PREPRINT[[1]](#footnote-2)

Chance and the dissipation of our acts' effects

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The stomp of your foot, on one mouse, could start an earthquake, the effects of which could shake our earth and destinies down through Time, to their very foundations. With the death of that one caveman, a billion others yet unborn are throttled in the womb. Perhaps Rome never rises on its seven hills. Perhaps Europe is forever a dark forest, and only Asia waxes healthy and teeming. Step on a mouse and you crush the Pyramids. Step on a mouse and you leave your print, like a Grand Canyon, across Eternity...

Or maybe [the future] can be changed only in little subtle ways. A dead mouse here makes an insect imbalance there, a population disproportion later, a bad harvest further on, a depression, mass starvation, and finally, a change in social temperament in far-flung countries. Something much more subtle, like that. Perhaps only a soft breath, a whisper, a hair, pollen on the air, such a slight, slight change that unless you looked close you wouldn't see it. Who knows? Who really can say he knows?

-- Ray Bradbury, A Sound of Thunder

It is a common trope of science fiction that routine acts have huge and unpredictable effects on the far future. Actions which seem to create only trivial changes -- one less mouse or butterfly, a coffee cup set down here rather than there, a phone call caught instead of missed -- lead to more modest effects, which have their own modest effects. The causal ripple spreads out and grows increasingly significant with time, eventually making for huge differences. Quantifying the actual extent of this phenomenon is difficult. Despite its popular interest, it has received little serious attention.

Some thought has been given to the sensitivity of the future in the literature on consequentialism, where ethicists have long been concerned that the massiveness of an act's future effects may matter to its moral status. This concern's most prominent recent expositor, James Lenman (2000), argued that we are clueless about our actions' overall valence. Actions that appear to create more good than bad are about as likely as not to have unpredictable overwhelmingly bad consequences in the far future. Actions that appear to create more bad than good are about as likely as not to have unpredictable overwhelmingly good consequences in the far future.

The topic of this paper is the sensitivity of the future, not the metaethical issues bound up with it. In the course of arguing against consequentialism, Lenman built a compelling case that the future is highly sensitive to present acts. His framing of the issues will provide the point of departure for my own contrary position.

Lenman's critics have mostly quibbled about the epistemic status of our actions' consequences, not their scope.[[2]](#footnote-3) In contrast, this paper argues that the ubiquity of chancy[[3]](#footnote-4) events would suggest that the unpredictable effects of our actions quickly dissipate. The existence of chancy events entails that each action does not produce a single future, but rather narrows down a collection of possible futures. Just as the branches of two trees may bend in different ways while producing the same leafy outlines, the effects of alternative actions may accumulate within different possible branches of the future without much altering the overall shape of the collection.

The first section presents one precise account of the sensitivity of the future to present acts. The second section lays out Lenman's argument for that answer. The third section presents the dissipation response, Lenman's rebuttal of that response, and a difficulty facing his rebuttal. The fourth section makes the case that if chancy events are sufficiently common, then the futures produced by alternative actions will resemble each other in the way that is typical for large random samples from the same population.

# Sensitivity

In assessing the degree to which ordinary actions alter the shape of the future, it helps to take an oblique line of attack and consider a subset of ordinary actions, identity-affecting actions, with a clearer capacity for impact. I will follow Lenman in focusing on this subset, on the assumption that if it turns out that identity-affecting actions have massive consequences, then many ordinary actions that are not obviously identity-affecting will as well.

Lenman's view may be summarized as follows:

**Sensitivity**: Routine identity-affecting actions typically have massive socio-axiological future consequences.

Some terms in this summary require clarification.

**Identity-affecting actions** are actions that affect the identity of persons. While the metaphysical factors that determine personal identity determine which actions are identity-affecting are controversial, our present purposes permit operationalizing identity as a matter of ancestry and genetics. Distinct individuals cannot share both the same parents and the same DNA. No individual could have had either different parents or different DNA. Under this operationalization, identity-affecting actions change who exists in a future generation by either changing which individuals pair off as parents or by altering the genetic material that pairs of parents pass on to their offspring.

Actions may be indirectly identity-affecting by causing other identity-affecting actions. It is plausible that most relatively banal actions are indirectly identity-affecting insofar as they initiate cascades of tiny consequences that eventuate in directly identity-affecting actions.

