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Original Research Article

Calibrations and compliance: the role of motivations in policy instrument design

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Abstract

Most research on the role of policy calibrations in fostering policy target compliance has focused on the calibration of incentives and deterrents; less attention has been paid to examining the deployment and calibration of a wider range of policy instruments with the intention of eliciting a greater degree of compliance from policy targets with heterogeneous motivations. This article addresses this gap in the literature by empirically testing multiple hypotheses on the relationship between the calibration of different kinds of policy instruments and policy compliance for policy targets characterized by different motivations. Using data from a vignette experiment set in the context of dengue control in Singapore, we measure policy targets' economic, social, and normative motivations for compliance and relate these to changes in compliance intention resulting from changes in the calibration of authority-, treasure-, and organization-based policy instruments. Our research contributes policy-relevant recommendations on how policy tool calibrations can be employed to target different kinds of policy target motivations and increase overall policy compliance.

Keywords: calibration; compliance; motivation; policy design; policy instruments; policy tools

Policy compliance, and its inherent complexity, is a fundamental aspect of the policy process: successful policy implementation rests on the ability of governments to encourage behavioral changes in the target population that are aligned with stated policy goals. However, the policy sciences have only just begun to theoretically advance on the behavioral motivations of the targets of policy interventions (Howlett, 2018). Moreover, how these motivations moderate the public's compliance responses to, and engagement with, instrument calibrations and adjustments remains under-theorized as a research agenda (Capano & Howlett, 2021, 2024; Capano et al., 2019). Despite its importance, the issue of policy compliance has been relatively neglected in the policy sciences beyond simple utilitarian discussions. Until relatively recently, the predominant assumption was that policy targets use an economic or rational calculus when deciding on their compliance level, while alternative motivations for compliance, such as social norms and moral considerations, remained under-researched. Consequently, most compliance-oriented research has focused on the calibration of incentives and deterrents, with less attention being paid to examining the deployment and calibration of a wider range of policy instruments with the intention of eliciting a greater degree of engagement from policy targets with heterogeneous motivations (Howlett, 2018, 2020; Howlett & Leong, 2022). However, at the level of governments, and especially in sectors linked with sustainability such as energy use, environmental diseases and waste, there is a growing acceptance that the response of the public to different policy instruments can be quite diverse and that there can be different motivations for compliance and participation that warrant going beyond a focus on the incentive–disincentive dichotomy and towards understanding the complex ways in which people engage with policy.

This article addresses this gap in the literature by empirically testing multiple hypotheses on the relationship between policy target motivations, their compliance response, and the calibration of different kinds of policy instruments. Our data come from an online survey of Singapore residents that (a) measures the prevalence of, and behavioral motivations for, mosquito control behaviors for dengue prevention at baseline and (b) examines the effect of increased calibration of alternative policy instruments on stated mosquito control behaviors using an embedded vignette experiment. We consider economic, social, and normative behavioral motivations for policy targets, and relate these to experimental adjustments in the calibration of specific authority-, treasure-, and organization-based policy instruments commonly used for dengue control in Singapore.

The authority- and treasure-based instruments we use for the vignette experiment include government inspections of households for mosquito breeding and fines for households that fail the government inspections, respectively. We also include two types of organization-based policy instruments in our study. The first—based on direct government provision of goods and services—is the oiling of drains for mosquito control, while the second—based on community outreach and engagement efforts—is government-coordinated community outreach campaigns on dengue. Our research contributes policy-relevant recommendations on how policy tool calibrations can be employed to target different kinds of policy target motivations and increase overall policy compliance.

The rest of the article is structured as follows. In the "Behavioral motivations and sensitivity to policy tool design" section, we review the existing literature on policy target motivations and compliance responses triggered by instrument calibration changes and propose our testable hypotheses. The "The context: dengue in Singapore" section provides a brief description of the context (i.e., Singapore's dengue control policies) in which our study is located. The "Methodology" section describes the data and empirical methodology we employ, while our results are detailed in the "Analysis and results" section. We conclude in the "Discussion and concluding remarks" section with a discussion of our findings and their contribution to the literature, and limitations of the study.

Behavioral motivations and sensitivity to policy tool design

Calibrations, or the micro-level, on-the-ground mix of implementation choices made for the deployment of policy tools, represent the most under-theorized area of policy design research (Capano & Howlett, 2024). And yet, this level of analysis is depicted as the critical missing link between the research agenda of effective policy formulation, sound implementation, and policy change. Micro-level considerations of policy design afford policy scholars the opportunity to generalize about whether paradigmatic policy change is needed, or if small adjustments made at the margins suffice during the implementation of policy tools (Sewerin et al., 2022), or what exactly does a policy intervention involve beyond a general assertion about prevailing preferences for certain kinds of policy tools (Capano & Howlett, 2024).

Research on policy calibrations becomes especially pertinent in theorizing about how behavioral insights can be newly integrated into existing policy mixes. Pragmatically, the integration of behavioral considerations into adjustments made to environmental disease mitigation policy, for example, signals the deliberate combining of two different sets of policy objectives. This is unlike the concept of policy "packaging" in policy design theorization, which refers to design processes of replacement that remove previous policies from a mix and construct new assemblages of policy instruments (Howlett & Rayner, 2013; Kern et al., 2017). The scenario is, however, closer to the intentional "patching" of existing policies "much in the same way as software designers issue "patches" for their operating systems and programs in order to correct flaws or allow them to adapt to changing circumstances" (Howlett & Rayner, 2013, p. 177). Scholars of environmental policy integration, for example, argue that insofar as policy calibrations signal the actual adjustment of policy settings, they can play a critical role in "regulating the intensity of the policy intervention [and] affecting the allocation of scarce resources between several instruments" (Grohmann & Feindt, 2024, p. 20). In our work, micro-level policy calibrations are thus conceptualized as the location of policy design processes that issue behaviorally informed "patches" (Mukherjee & Mussagulova, 2024).

