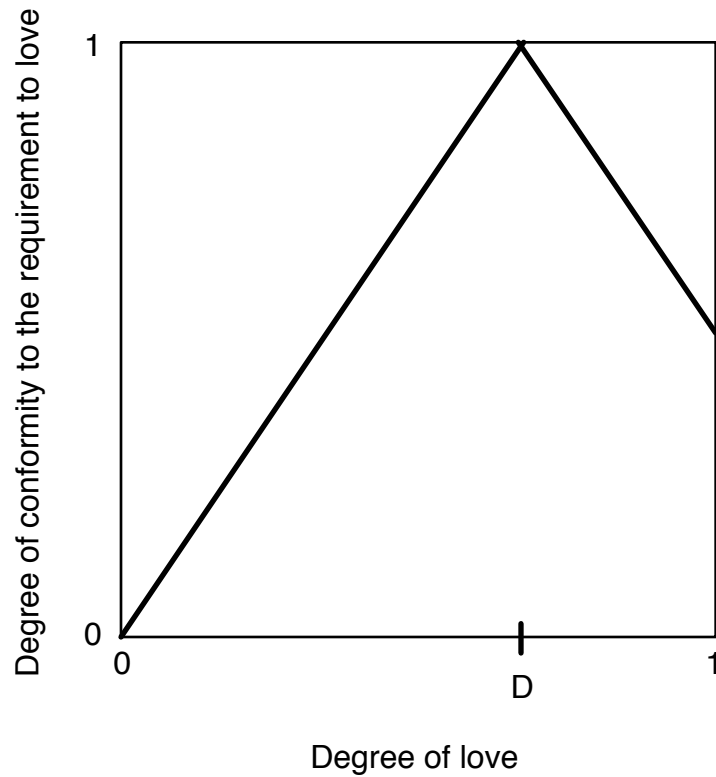


Figure 1: A graph of Φ , the function I use to measure conformity

that case, as I said before, his degree of conformity is 1. The measure I use says, similarly, that when Frank is ‘as far away as possible’ from doing what he ought to do, his degree of conformity is 0. In the diagram, Frank is as far away as possible from doing what he ought when he loves Stella to degree 0. (In general, whenever $D > 1/2$, Frank is as far away as possible from doing what he ought when he loves Stella to degree 0; when $D < 1/2$, he is as far away as possible when he loves her to degree 1; when $D = 1/2$, loving to degree 1 or degree 0 are tied.) What about when Frank is neither as close as possible to nor as far away as possible from doing what he ought? Then the simplest thing to do is to draw a straight line. And that is what I do. The graph between the points $(0, 0)$ and $(D, 1)$ is a straight line. What remains is the part of the graph to the right of D . That part corresponds to situations in which Frank loves Stella more than she deserves. Symmetry guided my choice of the shape of this part of the graph: I have the graph descend as one moves toward

the right from D at the same rate at which it descends as one moves toward the left. (These are instructions for drawing the graph when $D > 1/2$. It should be clear how to adapt these instructions to the case where $D < 1/2$ or $D = 1/2$. When the time comes, we will need mathematical equations for these graphs, but at this point those equations do not help to see why this measure is plausible.) I will use ' $\Phi(D, l)$ ' to name the function that gives the degree of conformity when l is the degree of love given and D is the degree of love deserved.

Now we have a way to compute the degree to which each person conforms to the requirement to love those who deserve it. What about the other, desert-independent, moral requirements? I will not try to give a procedure for computing the degree to which each person conforms to those requirements. All that matters for our purposes is this: for each person in a given situation, and for each desert-independent moral requirement, there is some number that represents the degree to which that person conforms to that requirement in that situation. It should not be controversial that there always is such a number. We do not even need to assume that the desert-independent requirements can be met to intermediate degrees: even if the only possible degrees to which they can be met are 1 (when someone conforms to the requirement) or 0 (when someone fails to conform), the solution I will present works.

So we now have, for each person, numbers representing the degrees to which he conforms to each of the moral requirements. What we need is a way to combine all this information into one number. That number represents the degree to which he conforms to morality generally. We should say that he conforms to degree 1 if and only if he conforms to each requirement to degree 1, and he conforms to degree 0 if and only if he conforms to each requirement to degree 0. But what about intermediate degrees? Clearly it should turn out that the better I do on the requirements, overall, the higher my total level of conformity. My theory meets this constraint by averaging the individual degrees of conformity. So suppose that there are n desert-independent moral requirements and that Frank conforms to the first of them to degree d_1 , the second to degree d_2 , and so on. Let D be the degree to which Stella deserves to be loved and l the degree to which Frank loves Stella. I shall say

that the degree to which Frank conforms to morality generally is given by

$$(\text{F's degree of conformity}) = \frac{d_1 + \cdots + d_n + \Phi(D, l)}{n + 1}. \quad (1)$$

(An analogous equation gives Stella's degree of conformity. A more complicated theory might say that some moral requirements are more important than others. In that case we would need to take the weighted average of the degrees of conformity. My solution works just as well in that sort of theory.)