**Routine** actions are ordinary actions in our present social and axiological context. Typical routine direct identity-affecting actions include acts of murder of would-be parents, acts of matchmaking between future parents, and acts that change which particular sperm meet which particular ova. Indirect identity-affecting actions may include both the relatively direct (setting friends up on blind dates) to the very indirect (choosing which cereal to buy, which changes one's roommate's breakfast choices, which changes their dinner plans, which causes their friends to engage in procreative sex at slightly different times, which causes a different person to be conceived).

The **consequences** of actions include those events that occur only because of those actions. Causation often plays a role in settling an act's consequences, but it is not sufficient. An event will not be the consequence of an action if that action merely rendered it more likely or if it was inevitable.

A chancy event occurs whenever there is an objective chance of something else. Such events may be individuated by the probabilities of their potential outcomes. For instance, when a fair coin is tossed, a chancy event occurs in which the coin has an objective chance of 0.5 of landing heads. If the coin were biased, a different chancy event would have occurred even if the coin subsequently landed the same way.

Some actions may have only chancy events as consequences. This happens when the action modulates the probabilities of its possible consequences. Some actions may also have no chancy events as consequences. The objective chances required are significant metaphysical commitments. They must be baked into the fundamental laws of nature, and cannot be mere summaries of more determinate lower-level patterns [pace Emery (2015); Glynn (2010); Lewis (1980);]. In order for a chancy event to occur, it must be nomically possible for things to go either way. If determinism is true, then no actions have genuinely chancy consequences. It remains unclear whether there are any genuinely chancy events, but the possibility is plausible enough to take seriously.

Events may inherit some of the chancy consequences of their own chancy consequences. An action that alters the probabilities with which particular events occur at one time will often also alter the probabilities of later events. If an act of revolution within a country has a 0.5 chance of changing a monarchy into a republic, and the resulting republic would have a 0.5 chance of becoming an oligarchy, then the act of revolution may have as a consequence a 0.25 chance that the country becomes an oligarchy (so long as it would not otherwise have had that chance of occurrence).

An action has **massive** consequences relative to a metric if its consequences measure more highly than the consequences of alternatives. If the decision to forgo a coaster for a cold drink eventuates in a repositioning of billions of tons of dust particles but no differences to political appointments or ideologies, then it has massive consequences under a fine-grained physical metric and not under coarse-grained political metric.

The metric specified for the interpretation of 'massiveness' in Sensitivity is **socio-axiological**. An action has massive socio-axiological consequences if its consequences include events that are distinctive in terms of their moral, social, cultural, or political features. These are the kinds of events that we would notice when comparing histories. They shape the human career in ways that we care about.

It does not make a socio-axiological difference precisely how the sands on a beach are situated, how farm plots are divided, the predominate gauge of railroad tracks, or the slogan of the most prosperous soft-drink manufacturer. Only general social, political, and cultural trends and events of elevated moral significance count. If an ordinary action's consequences include a reordering of the political structure of countries in fifty years or a genocide of one people, then its consequences are massive in a socio-axiological sense.

Some care is needed to interpret Sensitivity in the context of chancy events. If the consequences of actions are often chancy, then ordinary actions will not make any single specific future much more likely. Instead, actions can only raise the probabilities of each of a large number of different possible branches the future could take. Even if Sensitivity is false, it would still be plausible that many actions make minute absolute differences to the probabilities of specific future branches.

The significance of Sensitivity in the context of objective chances can be clarified by *probability shifts*, which capture the degree of difference between two probability assignments relative to a single partition of propositions. The value of a shift is the sum of the differences between the probabilities of individual propositions in each assignment, divided by two. For instance, suppose that tossing an otherwise fair coin in a certain manner produces heads with a 60% probability and tails with a 40% probability: the manner of tossing induces a probability shift of 0.1 against a fair toss over the partition: [the coin lands heads, the coin lands tails].

In coarse-grained partitions, similar possible futures are grouped together and so an action's chancy consequences may alter the fine details of the results without producing large probability shifts. If an action repositions tons of dust without altering the political landscape, then it induces no great probability shift relative to a political partitioning.

If purchasing a certain brand of cereal created a probability shift of 0.02 in the partition: [genocide in the next century, no genocide in the next century], its future effects would be massive. If matching a friend with a blind date created a probability shift of 0.13 in the partition [democracy will flourish in Australia in the next century, democracy will not flourish in Australia in the next century], its future effects would also be massive. On the other hand, if the same actions led to a probability shift of 10-20 in the same partitions, their consequences would not (on that account) be massive.