Research on policy targets and their responses to seemingly minor policy changes, at this level of policy design analysis, promises to be the most illuminating in terms of being able to gauge the effect of the substantive content of policy implementation on policy-taker engagement with policy. It can provide an opportunity, such as that explored in our article, to forward empirically testable hypotheses about

"how far", "how much", and "how frequently" policy instruments can be marginally adjusted during implementation to target different motivations for the public to participate.

Policy target motivations

Historically, the dominant view on policy target motivations within the policy sciences has been that policy-takers are mainly guided by instrumental or utilitarian decision-making that weighs the incentives and disincentives they face (Howlett & Leong, 2022; Leong & Howlett, 2022). However, a smaller strand of the literature has long recognized the heterogenous nature of policy target motivations. For instance, Tyler (1990) contrasted instrumental motivations for obeying the law with normative motivations, while several later authors (Burby & Paterson, 1993; Nielsen & Parker, 2012; Winter & May, 2001) made a distinction between instrumental, social, and normative bases of compliance. Sutinen & Kuperan (1999) highlighted the difference between intrinsic and extrinsic motivators, where the extrinsic motivators consist of economic and social gains and losses, while the intrinsic motivators consist of "standards of personal morality" or "perceptions of the fairness and appropriateness of the law and its institutions".

We distinguish between the following four sources of policy-taker motivation here: economic, social, normative (legitimacy-based), and normative (intrinsic) (Mukherjee & Guha, 2024). Economic motivation refers to responsiveness to policy-induced changes in one's own utility. By introducing incentives and deterrents that alter the policy-taker's costs and benefits, authority- and treasure-based policy instruments harness economic motivation for (usually involuntary) compliance.

Social motivation stems from the policy-taker's responsiveness to social norms and social approval/disapproval. Policy-takers primarily motivated by social motivation tend to be "conditional cooperators" (Feldman, 2011) who comply if they perceive that a social norm exists and social sanctions would result from non-compliance.

In contrast, policy-takers motivated by normative considerations comply because of personal, rather than social, norms. Normative motivation can stem from legitimacy-based or intrinsic motivations. Normative (legitimacy-based) motivation refers to responsiveness to the perceived legitimacy of the state to impose standards of behavior that must be complied with, with states that are effective, administratively competent, honest, and procedurally just considered to possess greater legitimacy (Levi & Sacks, 2009). Policy-takers motivated by normative (legitimacy-based) motivation will tend to comply even in the absence of strong personal support for the policy issue, because they believe that it is "the right thing to do" to follow the strictures of the state, regardless of their personal views on the appropriateness of the policy.

We use the term normative (intrinsic) motivation, on the other hand, to refer to responsiveness to the perceived "rightness" and appropriateness of the policy in view of the policy target's intrinsic values or moral code. In this case, policy-takers comply because they believe that taking policy action is "the right thing to do" given their personal beliefs.

From a policy standpoint, disentangling these different sources of motivation is useful because it indicates that policy-taker compliance can potentially be increased by targeting non-economic sources of motivation without resorting to expensive monitoring, sanctions, and enforcement (Sutinen & Kuperan, 1999). Mukherjee & Guha (2024), for instance, conceptualized variations in the compliance response of policy targets to changes in policy instrument calibrations based on their underlying motivations. Pedersen et al. (2020, p. 616) have previously highlighted the need for "a better understanding of the diversity of motivations found within target groups and how instrument packages can be designed to achieve a higher policy impact". In this article, we contribute to this effort by empirically examining the relationship between policy target motivations and policy compliance at the level of calibration changes to policy instruments.

Linking motivations to policy tools

Reiterating, then, the need to move beyond simplistic, binary notions of compliance in policy formulation, this study is inspired by two broad questions that have implications for both the theoretical advancement of policy design scholarship and its effective practice. First, we ask "what elements of policy design can explain the complex ways in which policy targets engage with policy implementation?" Relatedly, "how do changes in policy tool calibrations affect policy target motivations?".

The underlying assumption, as above, is that there is a "mix" of motivations on the part of the public to engage with the implementation of different policy tools (regulatory, financial, or organizational). In

embedding this study in the mechanistic perspective on policy design which unpacks the causal understanding of what mechanisms triggered by policy instruments appeal to policy target behavioral motivations, we respond to the call for a research agenda that goes beyond simple behavioral nudges and utility maximization considerations that have hitherto delimited the research on policy targets, towards more nuanced explanations that match target behavior with different policy instrument governance resources (Howlett, 2020).

Conceptually, a policy design process begins with an assessment of the abilities of different policy tools to affect policy outputs and outcomes, and the kinds of resources required to allow them to operate as intended (Hood, 2007). Theorization about the inherent causal chain of policy design has progressed insofar as providing starting points that can be used to craft propositions to understand policy instruments as classes of solutions whose implementation can be reasonably expected to yield a desired outcome (Capano et al., 2019). As a result, policy designs, then, become a mix of such reasoned expectations about how to attain a set of policy goals.

Understanding that changes or "tweaks" made to different instrument categories may trigger a variety of responses on the part of the public requires an appreciation of complex instrument–behavior interactions. For example, a major concern of those assuming a mechanistic perspective of policy design is to understand how exactly combinations of different policy instruments can activate predictable response pathways to achieve multi-dimensional policy goals (Capano et al., 2019). This requires not only knowledge of the basic behavioral assumptions underlying each tool category but also their interactive effects (Howlett, 2022). Where the "old" design orientation concentrated for the most part on single policy tools and goals, the new design orientation has engaged more in a discussion of integrative policy mixes (Peters et al., 2018), making the investigation of how different instrument types lead to "activating" distinct motivations of policy targets all the more timely.

