Formalizing Goldstone and Tilly 2001

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In their essay “Threat (and Opportunity): Popular Action and State Response in the Dynamics of Contentious Action”, Goldstone and Tilly challenge the idea that the occurrence of protest mobilization responds purely to the formation of opportunities within the state. They contend that the actions of protesters, and the subsequent reaction of the state, are themselves capable of changing the political opportunity and threat in such a way as to influence the likelihood of further protest.

The authors construct a formal model of the interaction of the political opportunity structure and the existential and repressive threat supplied by the regime. The formal model supports theory building by making the authors’ assumptions explicit and ensuring that the included mechanisms are internally consistent. The authors then go on to describe *verbally* the way protest actions influence regime behavior, and the subsequent effect on political opportunities and threats. They then make claims about the dynamic observable implications of this theory.

In this paper, I extend Goldstone and Tilly’s formal model to include the remaining verbal theory presented in their essay. Doing so reveals ambiguities in the informal theory and suggests ways in which they may be resolved, such that each proposed mechanism is *structurally consistent* with the others. I then simulate this model to test the *dynamic consistency* of the theory – or it’s ability to produce the indicated behavior. Doing so suggests the need for further modifications to the theory and how it is interpreted.

Formal models have been used in the social movement literature to help untangle the complex structure associated with the interaction between the regime and protesters. Jackson and colleagues (1978), Karmeshu, Jain, and Mahajan (1990), and Simon (1994) all construct models to evaluate the interplay between the level of activity of the regime and of protesters. Huckfeldt (1989) adds to these the level of popular support for the regime. Chong (1991) adds the concept of a supply of concessions, and Tsebelis and Sprague (1989) add concepts of relative deprivation and foreign intervention. Goldstone and Tilly’s paper builds on each of these concepts to explain further nuance in the system’s structure and behavior. For a thorough overview of formal models of social movements, see (Houghton 2016).

The present paper contributes to development of the theoretical matter concerned, and adds an example of formalization for theory building that may serve as a resource for other scholars.

## Formal Modeling for Theory Building

It is an academic stereotype to say that scientific rigor is achieved solely through observation. We can, however easily point out the need for rigorous theory building, in addition to rigorous theory testing. Some theories are clearly better than others, even before they are put to the test. The attributes that make for good theory include clarity, parsimony, falsifiability, internal compatibility of propositions, and consistency between propositions and predicted observable outcomes. For simple theories, we can achieve each of these through verbal argument. As the complexity of a theory grows, however, the tools of formalization and simulation become increasingly helpful for ensuring robustness. (Davis, Eisenhardt, and Bingham 2007; Freese 1980)

System dynamics modeling is an appropriate tool for formalizing types of theory that deal with the dynamics of aggregates – populations, organizations, etc. For example, Sterman (1985) uses system dynamics to assess the structural and dynamic consistency of Kuhn’s theory of scientific revolutions (Kuhn 1962).

Sastry (1997) uses a formal model to identify holes in theory of punctuated organizational change, and with lessons from that formalization goes on to find resolutions for those issues. As social movements and the effects of regime decision making occur at these collective levels, we have confidence that the methodology is appropriate in this instance.

While formalization thus does not work to assess a theory empirically, it has the ability to falsify a theory by showing it to be inconsistent. Additionally, mathematical formalization can enforce completeness and resolve ambiguity in theory, and be used to identify a strategy for empirical testing that is rigorously connected to the postulates of the theory itself.

# The existing formal model

Goldstone and Tilly begin the work of formalizing their theory by postulating that the gains expected from protest (G) are a function of the repressive cost of protest (C), and the likelihood-adjusted (O) advantages (V) to protest’s success:

To improve readability, in this paper I will use elaborated names of variables. The above equation thus is also expressed as:

Throughout the paper, I will also represent the structure of these equations graphically, as seen below. Diagramming the equations in this way highlights the causal mechanisms proposed by the theory and helps to make the structure of the overall system more explicit. In this diagram, arrows show the direction of theorized causal influence, with the plus (+) and minus (-) signs indicating the direction that this influence takes. Thus an increase in the **Probability of success** leads to an *increase* in **Expected net gain from protest**, while an increase in **Cost of protest** yields a corresponding *decrease* in **Expected net gain from protest**, all else being equal.