# The Rationale

Lenman's defense of Sensitivity centers on the capacity of identity-affecting actions to ramify. Identity-affecting actions induce further identity-affecting actions, rendering their effects increasingly significant over time. He illustrates this idea with a hypothetical story:

Imagine we are in what is now southern Germany a hundred years before the birth of Jesus. A certain bandit, Richard, quite lost to history, has raided a village and killed all its inhabitants bar one. This final survivor, a pregnant woman named Angie, he finds hiding in a house about to be burned. On a whim of compassion, he orders that her life be spared. But perhaps, by consequentialist standards, he should not have done so. For let us suppose Angie was a[n ancestor] of Adolf Hitler. The millions of Hitler's victims are thus also victims of Richard's sparing of Angie. (Lenman 2000, 344–5)

Because of the bifurcating structure of descendant relations, individuals are likely to have more descendants in each generation than in the previous. Hitler has on the order of 2100 ancestral relations to members of Angie's generation. Since this number so vastly exceeds the number of people alive at that time, Hitler must be related to some people in many different ways. Most people of that era with any 20th-century descendants can count Hitler among them.

The point is not (just) that Angie's genealogical necessity for Hitler's particular atrocities convey her sparing huge significance. Many contemporary and historical individuals can count Angie's sparing as a necessary condition for their existence. Insofar as ancestral dependence is the norm, rather than the exception, identity-affecting actions massively ramify. The change of a few individuals in one generation leads to, on average, at least twice as many changes in the next generation, four times as many in the generation after, then eight, sixteen, and so on.

Indirect identity-affecting actions also contribute to the explosion of effects. They are sufficiently common that most people perform at least a few throughout their lives, so identity-affecting actions not only sway the identities of series of lineal descendants but also the identities of all those whose existence is in any way dependent on those descendants' behavior.

The future may conceivably be occupied by different people without there being any socio-axiological differences. The argument requires a further assumption: different generational makeups will lead to massive socio-axiological differences. If populations were generally replaced by other populations of distinct individuals who behaved similarly, then the massive identity ramifications would not guarantee massive socio-axiological ramifications.

This rationale for Sensitivity can be formalized as such:

1. Identity-affecting actions have a large effect on the personal composition of future generations.
2. Large differences in the personal composition of generations make for large socio-axiological differences in the future.

So,

1. Identity-affecting actions have large socio-axiological effects in the future.

Richard's sparing was necessary for Hitler's existence. Without Hitler, 20th-century history would have been very different. Removing the big personalities of history is likely to alter its course. World events would not have played out exactly the same way with different starring characters. Thus, the tendency of identity-affecting actions to ramify supports Sensitivity.

# The Dissipation Objection

Sensitivity requires the persistence of identity-affecting actions' effects. If the effects of most actions quickly dissipate or if the differences in the changes produced become less dramatic with each link in the causal chain, then actions will not generally lead to perceptible differences in the far future.

G. E. Moore recognized the threat that Sensitivity posed to consequentialism and suggested in response that the effects of most actions might dissipate. He was hesitant about his own proposed solution:

It may, perhaps, be justified by some such considerations as the following. As we proceed further and further from the time at which alternative actions are open to us, the events of which either action would be part cause become increasingly dependent on those other circumstances, which are the same, whichever action we adopt. The effects of any individual action seem, after a sufficient space of time, to be found only in trifling modifications spread over a very wide area, whereas its immediate effects consist in some prominent modification of a comparatively narrow area. Since, however, most of the things which have any great importance for good or evil are things of this prominent kind, there may be a probability that after a certain time all the effects of any particular action become so nearly indifferent, that any difference between their value and that of the effects of another action, is very unlikely to outweigh an obvious difference in the value of the immediate effects. (Moore 1922, 152)

We may formulate the idea in opposition to Sensitivity:

**Dissipation**: Routine identity-affecting actions typically have consequences that dissipate quickly and are thus not massive.

Moore's noticed that events tend to be dependent on many different actions, and so the responsibility of an action disperses as its effects mingle with the effects of other actions. He suspected that since each event is the product of a large number of different actions, no individual action could claim much influence.

The previous argument for Sensitivity raises significant doubts about this rationale for Dissipation. It is possible for each event both to be the product of many different actions and to be highly sensitive to each. Identity-affecting actions have consequences that appear to satisfy these conditions: individuals result from the interaction of different identity-affecting actions but require each to be exactly as it is. Having written in a time of genetic ignorance, Moore may not quite have grasped the ways in which identity-altering effects can ramify.