To this end, to explore the motivational responses that are triggered by policy change, we rely on the resource-based taxonomy of policy instrument design, which has long been influenced by Christopher Hood's seminal works (Hood, 1986, 2007). This framework posits that governments have essentially four resources at their disposal—**N**odality (meaning the resource stemming from the fact that governments exist at the "centre" of social and political networks, but which can be thought of as "information" or "knowledge"), **A**uthority (coercion and regulatory resources), **T**reasure (financial tools), and **O**rganizational (based on the provision of governance services). Governments can fashion tools based on "NATO" resources for either of two purposes—to monitor society or to alter its behavior. In Hood's scheme, instruments are grouped together according to (a) which of the NATO resources they rely upon for their effectiveness and (b) whether the instrument is designed to effect a change in a policy environment or to detect changes in it (Hood, 1986). The applicability of the NATO framework has remained prominent since then, especially in understanding how preferred policy styles or dominant governance modes can condition a preference for the use of some of these resources over others (Capano & Howlett, 2020). However, while these considerations highlight the "supply" side of policy design to inform how a government may choose to deploy some governance resources over others, it still does not arrive at a theory of how these tools, through what behavioral mechanisms, activate various responses by policy targets—or the "demand" side (Strassheim, 2020). We build our hypotheses specifically in this theoretical space.

Building testable hypotheses

Howlett (2020) and Howlett & Leong (2022) have since led the discussion on how the "supply" of policy instruments emanating from NATO resource categories elicit particular responses on the part of policy targets. While behavioral public policy scholars have surmised that "all tools are informational now" and fundamental to "recalibrating" the state (John, 2014), they also express that not every behavioral intervention is a simple heuristic-modifying nudge which might only imply supplying **N**odality-oriented "tweaks" to existing policy tool calibrations (Howlett, 2022), an observation that has implications for what can be systematically learnt about the effective design of this large category of policy means. "Nudges," generally, are designed to direct the short-term behavior or actions of the public towards a particular decision using defaults, where the desired decision is the default one. However, the behavioral implications of policy tools are not limited to simplistic nudges and may take the form of more sustained commitment devices to encourage a range of policy-taker participation in policy (Gopalan & Pirog, 2017; John et al., 2019).

The view that mechanisms are triggered by the deployment of certain policy tools over others surmises that "the use of policy tools activates certain propensities on the part of policy actors leading to policy outputs resulting from more or less predictable changes in target behavior and ultimately policy outcomes" (Capano & Howlett, 2021, p. 148). Furthermore, the "activation" link between the on-the-ground use of policy instruments (in the form of calibrations) and mechanisms is governed by particular policy contexts (e.g., dengue in Singapore). The causal chain of activities, in this conceptualization, is triggered first by the choice of governing resource (i.e., NATO), and the underlying mechanisms that choice activates in order to signal behavior change (Capano & Howlett, 2021).

In our conceptualization of this relationship (see Figure 1), these mechanisms map onto particular motivations on the part of policy targets. "Behavior 1" (Figure 1) represents the level of policy target compliance before any changes or tweaks are made to the design of policy calibrations. This is influenced by what Howlett (2020) and others have alluded to as the different target behavioral "pre-requisites" that the different types of policy tools assume at the individual level. (Nodality assumes credibility afforded to the government, Authority assumes legitimacy given to government coercive power, Treasure tools invoke simple utility maximization, and Organization relies on competence and the willingness to partner in delivering public value). Albeit an important development in the policy design research agenda, these assumptions do not yet forward testable hypotheses about how policy target motivations for engaging with policy are essentially targeted by different policy tool elements that stem from different governance resources—a gap our research directly addresses. Referring again to Figure 1, the conceptualized activation (or change made to the design of instrument calibrations) triggers policy mechanisms that are themselves conditioned by different motivations inherent in policy targets, therefore yielding complex policy compliance responses (Behavior 2).

An important aspect of our research is that we distinguish between two categories of organization-based tools, i.e., those involving direct provision and those involving community outreach. Traditionally, organization-based effector tools have revolved around direct government provision of public goods and services; although some scholars such as Schneider & Ingram (1990) discussed the role of community mobilization and outreach programs as capacity-building policy instruments, these were not greatly emphasized in the early literature on policy tools. In recent decades, however, tools aimed at increasing collaboration with non-State actors to implement policies and deliver public services have emerged as a very important category of organization-based tools (Kekez, 2022; Kekez et al., 2018). As Kekez (2022, p. 524) noted, "contemporary practice of public service delivery and goods production is increasingly marked by a widespread reliance on arrangements based on or augmented with

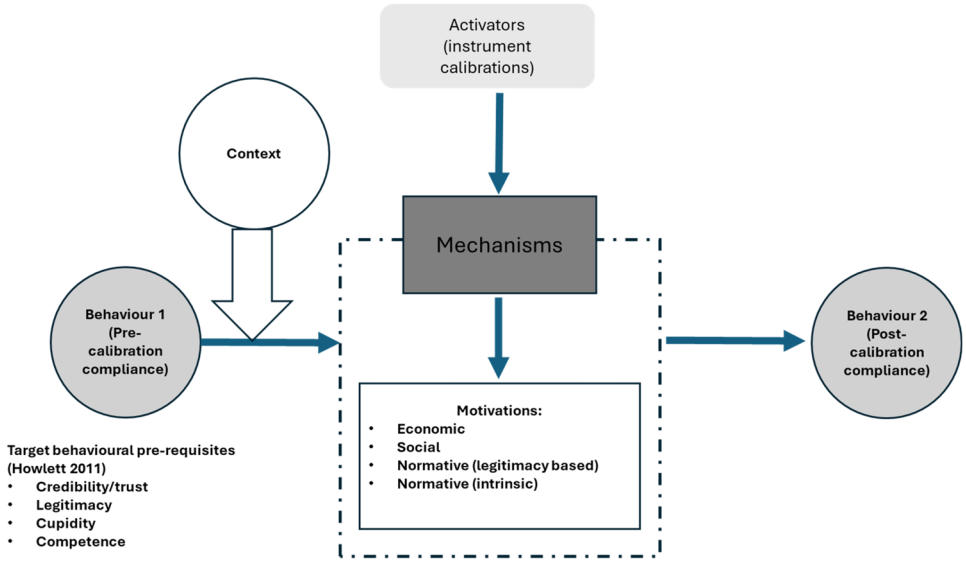

Figure 1. Policy–mechanism–motivation–behavior linkages for policy design.
Note. Authors' modification based on Capano & Howlett (2021) and Howlett (2018).