So far, so good. In the theory, once we have fixed the degrees to which Frank and Stella conform to the desert-independent moral requirements, and also fixed the degrees to which Frank and Stella love each other, the facts about the degrees to which Frank and Stella deserve to be loved determine the level to which each of them conforms to morality generally. We can represent this determination by a function g from E to M :

$$g(\text{degrees of love F and S deserve}) = (\text{how well each conforms to morality}).$$

The mathematical representation of g is got just by substituting in equation (1). I will use the following notation:

- l_f is the degree to which Frank loves Stella.
- l_s is the degree to which Stella loves Frank.
- d_f is the sum of the degrees to which Frank conforms to the desert-independent moral requirements.
- d_s is the sum of the degrees to which Stella conforms to the desert-independent moral requirements.

If Frank deserves to be loved to degree f , and Stella deserves to be loved to degree s , $g(f, s)$ is defined to be

$$g(f, s) = \left(\frac{d_f + \Phi(s, l_f)}{n + 1}, \frac{d_s + \Phi(f, l_s)}{n + 1} \right).$$

We can use our two functions g and h to build a function from E , the desert states, to itself. The function simply takes a desert state (f, s) to $h(g(f, s))$. Call this function ‘ k ’: starting from a claim about Frank and Stella’s levels of desert, this function (using independent facts about how Frank and Stella love and how well they conform to the desert-independent requirements) takes us to how well they conform to morality, and then back to their level of desert. Abstractly, k looks like this:

$$k(\text{F and S's level of desert}) = (\text{F and S's level of desert}).$$

Since h is the identity function,

$$k(f, s) = \left(\frac{d_f + \Phi(s, l_f)}{n + 1}, \frac{d_s + \Phi(f, l_s)}{n + 1} \right).$$

That completes my presentation of my desert-sensitive moral theory. Now to see how it avoids the problems of indeterminacy and inconsistency.

We can re-state the problems of consistency and indeterminacy in terms of properties of the function k . A *fixed point* of k is a joint level of desert for Frank and Stella (f, s) such that $k(f, s) = (f, s)$. Our assumptions about desert and conformity to morality are *consistent* just in case k has a fixed point. Our assumptions about desert and conformity are *determinate* just in case this function has a *unique* fixed point. Is there a unique fixed point?

Actually, we want the answer to a more general question than this one. The function g , and so the function k , depended on independently specified facts about how much Stella and Frank love each other and the degrees to which they conform to the desert-independent moral requirements. If we change our assumptions about these facts, we get a different function (corresponding to different values of l_f, d_f, l_s , and d_s). It is no good if some of these assumptions are consistent and determinate; what we need to do is show that *every one* of these assumptions is consistent and determinate.

It can be proved that k has a *unique* fixed point, given *any* assumptions about how Frank and Stella love and how well they meet their other moral requirements. That a fixed point exists solves the problem of inconsistency, and that it is unique solves the problem of indeterminacy. The proof, which is a little bit technical, is in

the appendix. But here is an informal explanation of the way the proof works.

The proof is an application of the contraction mapping theorem. A function from E to itself is a contraction mapping if it ‘moves pairs of points closer together’. Our function k is a contraction mapping: the distance between any pair of points (f_1, s_1) and (f_2, s_2) is greater than the distance between $k(f_1, s_1)$ and $k(f_2, s_2)$. (What follows is an explanation of the contraction mapping theorem. In the appendix I prove that k is a contraction mapping, but do not prove the contraction mapping theorem itself. A proof of the theorem may be found in, for example, Simmons 1963 (pp. 338–9).) The contraction mapping theorem says that every contraction mapping on E has exactly one fixed point. It is easy to see that if k has a fixed point, it has exactly one. For if (f_1, s_1) and (f_2, s_2) were two fixed points, then $k(f_1, s_1) = (f_1, s_1)$ and $k(f_2, s_2) = (f_2, s_2)$, so the distance between (f_1, s_1) and (f_2, s_2) is the same as the distance between $k(f_1, s_1)$ and $k(f_2, s_2)$; but then k is not a contraction mapping. Seeing that k has at least one fixed point is a little more difficult. The basic idea is to start with any point in E and look at what happens when we repeatedly apply k to it. Then we get a sequence of points $(f, s), k(f, s), k(k(f, s)), \dots$, where adjacent members of the sequence get closer and closer together. In fact this sequence approaches a limit: it gets infinitely close to some point (f^*, s^*) in E . It can be shown that this limit point is a fixed point of k .

Both of the features of my desert-sensitive moral theory that I have discussed are essential if we are to be able to use the contraction mapping theorem here. If the requirement to give others what they deserve were the only moral requirement then k would not be a contraction mapping. For suppose that that were the only moral requirement. Then we would have that $k(f, s) = (\Phi(s, l_f), \Phi(f, l_s))$. It is easy to see that when $l_f = l_s = 1$ both the point $(1, 1)$ and the point $(0, 0)$ are fixed points of k . So k no longer moves pairs of points in E closer together. It is because my theory averages someone’s degree of conformity to the desert requirement with their degrees of conformity to the desert-independent moral requirements that k is a contraction mapping.