However, if genuine chances are accepted, then Dissipation can be given a plausible rationale. The chancy effects of actions may revert to a probability that is dependent on broader trends. It is possible that some of the distant causal effects of our actions would have occurred with the same probability had we acted differently.

Richard's sparing of Angie initiated a causal chain that eventuated in Hitler's birth. If causation is deterministic, then we can be reasonably confident that no such individual would have been born had Richard acted differently. If causation is indeterministic, then Richard's sparing of Angie may have only shifted the probabilities.

It is unclear how Richard's acts might have changed the probability of the eventual birth of someone like Hitler. Even with a causal chain whose connections are recognizable in hindsight, the probability of each chancy twist and turn in that chain going the right way would have been rather small. Hitler was unlikely to result, however Richard acted. Had Richard acted differently, it is possible that someone else just like Hitler might have come to be -- we should not be confident that the probability of some similar figure would have been much less than it actually was.

Compare this with shuffling a deck and drawing the top card. Assuming that shuffling is fair and chancy, placing the three of diamonds on top of the deck before shuffling does not change the probability with which any given card is drawn after. If the intermediate generations between Richard and Hitler shuffle the possible 20th-century events, then Richard's sparing of Angie may have altered the probability that Hitler himself would eventually be born (given his necessary descent from Angie), without having changed the probability of the birth of someone just like him.

So far, I have suggested that Dissipation ought to be taken seriously. In the next section will argue that it is true.

# Chancy Dissipation

In outline, my argument goes as follows:

1. Large sets of samples randomly drawn from a single population tend to have distributions of properties that closely resemble those of the whole population.
2. The sets of futures left open by routine identity-affecting actions typically have distributions of socio-axiological properties as if randomly drawn from the set of all previously open futures.
3. If chancy events are ubiquitous, then for any given action, the number of futures that it leaves open is **very** large.

So,

1. Routine identity-affecting actions are likely to leave open sets of futures with distributions of socio-axiologically properties that closely resemble the population of all previously open futures.
2. Alternative routine identity-affecting actions are likely to leave open sets of futures with distributions of socio-axiological distributions that resemble one another by virtue of resembling the population of previously open futures.
3. Routine identity-affecting actions are likely to only produce small probability shifts on socio-axiological partitions.
4. Routine identity-affecting actions typically have consequences that dissipate quickly and are thus not massive.

### Premise 1

The first premise states that large sets of samples randomly drawn from a population tend to closely resemble that population. For any single way of partitioning the population and its samples, the proportion of each sample that falls into any part of the partition is likely to resemble the proportion of the whole population that falls into that corresponding part, and likely to very closely resemble the proportion for very large samples. This premise is foundational to modern statistics. It needs no further defense here.

### Premise 2

Whenever we take an action, we close off some futures that were previously open. Any ways things could have gone that depend upon our having acted otherwise become counterfactual. The remaining futures form a subset of those that were previously possible.

The second premise states that the futures left open by typical actions are distributed as if they were randomly chosen from the set of all previously possible futures. The qualifier 'as if' is necessary because the sets of futures left open by a given action are not randomly selected. It may be chancy which of those possible futures results from an act, but the whole set of futures that are left open is determined by the action, the laws of nature, and the prior states of things. This premise claims that we can treat the futures left open as random for the purposes of statistical inferences.

The sets of futures are distributed as if randomly chosen because the factors that determine which futures remain open are effectively random. A mechanism of sample selection is *effectively random* if it produces samples with the same a priori subjective probability of bias as genuinely random mechanisms. This absence of bias has two requirements.

First, the individuals selected by the mechanism must be as (subjectively) likely to display any of the properties under investigation as randomly selected members.

Pr(*x* has *f* | *x* is selected from the population by an effectively random mechanism) = Pr(*x* has *f* | *x* is selected from the population by a random mechanism).

Second, the probabilities of the properties of individuals selected by the mechanism must be subjectively independent. The conditional property with which each individual displays some property, given that another selected individual displays the same property, must be the same as its bare probability conditional on any particular distribution of the property throughout the whole population. In other words, the information about the whole population must screen off any information one sample provides about others.

Pr(*x* has *f* | *x* and *y...z* are selected by effectively random mechanisms & the population has distribution *d* of *f* & *y...z* have distribution *e* of *f*) = Pr(*x* has *f* | *x* is selected by an effectively random mechanism & the population has distribution *d* of *f*).