collaboration." Accordingly, we differentiate between these and more "traditional" organization-based tools involving direct government provision in our analysis. Addressing calls for more research on how these tools perform and the conditions under which they are more or less effective (Giest et al., 2022), we use our empirical analysis to determine how the increased calibration of these tools vis-à-vis other tool types affects the compliance of policy targets.

Do people projecting different dominant motivations for policy compliance respond differently to calibration changes of various categories of policy instruments? To help answer this research question, we forward some propositions in Table 1 linking the policy target motivations discussed previously and summarized below with different hypothesized scenarios of policy instrument calibrations:

- **Economic motivations** governed by rational, utility maximization,
- **Social motivations** led by notions of social appropriateness and acceptance,
- **Normative (legitimacy-based) motivations** stemming from the perceived legitimacy of the government to create public value, and:
- **Normative (intrinsic) motivation** based on alignment with the individual's personal values.

H1 compares the responsiveness of policy targets dominated by economic considerations to the calibration of authority- and treasure-based policy tools vs organizational policy tools. Since authority- and treasure-based tools set incentives and deterrents, and this group of policy targets is expected to be sensitive to incentives and deterrents which directly affect the perceived costs and benefits of compliance, we hypothesize that they will be more responsive to the increased calibration of authority- and treasure-based tools than the increased calibration of organizational tools.

H3 also compares responsiveness to the calibration of authority- and treasure-based policy tools vs organizational policy tools, but for policy targets dominated by legitimacy-based normative motivations. Capano & Howlett (2021) have noted that compliance with authority- and treasure-based tools increases not only with cupidity (willingness to be swayed by perceived gains and losses) but also with perceived

Table 1. Testable hypotheses.

Primary motivation:	Calibration of authority-based tools	Calibration of treasure-based tools	Calibration of organization-based tools (direct provision)	Calibration of organization-based tools (community outreach)
Economic	H1: Policy targets primarily motivated by economic motivation comply more with increased calibration of authority- and treasure-based tools than with increased calibration of organization-based tools.			
Social			H2. Policy targets primarily motivated by social motivation comply similarly with increased calibration of organization-based tools involving direct provision and community outreach.	
Normative (legitimacy-based)	H3: Policy targets primarily motivated by normative (legitimacy-based) motivation comply more with increased calibration of authority- and treasure-based tools than with increased calibration of organization-based tools.			
Normative (intrinsic)	H4: Policy targets primarily motivated by normative (intrinsic) motivation comply more with increased calibration of organization-based tools involving community outreach than with increased calibration of authority- and treasure-based tools.		H5: Policy targets primarily motivated by normative (intrinsic) motivation comply more with increased calibration of organization-based tools involving community outreach than with increased calibration of organization-based tools involving direct provision.	

government legitimacy. Accordingly, we hypothesize that, all else being equal, policy targets with a greater legitimacy-based normative motivation will be more responsive to the increased calibration of authority- and treasure-based tools than the increased calibration of organizational tools since their belief in government legitimacy makes them more willing to accept government-imposed restrictions and penalties.

For hypotheses H2, H4, and H5, we bring in the distinction between the two kinds of organization-based tools discussed previously, that is, organization-based tools involving direct government provision and those involving community outreach. For policy targets motivated by social considerations (H2), we do not expect a stronger response to the increased calibration of tools involving community outreach than those involving direct government provision. Since the compliance motivation for this group of policy targets primarily stems from the behavior of other people in society rather than from the actions of the state, there is little basis to conjecture that they will be differentially sensitive to increased calibration of the different forms of organizational tools.

For those whose primary source of motivation is intrinsic normative motivation, however, we hypothesize greater responsiveness to the increased calibration of organization-based tools involving community outreach than to the increased calibration of either authority- and treasure-based tools (H4) or organization-based tools involving direct provision (H5). Motivation crowding theory (Folmer, 2021; Frey & Jegen, 2001) states that the imposition of external regulations or financial penalties can crowd out intrinsic motivation, suggesting a greater compliance response to the increased calibration of organizational tools. Within the overall category of organizational tools, we explore the hypothesis that policy targets motivated by intrinsic considerations will be more responsive to increased calibration of tools involving community outreach than those involving direct government provision. As intrinsic normative motivation suggests a heightened level of interest in the policy issue, we speculate that this group would be more responsive to the dialing up of public engagement campaigns that aim to raise awareness and convince others about its importance.

The context: dengue in Singapore

We tested our proposed hypotheses in the context of dengue control policies in Singapore. Dengue is a mosquito-borne viral disease that is responsible for about 10,000 fatalities and 100 million symptomatic infections annually in over 125 countries across the globe (Messina et al., 2019). It has been endemic for decades in the city-state of Singapore, where the frequency and magnitude of outbreaks have been on the rise since the 1990s. In the largest outbreak to date, more than 35,000 cases were reported. A recent study estimated that the total economic cost of dengue for the country between 2010 and 2020 lay between $1 and 2.3 billion (constant 2010 US$) (Soh et al., 2021).