Goldstone and Tilly elaborate this structure by providing additional components that contribute to each of the proposed components:

In these equations, **Current threat** is interpreted to be “harms under the existing regime” (184, 3)[[1]](#footnote-1), whereas **Repressive threat** is the “immediate risk involved with the act of protest itself” (184, 2). We add these equations to our existing model diagram by adding links upstream in what will become a ‘causal chain’ of factors influencing the expected gain from protest, as seen below:



# Expanding the existing structure

This structure forms the entirety of the formal model elaborated by Goldstone and Tilly, but only describes a part of the theory presented within the paper.

To ensure the structural consistency of the propositions laid forth in the remainder of the paper, I will build up formal structures for these propositions. To do so requires interpretation, and to resolve ambiguities in the theory’s presentation where multiple interpretations are possible, I discuss why one should be preferred over the other.

The first piece of additional theory is the influence that the **Expected net gain from protest** has on the actual level of protest. Goldstone and Tilly explain “protest actions are expected if gains (G) are greater than zero” (185, 2). This I formalize as a binary variable:



## Regime Levers

Goldstone and Tilly next describe the various levers that the regime has to influence the likelihood of protest, namely their ability to manipulate the levels of the **Current threat**, and the **Repressive threat** (185, 5). The authors describe the process of making “concessions to alleviate current threat” (186, 1) that suggests we model the **Current threat** as some **Initial level of current threat**minus the **Concessions** that have accumulated since that initial time.



When we come to formalize influence on the **Repressive threat**, we have an ambiguity to resolve. The paper describes this as “the level of repression that follows on protest action”(185, 5) suggesting that after each protest event, a particular response is chosen and implemented, with little inertia. At the same time, this level provides a form of deterrence, which itself requires a more persistent form. We will chose to interpret the **Repressive threat** as a level that represents the expectation of future response to protest action, which is manipulated by the regime through a process of threat making, which may take the form of either statements or acts of repression.



## Regime Decision Making

At this point we need to formalize how the regime makes decisions. Goldstone and Tilly define a “suppression line” which represents the linear combination of concessions and repression that would be necessary to halt protest, and which arises directly from the structure of their formalization. In Figure 1 this is shown as a thick black line in the space of possible concessions and repression that could be made. When the probability of success is high, this line will be shallow, as significant repression will be necessary to overcome the protesters expectation of gains due to the protest. When the probability of success is low, even moderate repression serves to dissuade protest activity.

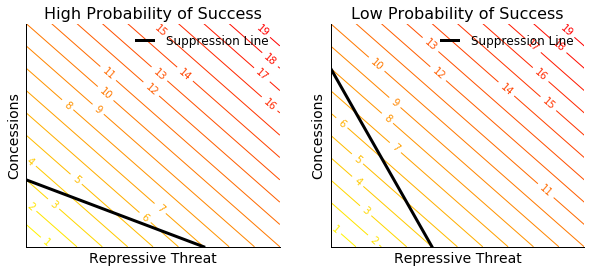


Figure : A combination of Repressive threat and Concessions is sufficient to halt protest. The costs of these actions to the regime (yellow->orange) may scale differently than their effectiveness in suppressing protest.

Goldstone and Tilly describe the task of the regime as to find a combination of concessions and repression that cross to the upper side of the suppression line, at which point the protest will stop. The authors also describe ‘constant cost’ lines (here shown in colors yellow becoming red with increasing cost, lines labeled with example values), such that “if repression is cheap compared to concessions, then the line[s] will be relatively flat… if concessions are cheaper, the line[s] will be relatively steep” (187,2), suggesting that the cost per unit of implementing repressive threats and concessions is constant regardless of the current level of threat or concessions, and that these costs combine linearly.

Their linear formulation of the interaction of threat with concessions has an interesting consequence, however, which is that for any given cost and opportunity structure, there is a clear policy preference that crosses the suppression line with minimal cost. When the slope of the suppression line is greater than that of the constant cost curve, increasing repressive threat is favored to the exclusion of increases in concessions, and vice versa. To see that this is an artifact of the model construction, consider the case in which the cost of either policy is nonlinear, as in Figure 2, each additional unit of repression or concessions coming at an increasing cost. Here the convex shape of the equal cost curves implies that a mixture of the two policies achieves suppression at the lowest cost.[[2]](#footnote-2)

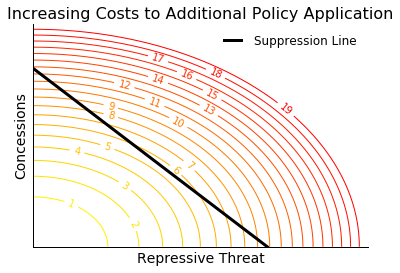


Figure : When costs scale nonlinearly, combinations of repression and concessions may be cost-optimal for the regime.

