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Abstract

This paper aims to describe and compare, by means of state-space models, two pathways through which mental activity reaches quieting: the faith-mediated type and the self-observation type. Mental activities such as anxiety, rumination, self-evaluation, achievement drive, and defensiveness can be understood as self-referential amplification loops grounded in memory. Research on rumination and mind wandering has demonstrated the repetitive, persistent, and self-referential character of such mental activity. On the other hand, studies on decentering and meta-awareness have shown that reactivity can diminish when direct identification with inner experience weakens. In this paper, we formulate a faith-mediated quieting model as the first pathway, in which self-amplification diminishes through the mediation of yearning for salvation, prayer, and God-reference, and a self-observation quieting model as the second pathway, in which the effective gain of self-amplification decreases as mental activity observes itself. We also introduce "trying to calm" as a distinct internal state and show that the phenomenon of "trying to calm prevents calming" can be derived from within the self-observation model. Furthermore, we carry out reduced-order analysis, numerical examples, and comparison of controllability and observability for both models, and show that the faith-mediated type has a strong entry point but is fragile with respect to the mediating structure, while the self-observation type has a narrow entry point but is structurally robust. Through these results, this paper provides a foundation for describing mental quieting as a comparable theoretical structure, without reducing it to mystification or simplistic technique.

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1 Introduction

People are often caught up in mental activities such as anxiety, rumination, self-evaluation, achievement drive, and defensiveness. These do not merely occur as isolated events; they can sustain and strengthen themselves by inviting further interpretations and evaluations. Research on rumination has organized the repetitive and self-referential nature of such thinking, while research on mind wandering has shown that consciousness does not rest statically on a single object but flows with deviations and re-awareness. It is therefore more natural to understand mental activity not as a static collection of contents but as a dynamic process capable of self-referential amplification.

On the other hand, this flow appears to be capable of calming when one simply observes it as it is. What is important here is that calming does not arise as the result of forceful suppression or volitional control; rather, it appears that the self-amplifying movement itself weakens through the act of "seeing." Furthermore, and paradoxically, when one intends to calm the mind, that very intention generates new tension and can push calming further away. How to understand this duality—that "observing leads to calming" and "trying to calm prevents calming"—within a single theoretical framework is the starting point of this paper.

In response to this problem, this paper distinguishes at least two typical pathways leading to mental quieting. The first is the faith-mediated type, which reaches quieting through the mediation of yearning for salvation, prayer, trust, and surrender. The second is the self-observation type, in which self-amplification weakens as mental activity observes itself, resulting in quieting. The former relates to the experience of peace that has been repeatedly described within religious traditions, while the latter can be connected to modern findings on self-observation, decentering, and meta-awareness. Nevertheless, these two have often been discussed separately and have rarely been compared under the same symbolic system.

The purpose of this paper is to formulate these two quieting processes in a comparable form as state-space models. In doing so, we treat mental activity as a memory-based self-amplification loop and express self-observation or faith-mediation as factors that reduce the effective gain of this loop. Through this approach, we aim to describe quieting not as mystical transformation but as a change in dynamic structure. At the same time, we recast the differences between the two not as superiority of experiential content but as differences in entry strength, mediating structure, and robustness.

The novelty of this paper is threefold. First, it makes two quieting pathways—faith-mediated and self-observation—comparable under the same state-space representation. Second, it derives not only "observing leads to calming" but also the seemingly opposite phenomenon of "trying to calm prevents calming" from within the self-observation model. Third, through reduced-order analysis, numerical examples, and comparison of controllability and observability, it shows that a structural trade-off exists between entry strength and robustness of quieting.

This paper has clear limitations. First, it deals only with the mechanism "up to the point of calming"; what appears after quieting or what it means ontologically is not addressed. Second, the variables introduced are operational concepts for minimal description of the phenomenon and do not provide definitive definitions of self, attention, faith, or observation. Third, this paper aims to present a theoretical model and does not offer comprehensive empirical validation. The claims of this paper should therefore be understood not as a complete theory of self-observation or faith in general, but as

an explanatory hypothesis describing one facet of mental quieting.