Singapore uses a gamut of policy measures to control dengue incidence (Ho et al., 2023; Sim et al., 2020). The policy response is centered around source reduction, that is controlling the population of the *Aedes* mosquitoes responsible for dengue transmission. There is a comprehensive regulatory framework in place that includes home inspections by public health inspectors in areas with heightened incidences of dengue and fines for households detected with mosquito breeding. The government implements many direct measures to monitor and reduce *Aedes* populations, including vector surveillance via a nationwide network of mosquito traps; daily litter collection; drain flushing, cleaning, and oiling; management of natural vegetation and water bodies, etc. It uses a variety of public education and messaging strategies to increase public awareness. It also employs strategies to increase community engagement and mobilization, making use of grassroots organizations such as Citizens' Consultative Committees, Residents' Committees, and Neighbourhood Committees to solicit local community participation (Sim et al., 2020).

A key reason why source reduction has underpinned Singapore's dengue control policy is that the mass vaccination route has been unfeasible: to date, no general population vaccine has been approved for dengue. In its absence, other solutions have been explored that can potentially be deployed on a nationwide scale and obviate the need for micro-level vector control requiring sustained commitment on the part of policy targets. For example, since 2016, field trials of a technology called *Wolbachia*, which aims to suppress the Aedes mosquito population in the long run, have been conducted in a phased manner. The trials, which presently cover almost 20% of Singapore's population, have yielded very encouraging results (Ho et al., 2023). However, government messaging repeatedly emphasizes that *Wolbachia* technology is not a "silver bullet" and that it is very important for households to continue regularly practising mosquito control behaviors (National Environment Agency, 2023).

Methodology

Research design

We used a survey experiment to test the proposed hypotheses. Our survey questionnaire consisted of three parts (see Figure 2). Part 1 captured background variables such as the socio-economic characteristics of respondents as well as their knowledge about, and experience of, dengue. Part 2 measured respondents' baseline compliance level with the following mosquito control behaviors recommended by the government: (a) emptying water from flowerpot plates; (b) loosening hardened soil in flowerpots; (c) changing water in flower vases when in use; (d) scrubbing the inner surface of flower vases when in use; (e) keeping pails dry when not in use; (f) keeping kitchen dish racks/drying racks dry; and (g) spraying insecticide in dark corners of the house. It also measured respondents' motivations for compliance: unless they indicated that they never or rarely engaged in a particular behavior, they were asked a follow-up question about their motivations for complying[1].

Part 3 incorporated a vignette experiment. After all respondents had answered Parts 1 and 2, they were randomly allocated to one of four vignettes. Each vignette altered the calibration of a specific type of policy instrument. After respondents were shown the vignette, they were asked a series of follow-up questions to measure any changes in intended behavioral frequencies of complying with the recommended mosquito control behaviors. Hence, we utilized a mixed research design for the vignette experiment in which the four treatment groups were exposed to different vignettes, but all respondents within each group were exposed to the same vignette (Atzmüller & Steiner, 2010). Because Part 2 of the questionnaire already captured compliance behaviors at baseline, the vignette experiment did not include a control group; each treatment group served as its own control because we recorded both pre- and post-treatment behavior.

Key variables

Our outcome of interest was the change in compliance with the set of seven recommended mosquito control behaviors resulting from changes in policy instrument calibrations. We measured changes in compliance as changes in behavioral frequency. Figure 3 illustrates a sample question about baseline

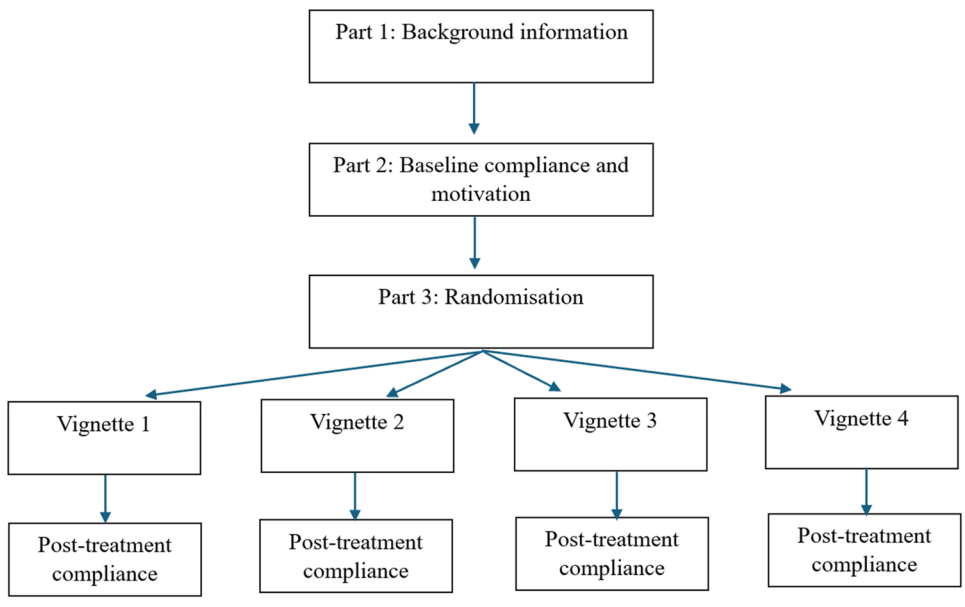

Figure 2. Survey questionnaire flow.

[1] See Mukherjee & Guha (2024) for an earlier discussion of our empirical results on baseline motivations for compliance.

compliance and motivation from Part 2 of the survey questionnaire. For each behavior, we scored compliance as 0 if the response was "never or rarely," 1 if "once in 3 months," 2 if "once a month," 3 if "once a week," and 4 if "several times a week." We then constructed a composite compliance score, constructed by aggregating the scores across all seven behaviors.

