

Modeling Minimal Conditions for Inequity

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Abstract:

This paper describes a class of idealized models that illuminate minimal conditions for inequity. Some such models will track the actual causal factors that generate real world inequity. Others may not. Whether or not these models do track these real-world factors is irrelevant to the epistemic role they play in showing that minimal commonplace factors are enough to generate inequity. In such cases, it is the fact that the model does not fit the world that makes it a particularly powerful argumentative tool. As I will argue, this epistemic role is a particularly important one when it comes to modeling inequity, because such models are often also aimed at interventions to stop it. Given this, it is crucial to know if we intervene on the current causes of inequity, what other, common social factors might continue to contribute to it.

I: Introduction

(Schelling 1971) famously introduced a simple, agent-based model to show how a set of bare bones assumptions could generate social patterns consistent with widespread racial segregation.¹ His model assumes that agents prefer not to be part of a racial minority in their locale. When such agents are randomly placed in a neighborhood, and given the opportunity to move whenever they find themselves in such a racial minority, the entire community will eventually end up segregated under many conditions.

As it turns out, successful explanations for racial segregation turn on many other factors, including more active bias against those in oppressed racial groups. In other words, as a full explanation for why there is real world segregation, Schelling's model fails. This does not mean, though, that Schelling's model does not tell us something about the world, or that it was not, in the end, important. I will describe in this paper a class of idealized models that illuminate what I call minimal conditions for inequity. I argue that these models can play an important epistemic role that might not be initially obvious. Some such models will track the actual causal factors that generate real world inequity. Others, like Schelling's model, may or may not. Whether or not these models do track these real-world factors is irrelevant to the epistemic role they play in showing that minimal commonplace

¹ This model was previously given a briefer description in (Schelling 1969). It was actually preempted by James Sakoda, who developed a precursor model in his 1949 dissertation, and published his full model a few months before Schelling did (Sakoda 1971), as outlined by (Hegselmann 2017).

factors are enough to generate inequity. In these cases, in fact, sometimes it is the fact that the model does not fit the world that makes it a particularly powerful argumentative tool. As I will argue, this epistemic role is a particularly important one for modeling inequity, because such models are often also aimed at interventions to stop it. Given this, it is important to know if we intervene on the current causes of inequity, what other, common social factors might continue to contribute to it.

I will proceed by examining in detail the epistemic implications of several models of injustice. Schelling's model will be one of these, but, in particular, I will focus on a set of models looking at how norms and conventions of bargaining and resource division emerge between social groups. (Axtell, Epstein, and Young 2001) present an early model showing that under very bare conditions discriminatory norms of this sort can emerge. More recently, along with co-authors, I have expanded this exploration to consider how minority status, power, intersectional effects, various psychological features, and social network structure influence the emergence of such norms (Bruner 2017; O'Connor and Bruner 2017; Bruner and O'Connor 2017; O'Connor 2017b, 2017a; Rubin and O'Connor 2017; O'Connor, Bright, and Bruner 2017). These models, like Schelling's model, abstract away from many complex psychological, and structural details involved in the emergence of inequitable norms. As I will argue, though, they still give us important counterfactual information about how little is needed to generate discrimination. And this information is critical to thinking about possible interventions.

I will proceed as follows. Section two very briefly describes Schelling's famous model of racial segregation and outlines some empirical work which may be taken to attenuate the importance of its insights. Section three describes the emergence of classes model introduced by (Axtell, Epstein, and Young 2001), and the models outlined by collaborators and myself intended to explore various aspects of the emergence of inequitable norms. As I make explicit, these models abstract away from important psychological and social factors implicated in inequity. In section four, I make the main arguments of the paper---that despite certain failures to represent, and, surprisingly, sometimes because of these very failures, the models described nonetheless provide crucial information to those interested in social interventions aimed at decreasing inequity. Section five briefly concludes.

II: Schelling's Model of Neighborhood Segregation

Schelling's famous model of neighborhood segregation is easy to understand. Imagine a checkerboard with black and white pieces placed randomly about it, so that there are still a good number of empty spaces. The squares of the board represent locations in a neighborhood, and the pieces represent homeowners of two racial groups. Suppose further that everyone prefers not to be in too small a racial minority in their immediate neighborhood, represented by the eight squares surrounding them. This is instantiated in the model by identifying which checker pieces are 'dissatisfied' and moving them, one after another, to the nearest empty square where they will no longer be below their minority threshold. This process is

iterated until everyone is satisfied with their location, and the checkerboard/neighborhood is at equilibrium.