Pseudorandom algorithms illustrate this idea. Pseudorandom algorithms select effectively random samples through properties that are probabilistically independent of the matter under investigation. The first one thousand individuals whose social security numbers appear in the decimal representation of pi is an effectively random sample for the assessment of political beliefs. There are no a priori connections bewteen ideology and the index of their social security number in pi. Any information about the political beliefs of such individuals tells us nothing about the political beliefs of others except by conveying information about the whole population. Despite not utilizing true randomness, pseudorandom algorithms are equally suited to statistical inferences because the mechanisms of sample selection they employ are equally unlikely to introduce biases.

Both genuine and effective random samples occasionally draw too heavily from biased subpopulations. It is possible that some actions leave open sets of futures that are unlike the population of previously possible futures. For large samples of either sort, biases should be extremely rare.

The justification for this premise is that the mechanisms that determine the futures that result from a given action, while not actually chancy, have a structure of causal mediation that makes collective biases extremely unlikely. This is supported by three considerations.

1. Actions have their effect on the future through coincidental interactions with contemporaneous events.

It is rare for actions to be uniquely responsible for any of their far future effects. The course of history is directed at each moment by the confluence of many events. The effects of routine actions depend upon highly complex relations between them and their contextual backgrounds. Given the importance of coincidental alignments in these complex relations, there is no reason to expect futures to be biased in any particular way. The arbitrariness of these alignments serves to effectively randomize the results of individual actions.

Compare this situation to a handful of dice shaken in a cup and tossed upon a table. The facing and trajectory of each die at the onset of shaking contributes to the resulting facings of the settled dice, but those final facings are determined by the interactions between the dice as they tumble about the cup. They depend upon extremely complex relationships between the initial trajectories that are fundamentally altered when any single modest trajectory changes. The complex relationships serve to randomize the effect of any single die's deviation.

Identity-affecting actions interact with background conditions just like the dice. Angie, if she is to contribute to the eventual birth of Hitler, needs to pair with just the right mate at just the right time to conceive the next link in the ancestral chain. The events in her vicinity are likely to influence not only her life but also the lives of everyone around her. They will affect who travels where and when and thereby help to determine with whom she works, who she befriends, who she marries, and ultimately, her children's identities. Against this backdrop of interactions, slight changes to the circumstances of Richard's sparing may lead to different sets of coincidences gaining hold and wildly different outcomes resulting, making the future effects of Richard's action taken in itself essentially random.

1. The effects of an action at any given future date are filtered through all of their causal intermediaries.

The possible futures left open by an action depend upon its effects, those effects' possible effects, those effects' possible effects, and so on. The causal intermediaries often have the same potency as the initial event in the chain. The intermediaries' own potential to influence the future vary arbitrarily with that of the initial action, and thereby scramble any capacity that the initial action might have had to influence the future. Assuming that those intermediaries bias the future in the same unpredictable way as the original action, the futures that result will depend upon the outcomes of intermediary events. The direction of the first step in a random walk makes little difference to the expectation of the final position.

In order for actions to induce large probability shifts in the far future, they must have a bearing that their own effects neither dissolve nor reverse. Any bias introduced by an action that has a continuing chance of dissolution or reversal will likely eventually do so. The same reasons to expect ordinary actions to have unpredictable effects on the future are also reasons to think that some of their intermediate effects will upset any possible bias they might have on subsequent events.

Suppose there are two coins. One coin is biased so that it lands heads 98% of the time. The othther is biased so that it lands tails 98% of the time. One coin will be tossed: if it lands in the direction of its bias, the toss will be repeated with that coin, if it lands against the direction of its bias, the other coin will be tossed next. The process will continue for one hundred tosses.

The last coin will land in the direction of the initial coin's bias a little under 51% of the time. A long stretch of tosses is about as likely to undergo an even number of reversals as an odd number, and so the initial bias makes little difference over the final result. Starting with one coin or the other produces less than a 0.01 probability shift on the partition: [the final toss lands heads, the final toss lands tails]. The long-term effects of the initial coin's bias are dissolved by the large number of repeated intermediary chancy events with their own power to set the future on a different course.

Routine identity-affecting actions are unlikely to have any irreversible long-term bearing. There are none that we can foresee, and such effects seldom appear in hindsight. Routine actions may initiate series of changes that eventuate in radically different futures, but the series will undergo so many twists and turns that the initial events must have very little power over the future results. Those actions that do clearly affect the future may have effects that continue indefinitely, but routine actions lack such a bearing.