Continuing with the model as it is presented by Goldstone and Tilly, we can calculate for any instant which of the two policies is preferred, operationalized as the regime’s **Preference for Repression**, which represents the expected price difference between the two alternatives, normalized by the expected cost of repression:

When the preference for repression is greater than zero (with protest occurring), the level of repression will be increased at some rate, and when it is below zero, further concessions will be made. While it should technically be possible to reduce both concessions and repression in attempt to find a more cost effective solution, the authors seem to suggest that the activities of the regime are limited to those that “increase repression, or increase concessions, or both.”(188,2) As such, we will assume that the rates of making concessions and threats are always positive, and so:



The authors recognize that “the state has
at best imperfect knowledge about the level of popular support for protest… and thus may arrive at a different estimate of opportunity
than that held by the protest group.” (187,3) As such, the **Concessions Needed** and **Repression Needed** variables in the above equation are themselves merely the regime’s estimate of the endpoints of the suppression curve.

## Updating Estimates

The authors tell us that the state
“may swing back and forth between concessions
and repression, trying to find a combination that quells protest” (188,2), suggesting that the regime is trying to learn about the true location of the ‘suppression line’ by implementing various policies. There is no further guidance at this point as to how this learning takes place, but we can make some inferences based upon the text. First we assume that learning is taking place while protest is happening, but when protest stops, there is no longer motivation to update estimates. Second, the regime may assume that if protest is ongoing, then either the level of concessions, the level of repression, or both need to be higher than they currently are. Lastly we assume there is some rate at which the regime updates its belief about the necessary levels of concessions or repression. Thus, the expected level of necessary repression/concessions adjusts over time to some value fractionally greater than the current manifest level of repression/concessions as long as protests exist. Or, more straightforwardly – if protests are occurring, ratchet up the desired response. Mathematically, we can express this as:

Updating our model diagram to include these additions, we can see that we have now created several balancing feedback loops that serve to influence the propensity of the regime to depend too heavily on one type of action vs. the other. Balancing loops B1 and B2 suggest that if increases in concessions or repression do not serve to eliminate protest, then the necessary level of concessions must be higher than previously expected, thus making that particular course of action less favorable. Balancing loop B3 is a only a loosely a feedback process (and so we have shown links as dashed lines) due to the ability of protest to switch the two learning loops on or off.



## Regime stability

Goldstone and Tilly describe the regime as having a maximum ability to respond with concessions or repression, and when the cost of action exceeds the cost, “it is now neither capable of enough repression, nor willing to provide enough concessions, to halt the movement” and “has doomed itself” (189,3). We’ll account for these total costs and their impact on **Regime survival** as follows:

We’ll define **Regime capability** as a total cost above which the regime fails.

# Discussion of theory formalization

One of the challenges of formalizing theory is the tension between faithfully representing the theory as it is verbally presented and maintaining fidelity to modeling conventions and best practices. In places this tension is instructive, as it serves to identify places in which the verbal theory is incomplete, ambiguous, or incoherent; here modeling brings clarity and serves to make the theory more complete. In other places, the verbal theory as it is presented requires that the modeler accept deviations from best practices so as not to misrepresent the theory or make the presentation overly complicated.

There are a number of constructs in the model as we have laid it out that would not be the first choice of many system dynamics modelers. Most notable amongst these are the binary variables for the presence of protest, and the discrete switching behavior between increases in concessions and increases in repression, which is a result of the cost structure. Going forward, it would interesting to formulate the level of protest activity as a continuous variable, such that a regime’s decision making (and perceived level of threat) would be dependent on a more nuanced signal than the raw fact of protest. It would be interesting also to model a nonlinear cost structure (and thus requiring a more complex decision structure than that elaborated here) to see if the model’s predicted behaviors change.