What Schelling showed is that strong patterns of segregation can emerge on the neighborhood level as the result of these individual preferences and actions. For example, when the two groups are of equal sizes, preferences on both sides to not be in less than a $\sim 1/3$ minority tend to lead to segregation. To understand this, let's imagine the subsequent moves by individuals in Schelling's model. If a white individual moves towards two other whites, this might make the area unsatisfactory for a black neighbor, who leaves, making it unsatisfactory for other black neighbors, who also leave, etc. When iterated, these subsequent adjustments lead to broad patterns of segregation. While Schelling derived these results using literal checkerboards and the like, subsequent authors have confirmed and expanded them with more sophisticated computational modeling methods (Pancs and Vriend 2007; Rogers and McKane 2011).

Schelling intended his model as a demonstration of how discrimination on the part of individuals can lead to community level segregation, and, more generally, as a demonstration of how individual decision making can lead to unexpected group dynamics. One further point that many have taken away from the model is that racism of a pernicious form is not necessary to explain racial segregation. Individuals can even prefer mixed neighborhoods, but have a stronger preference that they themselves not be in a small racial minority, and we should expect segregation to emerge robustly. In other words, remarkably little is needed to generate segregated neighborhoods.

Does the Schelling model explain racial segregation? It certainly does not capture the full picture (and Schelling was well aware of this). A further question is whether it captures key causal factors responsible for segregation. Many other, perhaps more important factors, seem to be at play. Exclusionary zoning practices played a large role, traditionally, in segregating neighborhoods. Various studies have shown that real-estate agents steer white home buyers towards largely white neighborhoods, likely contributing to segregation (Galster and Godfrey 2005). Discriminatory mortgage and lending practices prevent minority families from entering wealthy white neighborhoods (Denton 2006; de Leeuw et al. 2007). Government housing policies promote segregation (de Leeuw et al. 2007). And even preferences for neighborhood make-up, where relevant, may not quite fit Schelling's picture. (Farley, Fielding, and Krysan 1997), for example, finds that black people may be hesitant to live in largely white neighborhoods due to fear of bias and discrimination, rather than due to simple preference to be near like-individuals. They also find asymmetries in preferences for racial make-up of neighborhoods, with black people preferring mixed neighborhoods, and white people showing an increasing unwillingness to live in a neighborhood as the proportion of black people increases.

The story that emerges is one where the kinds of mild preferences for in-group neighbors that play the key causal role in explaining segregation in Schelling's

model are probably not the causal factors that most significantly contribute to real world segregation. Does this mean that Schelling's model is unimportant? That it doesn't tell us something about the real world? In the next section, I will describe a different sort of model, focusing on the emergence of inequitable norms. As I will then argue, Schelling's model, and these models of inequity, play a similar epistemic role that tells us about the real world, but does not require that the models faithfully represent real communities.

III. Models of the Emergence of Inequitable Norms

Empirical literature has revealed that women and racial minorities tend to get less on average in scenarios of resources division than men and white people (Yinger 1986; Ayres and Siegelman 1995; Steinpreis, Anders, and Ritzke 1999; Bertrand and Mullainathan 2004). Furthermore, this pattern seems to be normative in the sense that individuals think that women and racial minorities ought not demand too much, and are sometimes willing to punish those who do (Bowles, Babcock, and Lai 2007; Tinsley et al. 2009). This observation will (likely) not come as a shock – the evidence is irrefutable that throughout human cultures, some types of people get more and others get less.

(Axtell, Epstein, and Young 2001) provide an early model explaining this sort of phenomenon via the emergence of what they label discriminatory norms.² Their model involves agents of two types (men or women, black or white people, etc.) who interact in a bargaining scenario called a Nash demand game. This involves dividing a resource (let's say of size 100), by requesting a low, medium, or high amount of it (say 30, 50, or 70). If the demands are compatible – add up to 100 or less – each agent gets what they request. Otherwise, they get nothing, because they are jointly too aggressive to reach an agreement.

In the model, each agent remembers their last n interactions with the two different types of individuals, and uses these memories to decide which demand to pick. In particular, they choose the demand that would have done best against those they met in the past. So suppose the two types are men and women, that the last five men Jane met demanded 70, and that the last five women she met demanded 50. The next time Jane meets a man she will demand 30, which would have done best against her memories, and the next time she meets a woman she will demand 50.