Our key independent variables were exposure to the four experimental treatments embedded in the vignettes. These are shown in Figure 4. After respondents were shown the vignette, they were asked a series of follow-up questions to measure the post-treatment intended behavioral frequencies of complying with the recommended mosquito control behaviors.

To be able to test our proposed hypotheses, we also had to measure respondents' motivations for compliance so that we could derive their primary compliance motivation. In the follow-up question in Figure 3, statements (1) and (2) relate to economic/rational motivation; statement (4) relates to social motivation; statement (5) relates to normative (legitimacy-based) motivation; and statement (3) relates to normative (intrinsic) motivation. Similar answer options were used for all other behaviors. We assigned scores to each motivation type as follows: 0 if the response was "Not at all important," 1 if "Not very important," 2 if "Somewhat important," and 3 if "Very important."[2] We then aggregated the motivation scores across all behaviors to obtain a set of composite motivation scores for each respondent. Finally, we selected the motivation type with the highest motivation as the respondent's primary motivation.

Sample

Our data came from an online survey of 2,935 adult Singapore residents (one per household) conducted in June–July 2023. A power analysis was not conducted prior to sampling due to a lack of information on probable effect sizes. Respondents were recruited by Qualtrics from online commercial research panels. Gender and region quotas were imposed to ensure that the sample was representative of the Singapore population. Age quotas were also imposed, but not fully met due to the lower online presence of older residents. Consequently, people aged 60 years and above were under-represented in the sample. All survey respondents gave their written consent to participate. Two rounds of pre-testing ($N = 100$ each) were conducted in May 2023 prior to the launch of the final survey.

As explained above, all respondents answered Parts 1 and 2 of the survey questionnaire and were subsequently randomly allocated to one of four vignettes. A total of 729 respondents received vignette 1; 741 respondents received vignette 2; 715 respondents received vignette 3; and 750 respondents received vignette 4.

Do you or a household member keep kitchen dish racks/drying racks dry? Please check the option that applies most closely.

- o Never or rarely
- o Once in 3 months
- o Once a month
- o Once a week
- o Several times a week

[Skip follow-up question if "Never or rarely"]

Why do you or a household member keep kitchen dish racks/drying racks dry? Please respond to each option below.

		Not at all important	Not very important	Somewhat important	Very important
1)	My household is less likely to be fined for mosquito breeding if there is a government inspection	o	o	o	o
2)	It protects me and my household from diseases carried by mosquitoes	o	o	o	o
3)	It protects people in my neighbourhood from diseases carried by mosquitoes	o	o	o	o
4)	My friends/neighbours/colleagues do this, so I think it's important to do it too	o	o	o	o
5)	The government tells me I should do this	o	o	o	o

Figure 3. Sample question about baseline compliance and motivation.

[2] Because economic motivation was typically measured using two statements, the economic motivation score was computed as the average of the scores for the two statements.

Dengue is a viral disease that is transmitted to humans through the bite of infected *Aedes* mosquitoes. People infected with the dengue virus may experience symptoms such as high fever, headaches, nausea, and rashes, and a small percentage experience a very severe form of the disease that can be fatal. Dengue outbreaks occur frequently in Singapore. Currently, there is no dengue vaccine available for the general population.

Vignette 1: authority-based instrument

Several policy measures have been adopted to prevent the spread of dengue and other mosquito-borne diseases in Singapore, including official inspections of homes for mosquito breeding habitats by dengue inspection officers. Due to the high number of dengue cases in Singapore, the number of official home inspections is projected to increase by twenty percent from this year onwards. This means that, if 1,000 households are currently being inspected every month, this will increase to 1,200 households being inspected every month.

Vignette 2: treasure-based instrument

Several policy measures have been adopted to prevent the spread of dengue and other mosquito-borne diseases in Singapore, including fines for homes where mosquito breeding habitats are detected by dengue inspection officers. Due to the high number of dengue cases in Singapore, the amount of fines for homes where mosquito breeding habitats are detected is projected to increase by twenty percent from this year onwards. This means that, if households that fail mosquito inspections are currently being fined $200 each, this will increase to fines of $240 per household.

Vignette 3: organization-based instrument (direct provision)

Several policy measures have been adopted to prevent the spread of dengue and other mosquito-borne diseases in Singapore, including application of anti-mosquito oil to drains to kill mosquito larva. Due to the high number of dengue cases in Singapore, the number of drain oilings is projected to increase by twenty percent from this year onwards. This means that, if 1,000 drains are currently being oiled every month, this will increase to 1,200 drains being oiled every month.

Vignette 4: organization-based instrument (community outreach)

Several policy measures have been adopted to prevent the spread of dengue and other mosquito-borne diseases in Singapore, including government-coordinated community outreach campaigns to increase community awareness on preventing mosquito breeding. Due to the high number of dengue cases in Singapore, the number of community outreach campaigns is projected to increase by twenty percent from this year onwards. This means that, if 100 neighbourhood outreach campaigns are currently being conducted every month, this will increase to 120 neighbourhood outreach campaigns being conducted every month.

Figure 4. Vignettes.

Sample descriptive statistics are shown in Supplementary Table A1. The table also shows the results of balance tests to check for statistically significant differences in socio-economic characteristics across the four experimental groups. The results show that there were no significant differences across the groups, indicating that randomization was successful. Supplementary Table A2 shows the pre- and post-treatment compliance scores for the entire sample, while Table 2 shows the pre- and post-treatment composite compliance scores for each of the four experimental groups.

Analysis and results

Figure 5 illustrates the distribution of respondents by primary motivation type. It shows that some respondents (about 42% of the sample) identified a single source of motivation as their primary motivation. Most of these respondents identified a normative value as their source of motivation: about 18%

(218 respondents) identified normative (legitimacy-based) motivation, while 43% (531 respondents) identified normative (intrinsic) motivation. Economic motivation was the sole source of motivation for about 30% (372 respondents), while social motivation was the sole source of motivation for less than 10% (120 respondents).