1. Any bias an action places on the far future must persist along very different paths.

Not only do actions' effects on the far future require sustenance through long chains of causal intermediaries, but given that chancy outcomes produce branching futures, they must do so within a variety of futures. Since each precise course of history can have only a minute probability of resulting from any action, actions need to shift the probabilities of many different possible courses in order to introduce a non-negligible bias overall.

Suppose that Richard's sparing of Angie made the rise of a 20th-century genocidal dictator significantly more likely. For that to be the case, at every intermediate point -- including 735, 951, and 1429 C.E. -- the sparing's many possible effects would need to be on average biased toward the future rise of such a figure. This might be so for some of the effects. However, given that the effects follow increasingly diverging histories, they are likely to differ greatly from one another and unlikely to share trends.

Each shape a history could take will be exceedingly unlikely by virtue of the numerous events that need to come together to make it happen. These histories depart from each other drastically as a result of happenstance -- slightly different strategies may lead battles to be won or lost, individual merchants' plans of travel determine where plagues spread, the whims of leaders shift the economic, religious, and scientific environments of their countries.

In some of the alternate histories that could result from Angie's sparing, Rome will fall and be replaced by a series of successor kingdoms: Christianity and Islam will flourish. In others, the Sasanian empire will extend across Africa and Manichaeanism will overtake Christianity as Europe's dominant religion. In some, Roman Europe will descend into a dark age before being rejuvenated by exchanges with its neighbors, the Mongols will unite under Genghis Khan and spread across the world, and Italian merchant princes will set the context for exchange between Asia, Europe, and the Americas. In others, a fortuitous economic climate will lead to an early industrial revolution in the East and trade will line the African coast with prosperous city-states. In many, the world will differ in ways that our own history has not prepared us to imagine.

The diverse possible futures left open by the sparing differ chiefly in the event with which they begin to depart from each other. The foreclosed futures will differ from most of the remaining futures in whether they include any of Angie's descendants. She will only have descendants in those futures that begin with her sparing. However, unless Angie was genetically anomalous, her descendants will have the same potential genetic diversity as the people who would otherwise have existed. Angie's many and varied possible descendants are unlikely to behave in atypical ways, so it is implausible that, of the incredible number of different paths history could subsequently take, the paths that lead to genocidal dictators are collectively made more likely while the paths that lead to peace are collectively less likely.

The three considerations work together to support the two components of effective randomness. Given the importance of highly complex and largely accidental relations between an action and its background context and given the varied intermediary chancy events necessary for an action to produce a particular history (whose impacts depend upon their own highly complex and accidental relations with their own background contexts), we should think that the probability with which a particular coarsely-individuated future results from an action to be about the same as the background probability that it would result anyway. In light of the independent paths traced by alternative futures, the effect an action has on the probabilities of any particular set of futures tells us nothing about its effect on the probabilities of other futures.

Given that routine identity-affecting actions have no clear propensity for initiating long-term trends, and since their effects on the future are swayed by millions of contemporary and intermediary events with an equal power to shape the future in equally unpredictable ways, we should expect their consequences to form an effectively random sample of the previously possible futures.

### Premise 3

The third premise states that the sets of possible futures left open by actions is very large. For the argument to succeed, the possible futures must be large enough to secure the representativeness of the effectively random sample of futures left open by a typical action. What matters for the representativeness of samples is not that the samples pass some threshold of size, but that they are large relative to the number of categories in the population and those different categories relative frequencies. A random sample of five hundred individuals from a population that is divided into billions of categories may not provide an accurate fine-grained representation of the distribution of the population into those categories. A sample of five quintillion individuals is almost certain to produce a reasonably faithful distribution.

The third premise tacitly asserts a comparison: there are relatively few socio-axiologically distinct ways a future can be when compared to the total number of different ways that have some non-negligible chance of resulting from a given action. Neither of these numbers can be estimated with any precision. My approach will be to try to produce a rough estimate of the number of possible socio-axiologically distinct ways the future might be, and then show that the number of different total futures left open by typical actions is staggeringly larger.

How many purely axiologically distinct futures are possible at any given time? Axiologically distinct futures differ in terms of their value. They ignore differences in the possible distributions of value in futures that are equally good overall. To simplify the issues, I will make two further assumptions. First, I will assume that what matters is the qualities of lives: it does not matter to whom those lives belong or when those lives are lived. Second, I will assume that the total future human population will include, at most, a few quintillion people.