What the authors find is that simulations of this model – where agents meet each other randomly, and update their memories each time – often arrive at stable patterns where each type demands 50 of those in their own group, but between groups one side always demands 70 and the other 30. In other words, everyone treats in-groupers fairly, and treats out-grouper differently to the detriment of one out-group. This pattern emerges quite commonly despite the fact that a fair outcome is possible between the two groups, and that the two groups are

² In designing their model, they draw on previous work by (H. P. Young 1993; H. Peyton Young 1993).

completely symmetric. In other words, there is nothing to explain the inequity, besides the bare existence of social categories.

Along with co-authors, I have used this sort of model, and many variations of it, as a framework for understanding the emergence of inequitable norms, and especially for exploring the conditions under which one social group tends to get more than another.³ For example, inspired by the work of (Bruner 2017), he and I have shown that under many circumstances the bare fact of minority status increases the likelihood that a social group will end up being discriminated against in these models. This occurs because minorities meet their out-group very commonly, while majorities meet them only rarely. As a result, minorities tend to learn more quickly how to interact with their out-group, which, in a bargaining scenario, often involves making low, safe, accommodating demands (30 rather than 50 or 70). The majority group can then slowly learn to take advantage of this accommodation. We call this the cultural Red King effect after an analogous effect in biology where a slow evolving species can gain an advantage in mutualisms. (See (Bergstrom and Lachmann 2003) for the biological version of the effect, and (Bruner 2017; O'Connor 2017b; O'Connor and Bruner 2017; O'Connor 2017a) for our work on the cultural version.)

We also explore the effects of power on the emergence of such norms, arguing that various sorts of empowerment can increase the likelihood that a social group will end up at an advantaged norm in terms of resource division (Bruner and O'Connor 2017; O'Connor 2017a). In (O'Connor, Bright, and Bruner 2017) we use these minority and power effects to explore what happens to particularly small or disempowered intersectional groups. We find that identities at the intersection of two minority or disempowered groups can be especially disadvantaged in these models. In (Rubin and O'Connor 2017), we explore the emergence of such norms on a network, and look at how discrimination changes patterns of social interaction. In particular, we find that a sort of interactive segregation, or homophily, emerges as those being discriminated against learn to avoid their discriminators.

IV: Modeling Minimal Conditions for Inequity

Like Schelling's model, the models described in the last section are all high idealized, by which I mean that they ignore and alter real world features of the systems they represent.⁴ No model can embody every possible modeling virtue (for example, by being maximally simple, causally transparent, and perfectly accurate), so modelers must choose to elevate some virtues over others (Weisberg 2012). These particular

³ For those who care about such distinctions, many of the results I now mention are from population models using the replicator dynamics, rather than agent-based models like those used by (Axtell, Epstein, and Young 2001). The work all involves the use of Nash demand games and social categories within a population to see how patterns of resource division emerge that disadvantage those in one social group.

⁴ We might draw a distinction here between models that are abstract, meaning that they ignore some features of the world, and models that are idealized, meaning that they alter these features in some way. These models are actually both.

models opt for causal transparency and simplicity over complexity and fit to real phenomena. This means that they illuminate causal pathways that could potentially occur in real societies, but that the fit to the real world is less tight, and so the applicability of the model is typically in question.

Philosophers of science have sometimes described such models as minimal or minimalistic. A typical goal of minimalistic models is to pare away irrelevant details from real world processes to arrive at a few key, causal factors for the target phenomenon (Weisberg 2007).⁵ These models explain the phenomenon at hand by virtue of properly representing the corresponding causal factors in the world, even if they do not represent other, irrelevant aspects of the real world system.⁶ Models that explore minimal conditions for inequity, such as the Schelling model, may sometimes capture the most relevant causal factors at play in the world, and when they do they can act as minimalist models, though they need not play this role to be informative. In other words, although the models I consider here, and minimalist models, are all highly idealized, they play distinct explanatory roles that need not always go hand in hand.

Before further discussing the epistemic role this paper attempts to illuminate, I'd like to note that I talk about models here in a slightly different way than is standardly done in the philosophy of modeling literature. This is because philosophers of modeling usually describe a model itself as 'minimal' or 'how-possibly' etc. I prefer to think of models and their explanatory roles as separate, because the same model, applied to the same target system, can play multiple, different roles in various arguments, even within the same modeling project. ((Jhun, Palacios, and Weatherall 2017) make a similar argument.) I'll return to this idea shortly.