It is also essential that there be a continuum of levels of desert and of conformity. If the ‘space’ of possible desert states were (for example) finite, then k would still be a contraction mapping, but it would not be a contraction mapping on

E . Then there would be no guarantee that the sequence $(f, s), k(f, s), k(k(f, s)), \dots$ approaches a limit.

One might worry about the theory's use of a continuous infinity of desert and conformity levels. For one might worry that the theory only solves the problem of indeterminate desert if Frank is able to conform to morality to any of the continuum-many desert levels between 0 and 1. If Frank is not able to do this, if some of the conformity levels are inaccessible to Frank, then (it might seem) we should remove those levels from E — and then the contraction mapping theorem fails to apply. But humans are finite; so (one might think) it is not plausible that humans like Frank are able to conform to morality in so fine-grained a way.

In fact there is no problem here. The worry focuses on which levels of conformity Frank is able to achieve. But Frank does not conform to morality 'directly'; instead, he conforms to some degree *by* loving Stella to some degree. Now the fact that humans are finite may make it plausible that Frank is not able to love Stella to each of a continuous infinity of degrees. But the theory does not presuppose that he can. The theory just says that for each of the (finite, infinite, or whatever) degrees of love that are available to Frank and Stella there is a unique joint level of desert and conformity for the pair.

(Of course, if we suppose that Frank and Stella can only achieve a finite number of degrees of love for each other, then there will only be a finite number of joint conformity/desert states that the two of them will be able to achieve. My theory tells us which these states are — the fixed points of k when l_f and l_s are set to Frank's and Stella's achievable degrees of love. And the set of available desert/conformity states will be such that there is exactly one of them for each of the ways that Frank and Stella can love each other.)

4 A Solution for consequentialists

The solution I have presented to the problem of indeterminate desert is not available to consequentialists. That is because the solution works only if there are multiple moral requirements. But (act) consequentialists believe that there is only one moral

requirement: each person is morally required to produce the best outcome he can.⁷

Before saying anything more about consequentialist solutions to the problem of indeterminate desert, though, we should ask whether the problem even arises for consequentialism. Of course, the problem does not arise for versions of consequentialism that are not desert-sensitive. But what about the desert-sensitive versions that incorporate DDC (the doctrine that desert depends on conformity to morality)? These theories do not achieve desert-sensitivity by including a basic moral requirement to ensure that others get what they deserve. And it was by including that basic moral requirement that the theories we have been looking at opened the door to the problem of indeterminate desert.

Desert-sensitive versions of consequentialism take desert into account not in their list of basic moral requirements, but in their axiology, or theory of the good. These theories say that the goodness, or intrinsic value, of a possible situation depends, in part, on the extent to which people in that situation get what they deserve.

A version of consequentialism with an extremely simplified desert-adjusted axiology does face the problem of indeterminate desert. This axiology says that the intrinsic value of a scenario is *entirely* determined by the extent to which people in that outcome get what they deserve: the closer people are to getting what they deserve, the higher the intrinsic value of the scenario. Here is how the argument goes. Suppose that someone deserves love if and only if he conforms to morality. Now return to Frank and Stella and the situation in which they love each other. As before, there are two consistent suppositions about what Frank and Stella deserve. The reasoning required to show this is a little more involved than it was with Kagan's initial example, but still not complicated. Suppose Frank and Stella both deserve love. We need to figure out whether Frank and Stella conform to the consequentialist moral requirement. If Frank had hated Stella instead of loving her, then he would have failed to give her what she deserved; since she would have failed to get what she deserved, the intrinsic value of the scenario would have been lower

⁷There are, of course, satisficing consequentialists, who say that we are required to produce an outcome that is 'good enough'. What I will say on behalf of maximizing consequentialism can be said on behalf of satisficing consequentialism as well.

than it actually is. So by loving Stella Frank produces the best outcome open to him. So he conforms to the requirements of morality, and so deserves love. Similarly for Stella. So the supposition that both deserve love is consistent. The same sort of reasoning shows that the supposition that both deserve hate is also consistent. So this desert-sensitive version of consequentialism permits situations in which it is indeterminate what people deserve.

This version of consequentialism has an incredibly implausible axiology. It says that the only thing that is good is getting what one deserves. Any decent version of consequentialism will use an axiology that says that other things are also good: pleasure, for example, or the satisfaction of desire.

For reasons that will be familiar, though, using one of these more complicated theories of the good does not help. Suppose that, in our Frank and Stella scenarios, the intrinsic value of a situation depends both on the extent to which people get what they deserve and also on the amount of love in the world. (Other things being equal, situations with a greater balance of love over hate are better.) It is still consistent to suppose that Frank and Stella both deserve love, and to suppose that neither does.