Given welfarism and a limited population, one way to get a handle on the question is to estimate a possible range of populations and measure the maximum amount of variation in the lives that constitute those populations. Suppose that we took an individual life and rated each second of its duration on a scale from -2,000 to 2,000[[4]](#footnote-5), then treated the life's value as the sum of those ratings. Assuming a length of eighty years, there would be about 1013 possible distinct total sums of second-by-second values for a single life. Evaluating a whole population requires summing the values of its lives. For a quintillion lives, there would be about 1031 possible sums.

It may be inappropriate to calculate the possible range through summing momentary values. The order in which good or bad events occur may matter. There might also be large-scale synergies in the welfare of individuals and populations that cannot be reduced. However, it is unlikely that these kinds of effects will add dozens of orders of magnitude to the possible degrees of variations in the value of populations. Even if we say that in addition to the variation produced by total sums, there are trillions of possible distributions of value in a life or valuable lives in a population that modulate the total, it will not radically alter the size of the range of values possibly experienced by a population.

Restricting value to welfare may also be wrong. Perhaps there is value in personal achievements, natural beauty, or biodiversity that is distinct from the value contained within lives. Even if this is the case, it again seems very unlikely that the additional sources will add more than a few dozen orders of magnitude.

There are about 1067 ways of sorting a single deck of cards. Games of blackjack often use six decks of cards shuffled together. Games of baccarat use eight. Millions of card games are played every year, and so millions of decks are shuffled. If the shape of the future is very sensitive to present events, then it plausible that different orderings of a shuffle in a given game of cards might lead to different futures. If each shuffling is a fair and chancy event, with an equal probability for each possible ordering, and each order of a shuffled deck gives rise to a different future, then the total number of distinct possible futures resulting from a single shuffle of a single deck of cards would be extraordinary. Dividing the possible futures resulting from the shuffle of a single deck of cards evenly over 1031 different possible levels of value, then there would be roughly 1036 futures *for each level*!

Any pair of parents can produce about 70,000,000,000,000 different chromosomal combinations in their children (ignoring mutations or other common sub-chromosomal changes). About 130,000,000 people are born each year. Holding parental pairings fixed, the number of genetic combinations for the newborns in a given year is roughly 101,800,000,000. If chromosomal recombination is a fair and chancy process and each result leads the future down a different path, the number of futures per possibility climbs unimaginably higher. Dividing 101,800,000,000 futures evenly over the 1031 possible different degrees of value would leave 101,799,999,969 number of futures for each level of value.

The discrepancy between the number of axiologically distinct futures and the total number of possible futures results in part from the stipulation that the ordering of goods is irrelevant. There are more ways of ordering a single deck of cards than possible values in the future because it matters how each card is arranged. Even so, the granularity of socio-axiological properties ensures that there are many fewer socio-axiological states to be ordered. Ordering effects can be admitted without erasing the discrepancy between the number of possible futures produced by an act and the number of different socio-axiological categories into which those futures may be placed.

Suppose that each human society differs in such ways as to produce 1010 distinct sets of sociological features, that there are 1,000,000 such societies on Earth, and that every society can change any of these features yearly for the next 10,000 years. Order effects matter to the number of possible futures at this level of granularity: switch one society's attributes with those of its neighbor and it becomes a different possibility.

Given these assumptions, there would be 10100,000,000,000 different sociologically distinct possible futures. This is a large number. It is much larger than the number of orderings of a single deck of cards, or even the number of chromosomal pairings in a generation's worth of individuals. However, it is not so large that it cannot be swamped. Should we let each of the seven billion currently living individuals shuffle one deck of cards one time, the number of different possible orderings among all those decks of cards would be about 10469,000,000,000. If each of these orderings gives rise to a different possible future, the number of futures per socio-axiologically distinct possibility would reach 10369,000,000,000.

Given the discrepancy between the number of futures and the number of socio-axiologically distinct possibilities, most of these different orderings cannot lead to significantly different futures. Many orderings must lead to futures that, while differing in their fine details, share all of their granular socio-axiological features.

It may be that neither shufflings nor sexual chromosomal sorting are perfectly fair chancy processes and also possible that not all orderings or combinations lead to distinct sets of possible futures. These cases are intended to illustrate the power of chancy processes to produce massive numbers of different results. Sequences of chancy events can accumulate large numbers of possible futures even if no individual event directly produces many distinct possibilities -- it takes a relatively small number of 50-50 chances to produce the randomness ascribed to a single instance of chromosomal sorting.