One of the most glaring representational lacunas in the models described in the last section has to do with the psychological factors involved in discrimination and inequity. Implicit bias, explicit bias, stereotype threat, and confirmation bias for

⁵ There is wide variation in philosophy of modeling over what is called minimal or minimalist modeling. As just described (Weisberg 2007, 2012) outlines minimalist idealization as a strategy of paring models down to only the most relevant causal factors. (See also (Potochnik 2007; Strevens 2008).) On the other hand, (Batterman 2002; Batterman and Rice 2014) argue that 'minimal' models explain by virtue of belonging to a 'universality class' that also includes real, complex systems. On this story, the representation relation between model and system is not supposed to do the work in allowing the model to tell us something about real systems. In yet another use of the term (Grüne-Yanoff 2009), describes minimal models as lacking, "any similarity, isomorphism or resemblance relation to the world" and "unconstrained by natural laws or structural identity" (83). Such models improve our understanding of the world via proofs of impossibility or necessity. (See also (Knuuttila 2009).) While the terms are the same, the epistemic roles of these various models are very different. I use the term in the sense of (Weisberg 2007, 2012).

⁶ Unsurprisingly, because of the idealizations inherent in building minimal models, some have argued that they cannot, in fact, explain, or that their capacity to do so is limited in various ways (Fumagalli 2015, 2016), though this discussion is beyond the scope of this paper.

example, are clearly important causes of the emergence of inequity across social groups.⁷ In the models described, however, the factors that lead to inequity are very basic, and do not involve these psychological elements – 1) actors learn to do what is best for them, 2) actors condition their choice of behavior on the social identity of their interactive partners, and 3) actors regularly engage in bargaining scenarios. In the various extensions mentioned, we add that actors may be in a minority group (that is otherwise identical to the majority group), or that actors on one side may have more power in a very minimal sense of the word.

Furthermore, these models lack other structural elements that are important causal factors in the emergence and stability of inequitable norms. For instance, when inheritance systems ensure that a wealthy class tends to stay wealthy, these reproduced wealth inequalities contribute to the inequitable norms governing interactions between classes. Our models, and those from (Axtell, Epstein, and Young 2001) do not involve any sort of generational structure, and lack much in the way of representations of economic empowerment.

The Schelling model, and models of the emergence of inequitable norms, then, have much in common. Both sorts of models produce phenomena that bear similarities to patterns seen in the real world. Both sorts of models involve causal factors that are realistic, and could very plausibly be important in the sorts of cases they represent (preference not to be in a small in-group for Schelling, and conditions 1-3 above for us). However, in both cases there are important causal factors not included in the model, but that almost certainly act to produce the phenomenon in question in the real world.

Do these models tell us anything then? Do they provide understanding? Do they explain? The argument here is that they do. As mentioned, these models can act as minimalist models, inasmuch as their causal variables are contributing to the phenomenon of interest in the real world. They have an orthogonal role to play as well, though, which is to outline which ubiquitous, bare bones, realistic conditions are enough to generate these phenomena. They identify the reasonable, minimal conditions for some sort of social ill to arise. To play this role, models must, 1) reproduce some social ill (segregation, inequitable norms) and 2) show that this outcome results from causal variables that are realistic, minimal commonplace conditions (preference to not be in a small minority, conditioning on social category membership, etc.) In doing this, these models show how little is needed to generate something surprisingly bad.

'How-possibly' modeling is a term that sometimes describes models which show that some phenomenon can in principle (possibly) be generated from a set of starting conditions.⁸ In playing this epistemic role, how-possibly models often

⁷ See, for example, (Saul 2013) for the effects of implicit bias and stereotype threat in academic philosophy.

⁸ Like the term 'minimal models', 'how-possibly models' has actually been used to describe a number of varying things, but this is beyond the scope of the discussion here.

respond to an extant impossibility claim. For example, Brian Skyrms's work on the evolution of signaling refuted claims by natural language skeptics like W.V.O. Quine that linguistic meaning could not emerge on its own (Skyrms 2010; W. V. O. Quine 1936; W. V. O. Quine 1960). An extra requirement for the epistemic role I outline here, that is not necessarily part of how-possibly modeling, is that the conditions contributing to the phenomenon observed be bare bones or minimal. If the Schelling model showed that racial segregation could result, in principle, from surprising but elaborate, or unrealistic conditions, it would not have made such a splash.