We cannot solve the problem of indeterminate desert for desert-sensitive versions of consequentialism by incorporating additional moral requirements, for there are none. But there is still a solution.

Rather than appealing to additional moral requirements, consequentialists can appeal to additional grounds for desert. We are interested in defending the claim that what someone deserves depends, in part, on how well they conform to the requirements of morality. The idea here is to focus on the words ‘in part’. There are plenty of examples of conformity-independent factors that we might want to play a role in determining someone’s desert level. Maybe when someone suffers from deficient past receipt — in the past he has gotten less than he deserves — his desert level goes up. Maybe just in virtue of being a person (or a human being), each of us deserve to be living a life that is pretty good — certainly better a life that is just barely worth living. (For a discussion of what factors might influence one’s desert level, see Feldman 1995.) It is independently plausible that there are factors other than conformity that influence desert.

But just accepting that there are other factors that influence desert is not

enough to avoid the problem of indeterminate desert. (The argument for this claim is the same as the earlier argument that accepting that there are moral requirements other than the requirement to give others what they deserve is not enough.) The theory must also include a continuous infinity of levels of desert and conformity, just as the non-consequentialist solution did. With these two ideas we can solve the problem of indeterminate desert for consequentialists.

I will sketch here how these ideas allow us to solve the problem of indeterminate desert for a version of consequentialism with a simplified axiology that is adapted to our Frank and Stella scenarios. We again represent degrees of love, levels of desert, and degrees of conformity to morality by real numbers between 0 and 1. What we need to do is to see what the functions g and h look like in this case. Recall that g is a function from E to M :

$$g(\text{degree of love F and S deserve}) = (\text{how well each conforms to morality}).$$

The simplified version of consequentialism I will describe uses a mathematical expression for g that is similar to the expression I used in the earlier theory. Let me go through how we get to g in this new theory.

We are using an axiology that says that how good a state of affairs is depends only on how close the people in that state of affairs are to getting what they deserve. (Closer is better.) Frank conforms perfectly (to degree 1) to the consequentialist moral requirement when he produces the best state of affairs that he can. And he conforms to degree 0 when he produces the worst state of affairs that he can. Our axiology makes it easy to see which states of affairs those are. Suppose, for example, that Stella deserves to be loved to degree $3/4$. Then the best Frank can do is to love Stella to degree $3/4$. And the worst he can do is to love her to degree 0 (no degree of love is farther away from $3/4$ than 0 is). What about a situation in which Frank loves Stella to degree $3/8$ — the degree that is half way between 0 and $3/4$? The simplest thing to say is that the intrinsic value of this scenario is half-way between the value of his worst outcome and the value of his best outcome.⁸ Figure

⁸The value of all of these states of affairs depends also on another factor: how close Frank is to getting what he deserves. But how close Frank is to getting what he

2 is a graph of intrinsic value as a function of Frank's degree of love. (The shape of the graph is the same as the shape of the graph in figure 1; but the vertical axis in figure 2 has a different meaning.)

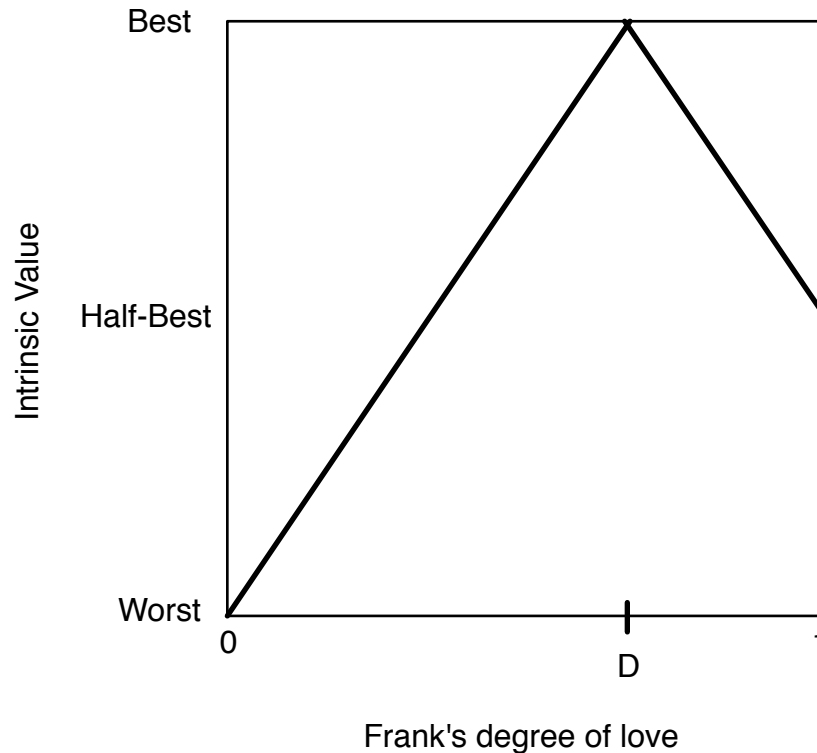


Figure 2: A graph of intrinsic value as a function of Frank's degree of love

I have not said anything about the shape of the graph to the right of D . The graph says that the value of a state of affairs in which Frank loves Stella .1 degrees more than she deserves is the same as the value of a state of affairs in which Frank loves Stella .1 degrees less than she deserves. This is in keeping with the idea that the value of a state of affairs depends only on how close the people in it are to getting what they deserve.⁹ (The graph for the case where $D < 1/2$ looks similar.)

deserves depends on how much Stella loves him, something that (I assume) Frank has no control over. So when ranking the values of Frank's alternatives we can regard the contribution to intrinsic value from this factor as a fixed number. It does not, therefore, affect the differences between the values of Frank's alternatives.