In their formalization, Goldstone and Tilly are not explicit about the units that accompany the variables or parameters in their model. Likewise, the remaining verbal theory does not have straightforward operationalization or easily associated units. As a result, essentially every parameter in the model is either a dimensionless ratio, or is implied as a fraction of an unspecified baseline condition. This lack of true dimensionality enables direct comparison between concepts such as ‘concessions’ and ‘repressive threat’ without going into details of the protesters’ mental calculus in formulating decisions. At the same time, it makes parameterizing the model difficult. For simplicity, we initially set all parameters to ‘1’, apart from the various factors k1-k3 that together sum to 0.5. This set of parameters initializes the model right at the edge of protest occurrence, and allows any deviation to be expressed as a fraction of the baseline case.

As our units are all set to 1, the model has a completely arbitrary timescale, existing purely in relationship to the parameters that control flow rates. It is reasonable to assume that the timescale should be such as to allow features to vary by an order of magnitude, and so we’ll run our simulation over 10 time units.

# Evaluating dynamic consistency of the theory

At this point we have constructed a model to account for the behavior of the various actors through endogenously specified mechanisms as described by Goldstone and Tilly. We are now in a position to test if the hypothesized structure does indeed result in the predicted systemic behavior. Our strategy at this point will be to identify predictions of behavior made by the authors, and formalize these as mathematical statements. We can then evaluate if and when the formalized statements hold true.

As an example, the paper states that: "The state, ... [may] manipulate the current threats to the protest group, and the level of repression that follows on protest action. Here there is room for effective action by the state..."(185,5). We interpret this to mean that in at least some cases, the state can quell protests through the use of concessions and repression, such that at the end of the simulation, protest can be driven to zero. Mathematically, we write this test as:

This test applies to a single simulation of our model, and so in order to test the paper’s claim that the test should pass *in at least some* cases, we need to define the set of cases we will evaluate. As the theory presented in the paper does not make claims about the range of validity of the theory, we will make some fairly modest assumptions about the bounds of our parameters, essentially single digit multiples of baseline conditions.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Minimum Value** | **Maximum Value** |
| Concession fractional adjustment | 1 | 2 |
| Repression fractional adjustment | 1 | 2 |
| Initial level of current threat | 0 | 5 |
| New advantages a | 0 | 5 |
| Threat rate | 0 | 2 |
| Concession rate | 0 | 2 |
| Probability of Success | 0 | 1 |

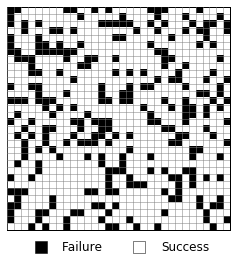
Given this parameter space, we can use Latin Hypercube sampling to generate 1024 test cases that explore this parameter space in a representative fashion. We are at this point trying to establish that the expected behavior is plausible with some reasonable combination of parameter values, and so do have little need to guide our testing to particular sets of values.

Figure : Protest is suppressed in 755 of 1024 hypothetical cases.

When we apply the mathematical test just described, we find (unsurprisingly) that the regime is able to suppress protest in the majority of cases, as shown in Figure 3. Goldstone and Tilly’s hypothesized structure is thus consistent with this particular hypothesized outcome.

A counterpart to this first test is the assertion that "If the regime is bound by the flatter [cost] line… it has doomed itself; it is now neither capable of enough repression, nor willing to provide enough concessions, to halt the movement." (189, 3). We formalize this as the assertion that in certain cases, the cost to the regime greater than the regime’s capability to pay, and the regime fails.

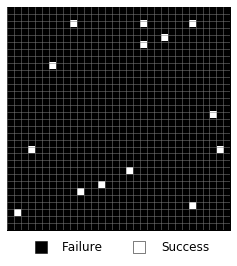


Figure : 14 cases of regime failure

This is almost the opposite of the prior test, but allows for the possibility that neither the regime nor the protest will have failed by the end of the simulation. Applying this test to the various cases, we find several in which the regime has indeed failed by the end of the simulation, as shown in Figure 4. Despite relatively high rate of failure of this test, the existence of a single success is sufficient to uphold the idea that there are times in which the regime is unable to control protest.

An additional prediction is that “[The State] may swing back and forth between concessions and repression, trying to find a combination that quells protest” (188,2). Thus, we would see at times concessions being increased, and at others an increase in the repressive threat, until protest is suppressed, as in Figure 5.