Assuming that there is one chancy event per person during each period of length *x* (i.e. minutes/days/decades...) with an equal probability of diverting the future down two different courses, then given the present population, it will take a time period lasting about fifty *x* to produce enough such chancy events for the future branches to swamp the 10100,000,000,000 sociologically distinct futures that were previously estimated for the next 10,000 years. If such events occur at a rate of one per person per minute, it would take under than an hour. If the rate were one per person per month, it would still happen in about four years.

There are a number of events with some claim to chanciness, so one such event per month is reasonable. It does not matter precisely which chancy processes generate the large number of possible futures. The chancy events need not themselves be the direct products of agency, for they will mingle with the effects of the action to divert its effects down different courses. If such events are reasonably common, then it is likely that they will work in concert with each other to produce an explosion of possible futures plentiful enough to vastly outstrip the number of socio-axiologically distinct possibilities.

If our actions have chancy consequences, then a tremendous number of different futures could result from any given action. Chancy events interact in such ways as to produce many possible results. This ensures that if chancy events are ubiquitous, and if the futures left open by our actions are effectively random samples from the set of the previously possible futures, then they will most likely share nearly identical distributions of socio-axiological properties with that set.

### Putting the Argument Together

Sensitivity requires that routine identity-affecting actions produce noticeable shifts in the probabilities of coarsely-individuated futures. It is not enough that they typically boost the probabilities of a handful of socio-axiological possibilities. To induce a large probability shift on socio-axiological partitions, individual identity-affecting actions must have an effect on the probabilities of a sizable portion of the very futures that might result. These futures are likely to greatly diverge, and thus likely not to be collectively subject to any biasing trends. While some special actions surely do have such an effect, it is implausible that identity-affecting actions generally do.

On any way of carving up possible futures along axiological or sociological lines, there will be an unfathomably large number of distinct possible futures. However, given the ubiquity of chancy events, the number of different possible futures left open by any given action is tremendously larger. Any two large effectively random samples from the same set of possible futures will exhibit like distributions of socio-axiological properties. If alternative actions manage to carve those futures that they leave open from those they foreclose in effectively random ways, then the sets of futures that result are almost sure to share nearly identical distributions of socio-axiological properties.

If different actions produce like distributions of possible futures, then the differences between their effects will dissipate. Actions have the modest short term effects that we are able to foresee, and though they do contribute to making some very fine-grained future possibilities more or less likely, they do not unpredictably shift the probabilities of the kinds of propositions about the far future that we care about.

# Conclusion

Lenman presented a powerful argument for Sensitivity and a convincing rebuttal of Moore's claim that effects dissipate. Dissipation may still be justified. If we are willing to countenance genuine chanciness, then it is not just conceivable that the future consequences of routine identity-affecting actions may dissipate, it is quite likely that they do. If the consequences of identity-affecting actions dissipate, then it is probable that the effects of most actions will. The probability shifts wrought by our actions are so subtle as to generally be unnoticeable. Our actions may modulate the probabilities of some future possibilities, but not to an extent worth troubling ourselves over.

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1. Note: This is a preprint, not the final published version. Some changes were made after peer review, though the shape of the arguments has not significantly been changed.

 For the final version, see: https://www.tandfonline.com/doi/abs/10.1080/00048402.2020.1760326?af=R&journalCode=rajp20 [↑](#footnote-ref-2)
2. Joanna Burch-Brown (2014) argued that while individual actions may have massive and unpredictable consequences, we can know something about the typical consequences of types of actions. Tyler Cowen (2006) argued that we can make reasonable guesses about certain significant actions. Elinor Mason (2004), Caspar Hare (2011), and Hillary Greaves (2016) argued that we are licensed to assign subjective probabilities in a way that justifies many commonsense ethical verdicts within consequentialist frameworks. Dale Dorsey (2012) argued that our absence of evidence about the long-term consequences of our actions allows us to treat the possibility of unforeseen consequences as we treat skeptical scenarios in metaphysics. [↑](#footnote-ref-3)
3. Lenman set aside the possibility of genuine chanciness with the comment "perhaps [we] must consider not two determinate possible futures but two futures that branch endlessly, assign probabilities to every branching, and seek to maximize the expected goodness... because [this and related] possibilities make matters even more intractable for consequentialists, let us stick to the most tractable cases, in which there are just two possible futures to consider" (Lenman 2000, 353). Insofar as our interest is not consequentialism but the sensitivity of the future to our actions, we cannot ignore chanciness. [↑](#footnote-ref-4)
4. These numbers are somewhat arbitrary and intended only as illustrative. [↑](#footnote-ref-5)