⁹This proposal is the simplest but it is not the most plausible. One might think

Now we know the (relative) values of Frank's alternatives. What we need to know is the degree to which each alternative conforms to the consequentialist moral requirement. But this is easy: if Frank takes the best alternative then he conforms to degree 1, if he takes the worst alternative he conforms to degree 0, if he takes the alternative with value half-way between the worst and the best he conforms to degree 1/2, and so on. The result is that the degree to which Frank conforms to morality is just the function $\Phi(s, l_f)$. The same goes for Stella, so we now know what the function g looks like in our desert-sensitive version of consequentialism: it is just what we get from taking the function g from the earlier theory and removing all moral requirements other than the requirement to give others what they deserve. So it looks like this:

$$g(f, s) = (\Phi(s, l_f), \Phi(f, l_s)).$$

(It is worth noting that the status of $\Phi(D, l)$ in the consequentialist theory is different from its status in the non-consequentialist theory I discussed in the previous section. Even if we make the non-consequentialist theory more complicated, $\Phi(D, l)$ will still give the degree to which someone conforms to the requirement to love. But if we make the consequentialist theory more complicated, by adopting a more realistic theory of the good, then $\Phi(D, l)$ will no longer give the degree to which people conform to the consequentialist moral requirement.)

Now let's work through what the function h should look like. Recall what h does:

$$h(\text{degree of conformity}) = (\text{degree of love deserved}).$$

We originally assumed that h was the identity function: $h(x_1, x_2) = (x_1, x_2)$. That is the right thing to say if one's degree of conformity is the only factor that goes in to what degree of love one deserves; but it no longer is. There are now other factors. How do these other factors work? The idea is to identify the influence on desert that is due to each factor, and then to somehow aggregate these influences.

that it is better (intrinsic value is higher) if Stella gets more love than she deserves than if she gets less. Feldman 1995 and Kagan 2003 endorse this principle and Carlson 1997 and Arrhenius 2006 discuss ways to implement it. My approach can be adapted to these more complex axiologies.

I will use numbers to represent the influence of each of these factors. If someone's degree of conformity is x , then (my theory says) the influence of his degree of conformity on his desert level is also x . I will not say anything substantive about how to figure out the influence of any of the conformity-independent factors. So for a given person (say, Frank) in a given situation we have numbers b_1, b_2, \dots, b_n representing the influence of the conformity-independent factors on his desert level in that situation. To aggregate these influences I take the average. So when x is the degree to which Frank conforms to the consequentialist moral requirement, Frank's desert level is

$$\frac{b_1 + b_2 + \dots + b_n + x}{n + 1}.$$

In general, let n be the number of conformity-independent factors that influence desert; let b_f be the sum of the numbers representing the influences of the conformity-independent factors on Frank's desert level, and b_s be the sum for Stella. Then h is defined to be:

$$h(x_1, x_2) = \left(\frac{b_f + x_1}{n + 1}, \frac{b_f + x_2}{n + 1} \right).$$

A few remarks should make averaging seem plausible here. Suppose that there is just one conformity-independent factor, and that its influence on Frank's desert level in some scenario is represented by the number $1/2$. And suppose that Frank conforms to the consequentialist moral requirement perfectly (to degree 1) in this scenario. What should his desert level be? Maybe the first thing one would think to do is to *add* these two numbers together. But in the current framework that makes no sense: if we add the numbers we get $3/2$, but no one can deserve love to degree $3/2$. Degree 1 is the highest degree of love available. Taking the average is the closest thing to adding the numbers that we can do that also ensures that we never end up with a number greater than 1 representing the degree of love someone deserves. By averaging we split the difference between the desert level Frank would have if the conformity-independent factor were the only factor influencing desert (namely, $1/2$) and the desert level Frank would have if conformity were the only factor influencing desert (namely, 1).

I want to ward off possible objections to my use of averaging. I admit that averaging the influences of moral factors might not be plausible in every context.

If two factors interact with each other, then the influence of each in the presence of the other might be very different from the influence each would have on its own. Abstractly speaking, we might have two factors such that, when each acts on its own in the absence of the other, each has a positive influence, but when both act together, they have a negative influence. To just assume that averaging (which is close to adding) is the correct way to represent the way the factors act together is to commit the additive fallacy (Kagan 1988 names and describes the additive fallacy).