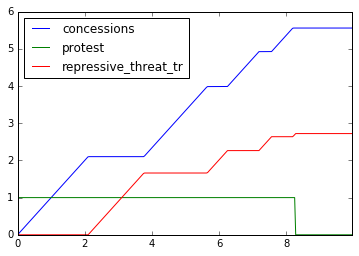


Figure : The regime alternately tries concessions and repression, trying to suppress protest

This we can interpret to say that in some cases, the regime may begin by primarily working to increase either repression or concessions, such that the instantaneous rate of **Making concessions** is greater (or less) than that of **Making threats** and then at some point in the simulation, the relative weighting of these two parameters will switch. To test this, we have to show a preference for one strategy at certain points in the simulation, and for the other strategy at other points, which we can express as:

This third test gives a positive result in the majority of cases as shown in Figure 6, and thus the predicted result is consistent with the hypothesized structure. Note, however, that this back and forth switching behavior is a result of the delays associated with learning about the suppression boundary, coupled with the regime’s reliance on one solution over the other at any given time. These conditions are modeling decisions that were made in response to somewhat uncertain structural explanation, and so should be seen more as evidence that the structure we formalized in this paper is consistent with the Goldstone and Tilly’s predictions, more than evidence that the structure as the original authors laid it out is sufficient to generate this behavior.

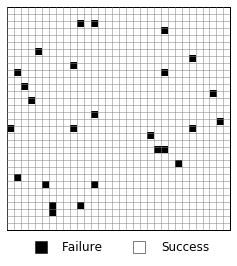
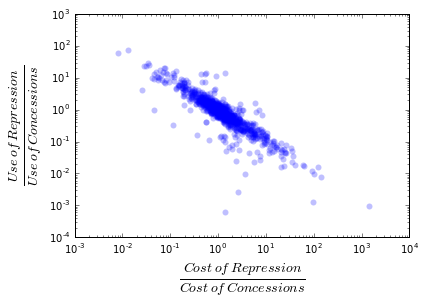


Figure : The regime alternates between strategies in 998 of 1024 hypothetical cases

A further class of tests looks at the differences between outcomes when various parameter values are biased towards one end of the spectrum of the other. As an example, "In liberal democratic regimes in wealthy countries… the costs of repression are likely to be higher than the costs of concessions …concessions and mild repression rather than reverse are the likely pattern." (192,3). Thus we expect to see that as the relative cost of repression over concessions rises, the use of repression will decrease with respect to the use of concessions. This indeed turns out to be the case, although the shape of this curve may be unexpected, in that it is linear here on a log-log plot.



# Conclusions and further work

The tests conducted to ensure the consistency between structural and behavioral theory have by and large supported the conclusions of the authors. This consistency, however, has depended upon the choices made in resolving the ambiguities in the verbal presentation of theory. These resolutions should be considered a contribution to the theory as it is presented in the original work.

The structure presented in this paper does not describe the entirety of the theory presented in Goldstone and Tilly(2001). Their paper goes on to describe interaction between the regime’s choice of concessions/repression and the probability of success of the protesters, and also links between repressive threat and current threat. These additional elements of theory could also be formalized, and their implications tested for consistency with the behavior outlined in the paper. These additional pieces of theory add complexity to the model, and in future work it would be worth examining these additional components to evaluate their structural consistency. It is likely that these additions would reveal further structural ambiguities, or inconsistency between the structure and hypothesized dynamic behavior of the system.

The paper by Goldstone and Tilly considered in this work is but one example of similar theories of social movements which may benefit from formal modeling and analysis. More elaborate, book-length works such as (McAdam et al. 2001) could be a fertile ground for formal theorizing, as in these presentations more detail is available to help resolve the ambiguities of verbal presentation, and a more impactful body of theory will be put to the test.

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1. Where direct quotes are taken, or concepts are drawn from text, I give page and paragraph number from (Goldstone and Tilly 2001) in format (page, paragraph). [↑](#footnote-ref-1)
2. Likewise, the optimal policy is influenced by the level at which repressive threat and concessions interact in the suppression of protest. If these interact as strongly as the cost curve, in the same direction, then the policy choice is as before. If they interact more strongly, a third condition is reached in which a combination of policies is more expensive than *either* option pursued individually. Understanding the mental models of regime decision makers in this context could have large implications for how those decisions are made. [↑](#footnote-ref-2)