Most respondents, however, were driven by a mix of motivations. 253 respondents (almost 9% of the sample), for instance, consisted of people who identified both economic considerations and intrinsic normative beliefs as their primary source of compliance motivation, while 743 respondents (a quarter of the sample) reported being equally motivated by all four motivation types.

As explained previously, the rationale for identifying respondents' primary motivation was to enable us to identify the relevant sub-groups for testing each hypothesis. Testing hypothesis H1, for instance, required us to use only those respondents whose primary motivation is economic. We included all respondents who identified economic motivation as their single source of motivation in this category, as well as respondents who identified economic motivation as one of their two or three primary motivations. However, we excluded the 743 respondents with all four sources of motivation as their primary source of motivation, as such respondents are equally motivated (or unmotivated) by all four motivation types.[3]

We continue with hypothesis H1 as an example to illustrate the rest of our methodology. After identifying those respondents whose primary motivation is economic, we estimated the following regression:

$$y_i = \beta_0 + \beta_1 dummy_i + X_i\gamma + \varepsilon_i,$$

where y_i represents the change in the composite compliance score (post-treatment score—pre-treatment score) for respondent i; $dummy_i$ is a dummy variable that takes the value 1 for respondents exposed to the authority- and treasure-based instrument vignettes and 0 for those exposed to the two organisation-based instrument vignettes; and Xi is a vector of control variables consisting of respondents' socio-economic characteristics. Although the treatment groups appeared to be balanced on socio-economic characteristics in Supplementary Table A1, we included these characteristics in the regression estimation to improve the precision of our estimates (Angrist & Pischke, 2009). However, Supplementary Table A4 presents the results of re-estimating the regression models after excluding the control variables.

The other hypotheses were tested using a similar methodology, although respondents exposed to the authority- and treasure-based vignettes were dropped for testing hypotheses H2 and H5 since these hypotheses compare compliance responses to the increased calibration of the two organization-based instruments only.

The estimation results are shown in Table 3. Overall, they support four of our five hypotheses (all but H4). The coefficient in column (H1) shows that policy targets primarily driven by economic motivation reported higher compliance intention when they were exposed to the authority- and treasure-based vignettes than when they were exposed to the two organization-based vignettes and that the increase in compliance intention was statistically significant at the 5% significance level.

Hypothesis H2 relates to the responsiveness of policy targets primarily driven by social motivation, predicting that they are not differentially responsive to the increased calibration of organization-based instruments based on direct provision and community outreach. Because the coefficient reported in Table 3 is statistically insignificant, we tentatively conclude that this hypothesis was supported by the

Table 2. Pre- and post-treatment composite compliance scores by experimental group.

	Pre-treatment	Post-treatment
Vignette 1: authority-based instrument	2.58	3.01
Vignette 2: treasure-based instrument	2.62	3.27
Vignette 3: organization-based instrument (direct provision)	2.59	2.93
Vignette 4: organization-based instrument (community outreach)	2.61	3.09

[3] Supplementary Table A3 also presents the results after (a) keeping respondents with up to two distinct sources of primary motivation only (Panel 1) and (b) keeping respondents with one source of primary motivation only (Panel 2). Since most respondents are driven by a mix of motivations, the sample sizes drop significantly relative to our main results in Table 3. However, the results remain qualitatively similar.

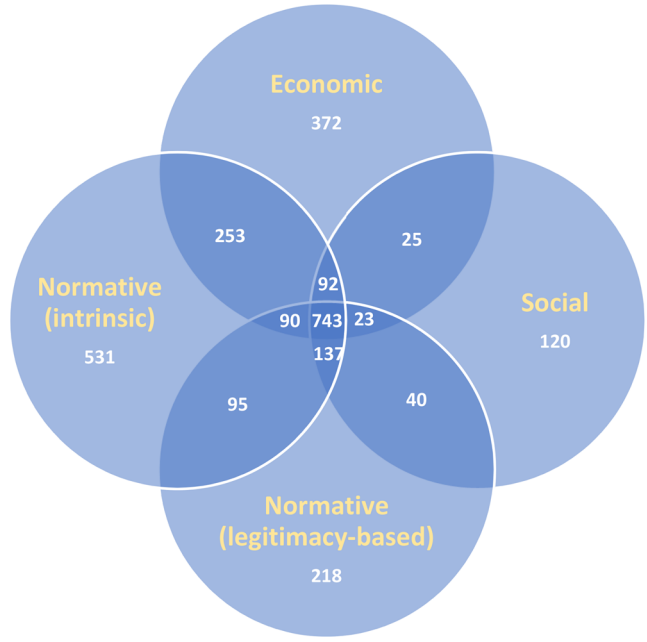

Figure 5. Distribution of respondents by primary motivation type.
Notes. It was not possible to represent all possible combinations of the four motivation types in the above figure. In addition to those shown above, there were 35 respondents who had both economic and normative (legitimacy-based) motivations as their primary motivation, and 73 respondents with both social and normative (intrinsic) motivations as their primary motivation.

data. However, given the absence of an a priori power calculation and the small sample size available to test this hypothesis ($N = 249$), it is also probable that a lack of sufficient power limited our ability to detect a statistically significant difference.

Hypothesis H3 predicts that policy targets primarily motivated by legitimacy-based normative considerations are more responsive to the increased calibration of authority- and treasure-based policy instruments than to the increased calibration of organization-based policy instruments. This hypothesis was strongly supported by the data, with the observed increase in compliance intention statistically significant at the 1% significance level.