I do not want to commit the additive fallacy. I am averaging the influence of factors on desert not because I think that is how things always work, but because the examples of desert-influencing factors that I mentioned do seem to me to act independently of each other. (It is hard to know how to make progress on the formal problem of avoiding indeterminacy if we adopt some form of moral particularism on which there is no finitely-expressible way to state how the factors influencing desert work together in each situation.)

Now that we have seen what h looks like, we can use it (and independently given facts about how Frank and Stella love) to define, as before, a function $K(f, s) = h(g(f, s))$ (a capital K this time, to avoid confusion) that takes levels of desert as inputs, and returns levels of desert as outputs. The function K looks almost exactly the same as our earlier function k :

$$K(f, s) = \left(\frac{b_f + \Phi(s, l_f)}{n + 1}, \frac{b_s + \Phi(g, l_s)}{n + 1} \right).$$

It can be proved that K has a unique fixed point. (The proof is formally identical to the proof for k .) Since K always has a unique fixed point, this desert-sensitive version of consequentialism assigns unique levels of desert to any Frank and Stella scenario. (And Frank and Stella's levels of desert in any situation, together with the degree to which each is loved in that situation, will determine a unique intrinsic value for that situation.) So consequentialists can solve the problem of indeterminate desert.

The consequentialist solution resembles the first solution I discussed. They both work by adding extra moral factors: the first solution adds moral requirements that are independent of desert, and the consequentialist solution adds factors that

contribute to desert that are independent of conformity to morality. Then the contributions of these additional factors get averaged in to the contribution that giving people what they deserve makes to conformity, or the contribution that conformity makes to desert.

5 Conclusion

What people deserve depends, in part, on their moral worthiness — on how well they conform to the requirements of morality. Shelly Kagan has argued that no desert-sensitive moral theory can incorporate this plausible idea. I have showed that this is not so, by describing two desert-sensitive moral theories that incorporate this idea and then *proving* that they avoid the problem of indeterminacy. The first theory I presented makes use of ideas that Kagan himself considered, but puts them together in a more sophisticated way. The second, consequentialist, theory I presented makes use of the idea that factors other than conformity to morality influence desert — surely a plausible idea. Although the theories I propose are adapted to the simplifying assumptions that Kagan makes and are over-simplified in other ways as well, I believe that the ideas in them can be incorporated into more realistic theories.

Appendix: proof that k has a unique fixed point

The proof is an application of the contraction mapping theorem. The contraction mapping theorem says that if X is any complete metric space, with metric d , and T is a function from X to itself satisfying

$$d(Tx, Ty) \leq q \cdot d(x, y),$$

where q is a non-negative real number less than 1, then T has a unique fixed point. (A metric space is just a set of points with a distance function d defined on it. A metric space is complete, roughly speaking, if it has ‘no holes’.) I will show that k is a contraction mapping from E to itself.

First, I need to say how I am talking about distance in E , the set of desert

states. Instead of using the Euclidean distance on E , I use the square metric:

$$d((x_1, x_2), (y_1, y_2)) = \max\{|x_1 - y_1|, |x_2 - y_2|\}. \quad (2)$$

So the distance between two points is either equal to their ‘vertical’ separation or their ‘horizontal’ separation, whichever is greater. E is a complete metric space using this metric.

Now to show that k is a contraction mapping. In general, k has the form

$$k(f, s) = \left(\frac{d_f + \Phi(s, l_f)}{n + 1}, \frac{d_s + \Phi(f, l_s)}{n + 1} \right). \quad (3)$$

For my proof I need to assume that $n \geq 4$. But I do not think that there are any interesting philosophical morals to be drawn from this. I certainly do not think that it shows that we must think there are at least four desert-independent moral requirements (or, for the consequentialist theory, four conformity-independent influences on desert) if we want to solve the problem of indeterminate desert. I have two reasons for this. First, a more talented mathematician than I can probably make this proof work with a weaker assumption. Second, and more importantly, we are working with a very artificial moral theory. I am presenting it not as the true moral theory, but as an example of how a moral theory can avoid Kagan’s argument. More realistic moral theories should be able to avoid his argument with fewer assumptions.

I now return to the proof. Look at what happens when we apply k to two points in E , (x_1, x_2) and (y_1, y_2) . Let us write $k(x_1, x_2) = (k_1(x_1, x_2), k_2(x_1, x_2))$ (and similarly for the y ’s); then $k_1(x_1, x_2)$ is just Frank’s resulting level of desert, given the initial joint desert state (x_1, x_2) . Looking just at what happens to Frank’s level of desert, we see that

$$\begin{aligned} |k_1(x_1, x_2) - k_1(y_1, y_2)| &= \left| \left(\frac{d_f + \Phi(x_2, l_f)}{n + 1} - \frac{d_f + \Phi(y_2, l_f)}{n + 1} \right) \right| \\ &= \frac{|\Phi(x_2, l_f) - \Phi(y_2, l_f)|}{n + 1}. \end{aligned}$$