Philosopher of biology Brett Calcott has also described what he calls 'how-MacGyvery' models, which show how from extremely minimal conditions some surprising phenomenon can arise.⁹ (This refers to the 80s and 90s TV show MacGyver, where the title character routinely built technological apparatuses from random everyday objects.) The role I am outlining here is similar, but not identical. An extra requirement that goes beyond how-MacGyvery modeling is that these minimal conditions are ones we think might actually be instantiated in the world. For instance, if Schelling had showed that patterns of segregation could emerge in a group where all actors only wanted to live on the corners of a neighborhood, no one would care. If (Axtell, Epstein, and Young 2001) and our previous work showed that inequitable norms could emerge among people with the surprisingly minimal condition that they like cockatoos, again, it would be completely irrelevant.

One reason that some realism is necessary for these models to play the how-minimally role I am outlining is that they give important counterfactual information about the world. Whether or not the factors in the model are at play in the real world, these factors *could* be at play. They are plausible candidates to act as causes in the real world. One thing we learn from our models of inequitable norms is that removing implicit bias, stereotype threat, and confirmation bias might not be enough to fix the problem. In other words, the sorts of interventions being implemented by businesses, universities, etc. to improve inequity are not doing anything about a set of conditions which occurs in these organizations, and should be expected to generate inequity even without various biases at play. In the case of the Schelling model, it tells us that even if we manage to stop predatory mortgage practices, and steering by real estate agents, this might not be enough to stop segregation. As briefly described in the outline, this sort of modeling is particularly useful when it comes to social ills – segregation, inequitable norms, etc. – for the reason that models in these areas are often aimed at generating understanding that can be used for intervention. In both of these cases, we learn that sensible, current interventions might not have the desired outcome because other factors can easily generate inequity and segregation.

Notice that when models outline minimal conditions for inequity, it is the very fact that they *do not* capture many aspects of the real world that generates their

⁹ This term comes from public talks, rather than published work. For an example, see (Soriano et al. 2015).

explanatory power. Implicit bias, or more pernicious racism could be added to these models, and that would, in some ways, improve their fit to the world. But doing so would obscure the observation that more minimal conditions can get the same effect. In other words, we could not draw important conclusions about counterfactual conditions if we altered these models to be more realistic. In this way, the models discussed in this paper are similar to models outlined by (Batterman 2002; Batterman and Rice 2014) who show how a lack of fit to the world, or representative power, can sometimes enhance a model's ability to explain.

Before concluding, I'd like to make clear how the models described in section three reflect the sort of explanatory plurality I described above. (The plurality which I cited for a reason to pull apart how we think of models and how we think of their explanatory roles.) Our models on the cultural Red King effect, for instance, play at least three separate, explanatory roles within one, single modeling project aimed at the same target phenomena. They, 1) show an effect that is potentially at play in the real world, and so is deserving of empirical observation ¹⁰, 2) outline extremely minimal conditions for a minority group to end up disadvantaged by norms, and in doing so provide the counterfactual information just described, and 3) may provide a minimalist model in the sense that they capture real causal factors of minority disadvantage. To reiterate, in thinking about models that outline minimal conditions for inequity, then, we shouldn't label a model itself by the epistemic role it can play. Instead, we should think of many models as capable to play this, and other, epistemic roles. In other words, we shouldn't call the models themselves 'how-minimally' or 'minimalist', because the same model plays multiple, explanatory roles even while being applied to the same target system.

V: Conclusion

The goal of this paper was to pull out in detail an epistemic role played by a class of models that focus on inequity. These models outline minimal conditions for inequity, while idealizing away from causal factors that are very likely at play in the real world. Nonetheless, in identifying minimal, realistic conditions that can generate patterns of inequity, they provide important counterfactual information about the target system that is especially useful for planned interventions.

One broader take-away from this discussion responds to worries that highly idealized models cannot inform us about the world. In fact, the epistemic roles that models play are promiscuous and varied.¹¹ The ways that models can be used as tools to shine light on the world are too many to be quantified, and fully general claims about what models can and cannot do will tend to be wrong for this reason. As we saw here, both Schelling's model and models of the emergence of inequitable

¹⁰ In (Rosenstock, Bruner, and O'Connor 2016) we call this 'how-potentially' modeling, because it involves finding something that could potentially be happening in the world, and directing empirical attention to this phenomenon.

¹¹ For elaborations on this claim see (Downes 1992; O'Connor and Weatherall 2016).

norms give insights into the real world despite their idealizations. As I have argued, counterintuitively these models gain explanatory power by failing to represent actual causal factors in the world.

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