Finally, hypotheses H4 and H5 relate to the responsiveness of policy targets primarily driven by intrinsic normative motivation, suggesting that such policy targets are more responsive to the calibration of organization-based policy instruments involving community outreach than they are to the calibration of authority- and treasure-based instruments (H4) or organization-based instruments involving direct provision (H5). Hypothesis H4 was not supported by the data as the coefficient is statistically indistinguishable from zero. Hypothesis H5, on the other hand, was strongly supported by the data; respondents exposed to the organization-based (community outreach) vignette reported higher compliance intention than those exposed to the organization-based (direct provision) vignette, and the increase was statistically significant at the 1% significance level.

Discussion and concluding remarks

Overall, the results from our vignette experiment confirm our expectation that policy targets with different sources of motivation for policy compliance respond differently to changes in the calibration of different types of policy instruments. As expected, policy targets whose compliance primarily stems from economic considerations are more responsive to the increased calibration of authority- and treasure-based tools—which, in our case of dengue control policies in Singapore, increase the probability of being caught and fined for mosquito breeding inside the home—than they are to the increased calibration of

Table 3. OLS regression estimation.

	(H1)	(H2)	(H3)	(H4)	(H5)
Change in score	0.1131** (0.0464)	–0.1130 (0.0859)	0.1657*** (0.0600)	–0.0218 (0.0484)	0.1741*** (0.0523)
Primary motivation	Economic	Social	Normative (legitimacy-based)	Normative (intrinsic)	Normative (intrinsic)
Treatment group(s) received	Authority- and treasure-based vignettes	Organization-based (community outreach) vignette	Authority- and treasure-based vignettes	Organization-based (community outreach) vignette	Organization-based (community outreach) vignette
Comparison group(s) received	Organization-based vignettes	Organization-based (direct provision) vignette	Organization-based vignettes	Authority- and treasure-based vignettes	Organization-based (direct provision) vignette
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	890	249	638	959	632

Notes. Robust standard errors in parentheses. Control variables include dummy variables for sex, age groups (30–39, 40–49, 50–59, and 60+), and gross monthly household income categories ($5–10k, $10–15k, and $15k+).
***$p<0.01$,
**$p<0.05$,
*$p<0.1$.

organizational tools. Also as expected, policy targets whose compliance primarily stems from their need for social approval and avoidance of social disapproval respond similarly to the increased calibration of the two types of organizational tools; they are not more motivated to comply when the government makes efforts to engage the community in dengue control than when it provides public services to prevent mosquito breeding.

Next, we turn to policy targets motivated by intrinsic moral norms. Ex ante, we hypothesized that this group is more motivated to comply when the government increases its deployment of public collaboration/engagement-oriented tools than when it steps up its use of the more conventional authority-, treasure, or provision-oriented tools. We find partial support for this; while this group of policy-takers does not respond more to the increased calibration of organizational tools centered around community outreach than it does to the increased calibration of authority- and treasure-based tools, it does respond more to the increased calibration of the former set of tools than it does to the increased calibration of organizational tools based on direct service provision. We view this as a novel finding; there is little discussion in the policy literature on the differences between these two categories of organizational tools, let alone exploration of the relationship between their calibration and policy compliance.

How far and to what extent knowledge of policy-taker behaviors influences or changes the policy process remains an emergent discussion. Our examination in this article provides a first step in establishing the potential of applying the knowledge of behavioral motivations to improve the design of policy tool implementation. While the extent to which this kind of knowledge permeates procedural or organizational decisions by policymakers remains to be seen, expanding research on this aspect of policy design provides an important avenue for bringing in insights about policy target behaviors into how policy tools are marginally adjusted and fine-tuned as they are implemented. The promise of this line of research for more effective policy design stems from accepting that the behavioral responses of policy targets are more nuanced than traditional compliance deterrent logics.

To this end, our study unpacks policy target response by providing evidence of heterogeneous motivations for policy compliance and illustrating that these underlying motivations influence how policy targets respond and are differently sensitive to the calibrations of diverse types of policy instruments. Especially so in the context of a cyclical environmental disease and its repercussions on public health, where marginal adjustments to instruments are steady and ongoing in response to disease markers. Against this backdrop, we show that policy targets with intrinsic moral norms participate and comply more when they see policymakers trying to engage and involve the community, suggesting that it is in principle possible to use policy instrument calibrations to harness non-economic motivations to elicit greater policy participation.

A caveat about complexity is in order here. First, policy targets do not neatly sort into distinct motivation categories; many of us are likely to be driven by more than one motivational factor guiding our compliance with policy (Nielsen & Parker, 2012). This raises the possibility of crowding-out effects: policy changes intended to increase compliance by targeting a particular source of motivation may result in reducing compliance stemming from other sources (Frey & Jegen, 2001; Gneezy & Rustichini, 2000; Guha, 2020). It is also important to acknowledge that policy target motivation is only one piece of the compliance puzzle; many other factors affect compliance (Weaver, 2014), not the least of which is program context, design, and scope (Carter & Siddiki, 2021; Siddiki et al., 2012).

We should acknowledge that the study is subject to several limitations. First and foremost, our vignette experiment relies on hypothetical scenarios and self-reported compliance intentions instead of real-world changes in policy instrument calibrations and observed behavioral changes. Although the results of vignette experiments have been found to closely approximate real-world data in some applications (Hainmueller et al., 2015), it is not possible to test the correspondence in our case. Second, the external validity of our findings may be limited since our data are from a single environmental disease context in a single country, and one, moreover, in which the policy response is highly state-led. Although the same methods can certainly be replicated in other contexts, whether the results will replicate is uncertain. Third, as mentioned previously, we should treat the results of testing hypothesis H2 with caution since the small sample size available for testing it may have led to low statistical power.

Supplementary material

Supplementary material is available at *Policy and Society* online.

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Conflicts of interest.

None declared.

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