If we can show that $|\Phi(x_2, l_f) - \Phi(y_2, l_f)| \leq 4|x_2 - y_2|$ then it will follow that

$|k_1(x_1, x_2) - k_1(y_1, y_2)| \leq \frac{4}{5}|x_2 - y_2|$. A similar proof will show that $|k_2(x_1, x_2) - k_2(y_1, y_2)| \leq \frac{4}{5}|x_2 - y_2|$. Since $d(k(x_1, x_2), k(y_1, y_2)) = \max\{|k_1(x_1, x_2) - k_1(y_1, y_2)|, |k_2(x_1, x_2) - k_2(y_1, y_2)|\}$ this shows that

$$d(k(x_1, x_2), k(y_1, y_2)) \leq \frac{4}{5}d((x_1, x_2), (y_1, y_2)),$$

that is, that k is a contraction mapping.

Showing that $|\Phi(x_2, l_f) - \Phi(y_2, l_f)| \leq 4|x_2 - y_2|$ is straightforward but tedious. First we need an explicit equation for $\Phi(D, l)$. The equation is

$$\Phi(D, l) = \begin{cases} \frac{l}{D} & \text{if } D \geq \frac{1}{2}, l \leq D; \\ -\frac{l}{D} + 2 & \text{if } D \geq \frac{1}{2}, l > D; \\ \frac{l}{1-D} + \frac{1-2D}{1-D} & \text{if } D < \frac{1}{2}, l \leq D; \\ -\frac{l}{1-D} + \frac{1}{1-D} & \text{if } D < \frac{1}{2}, l > D. \end{cases} \quad (4)$$

Now to show that $|\Phi(x_2, l_f) - \Phi(y_2, l_f)| \leq 4|x_2 - y_2|$ we need to check twelve cases. The idea is to divide the possible cases into those in which l is between x and y and those in which it is not. (I will start with the latter cases.) To simplify notation I will now write $x_2 = x$, $y_2 = y$, and $l_f = l$. We only need to consider cases where $x \neq y$; without loss of generality I will assume that $x < y$.

Case 1: $1/2 \leq x < y$ and $l \leq x$. It is easiest to see how the proof for each case goes by drawing a diagram. I will only draw the diagram for cases 1 and 3. The diagram appears in figure 3.

The graph peaked at x is the graph of $\Phi(x, l)$, and the graph peaked at y is the graph of $\Phi(y, l)$. The difference $|\Phi(x, l) - \Phi(y, l)|$ is just the vertical separation between points A and B . It is clear from inspection of the diagram that $|\Phi(x, l) - \Phi(y, l)| \leq |\Phi(x, x) - \Phi(y, x)|$. (Just imagine moving the dotted line to the right until it hits the x mark. This can be proved analytically but there is no point in going through the details. The proofs in all the cases to follow use this same basic trick.)

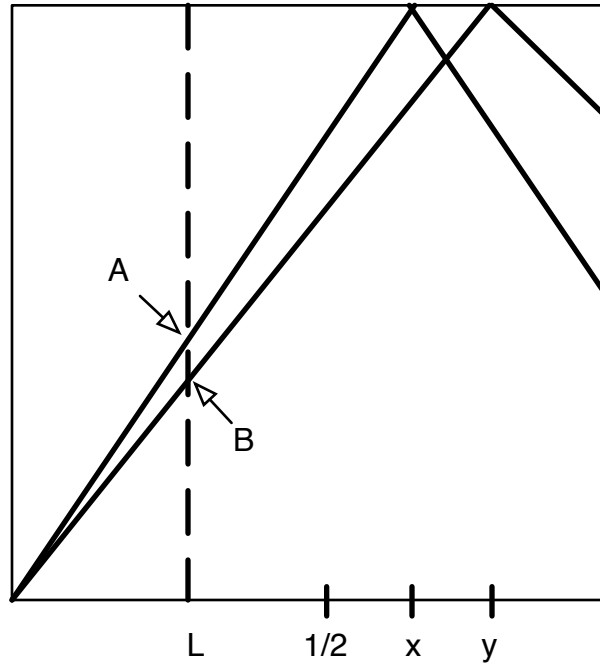


Figure 3: The situation for case 1

But

$$\begin{aligned}
 |\Phi(x, x) - \Phi(y, x)| &= 1 - \frac{x}{y} \\
 &= \frac{1}{y}|y - x| \\
 &\leq 2|y - x|,
 \end{aligned}$$

since $1/2 \leq y$ entails that $1/y \leq 2$.

Case 2: $x < y \leq 1/2$ and $y \leq l$. This case is the same as case 1 if we mirror reverse the diagram along the vertical line passing through $1/2$ on the horizontal axis. So, by symmetry, $|\Phi(x, l) - \Phi(y, l)| \leq 2|y - x|$ in this case as well.

Case 3: $l \leq x < y \leq 1/2$. Figure 4 depicts this situation.

In case 1 we slid the line for l to the right. This time we slide it to the left. So

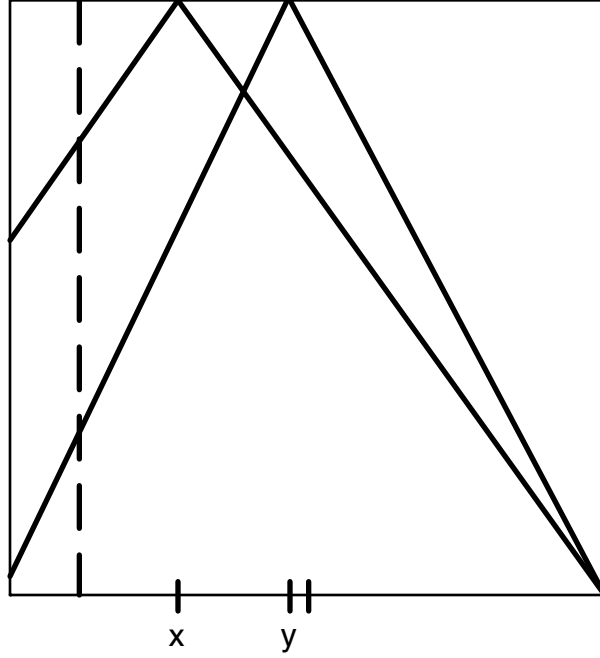


Figure 4: The situation for case 3

we have

$$\begin{aligned}
 |\Phi(x, l) - \Phi(y, l)| &\leq |\Phi(x, 0) - \Phi(y, 0)| \\
 &= \left| \frac{1-2x}{1-x} - \frac{1-2y}{1-y} \right| \\
 &= \left| \frac{y-x}{(1-x)(1-y)} \right| \\
 &\leq 4|y-x|.
 \end{aligned}$$

(To justify the last step, note that $y \leq \frac{1}{2}$ implies that $\frac{1}{1-y} \leq 2$, and similarly for $\frac{1}{1-x}$.)

Case 4: $1/2 \leq x < y \leq l$. Follows from case 3 by symmetry.

Case 5: $l \leq x \leq 1/2$ and $y \geq 1 - x$. Then

$$\begin{aligned}
 |\Phi(x, l) - \Phi(y, l)| &\leq |\Phi(x, x) - \Phi(y, x)| \\
 &= 1 - \frac{x}{y} \\
 &= \frac{1}{y}|y - x| \\
 &\leq \frac{1}{1 - x}|y - x| \\
 &\leq 2|y - x|.
 \end{aligned}$$

Case 6: $1/2 \leq y \leq l$ and $x \leq 1 - y$. Follows from case 5 by symmetry.

Case 7: $l \leq x \leq 1/2$ and $1/2 < y < 1 - x$. Then

$$\begin{aligned}
 |\Phi(x, l) - \Phi(y, l)| &\leq |\Phi(x, 0) - \Phi(y, 0)| \\
 &= \Phi(x, 0) \\
 &= \frac{1 - 2x}{1 - x} \\
 &\leq \frac{1 - 2x}{y} \\
 &\leq 2(1 - 2x) \\
 &\leq 4|y - x|.
 \end{aligned}$$

(For the last step, $1/2 \leq y$ implies that $1 - 2x \leq 2(y - x)$.)

Case 8: $1/2 < y \leq l$ and $1 - y < x < 1/2$. Follows from case 7 by symmetry.

We have now checked all cases where l is either to the left of x and y , or to the right (or equal to one of them). What remain are cases where l is between them.

Case 9: $x < l < y \leq 1/2$. Then

$$\begin{aligned}
 |\Phi(x, l) - \Phi(y, l)| &\leq |\Phi(x, x) - \Phi(y, x)| \\
 &= 1 - \left(\frac{x}{x - y} + \frac{1 - 2y}{1 - y} \right) \\
 &= \frac{y - x}{1 - y} \\
 &\leq 2|y - x|.
 \end{aligned}$$

Case 10: $1/2 < x < l < y$. Follows from case 9 by symmetry.

Case 11: $x \leq 1/2$, $1 - x \leq y$, and $x < l < y$. Then

$$\begin{aligned} |\Phi(x, l) - \Phi(y, l)| &\leq |\Phi(x, y) - \Phi(y, y)| \\ &= 1 - \Phi(x, y) \\ &= 1 - \frac{x}{y} \\ &= \frac{1}{y}|y - x| \\ &\leq 2|y - x|. \end{aligned}$$

Case 12: $x \leq 1/2 \leq y < 1 - x$ and $x < l < y$. Then

$$\begin{aligned} |\Phi(x, l) - \Phi(y, l)| &\leq |\Phi(x, x) - \Phi(y, x)| \\ &= 1 - \frac{x}{y} \\ &\leq 2|y - x|. \end{aligned}$$

That completes the proof that this desert-sensitive theory (which incorporates DDC) avoids inconsistency and indeterminacy.¹⁰

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