The structure of this paper is as follows. Section 2 reviews related research. Section 3 defines the basic concepts. Section 4 introduces the state-space representation and analytical perspectives. Sections 5 and 6 present the faith-mediated model and the self-observation model, respectively. Section 7 presents reduced-order analysis and semi-analytical solutions. Section 8 provides numerical examples and their interpretation. Section 9 compares the controllability and observability of both models. Section 10 discusses theoretical implications and limitations. Section 11 concludes.

2 Related Research

The effects of self-observation and awareness on mental activity have been examined in the fields of cognitive science, psychology, and meditation research. In particular, decentering and related constructs have been organized as workings that weaken direct identification with thoughts and emotions. Bernstein et al. [1, 2] discussed these in an integrative manner as a metacognitive process model. There, decentering is held to consist of at least meta-awareness, disidentification from inner experience, and reduced reactivity to thought content. This is consistent with the function that self-observation z serves in this paper: "reactivity decreases when inner experience is noticed as such."

Research on rumination [7] has problematized the cyclic structure in which a thought content provokes secondary evaluation and further thinking, thereby persisting and amplifying. What is important here is that mental activity is understood not as mere content but as a process that strengthens itself. Our treatment of mental activity as a self-amplification loop x is consistent with this finding. When considering mental quieting, the question is not simply "whether mental content exists or not," but whether that content is riding on a self-amplification loop.

Mind wandering research [6] has shown the fluidity of conscious experience and the importance of meta-awareness toward it. Consciousness does not continuously cling to one object; it deviates, is noticed, and returns. This finding overlaps with what we later describe as "patchy attention" and "re-entry into seeing." That is, we treat attention and observation not as a uniformly sustained state but as a dynamic process that arises, fades, and arises again.

A distinctive feature of this paper is that it connects modern findings in psychology and cognitive science with descriptions of quieting found in religious and philosophical traditions. However, this connection does not aim to reduce the content of any specific tradition directly into psychology. Rather, the task of this paper is to formulate the two quieting processes—faith-mediated and self-observation—as comparable dynamics and to clarify the differences in their entry points, mediation, and robustness. In this sense, this paper does not deny the findings of existing research but attempts to re-describe them under a smaller number of structural variables.

The conceptual inspiration for the self-observation model in this paper owes much to the discourse records of Krishnamurti [3, 4, 5], particularly the inquiries such as "the observer is the observed" and "can the image-making machinery stop?" However, these are transcripts of talks, not peer-reviewed academic literature. This paper therefore positions Krishnamurti's descriptions as a source of inspiration for the model, while carrying out theoretical justification independently on the basis of the internal structure of the state-space model and the academic findings on decentering and meta-awareness.

3 Basic Concepts

In this paper, *memory* does not refer merely to past recollection but to the totality of accumulated internal content that constitutes current mental activity, including experience, knowledge, evaluation, self-image, expectations, fears, comparisons, and reactive tendencies. Thus, internal movements such as "I must not fail," "I must do better," and "I am this kind of person" are understood as workings of memory. We treat memory in this sense not as a narrow concept of recollection but as the totality of the past that moves the present.

Mental activity refers to internal movements that arise on the basis of this memory, including anxiety, rumination, self-evaluation, achievement drive, defensiveness, comparison, and the urge to suppress. What is important is to understand mental activity not as isolated content but as a dynamic process in which each element calls forth others. For example, when anxiety arises, an evaluation of it is born, and that evaluation further strengthens the anxiety. In this sense, we treat mental activity as a self-amplifying loop.

Self-observation refers to a state of simply being aware of mental activity without immediately identifying with it, evaluating it, or suppressing it. What is important is to understand self-observation not as a new operation or intervention but as awareness of what is happening.

In contrast, *trying to calm* is positioned as a movement distinct from self-observation. Movements such as "I want to become quieter," "I want to end this state quickly," and "I must observe well" are themselves new mental activities that include evaluation and achievement drive. For this reason, we treat "trying to calm" not as an aid to quieting but as an internal state that often forms a separate positive feedback loop.

Furthermore, there are occasions when the self-amplification of mental activity weakens and a relatively quiet phase appears. We call this phase *blank* for convenience. Blank does not mean the complete disappearance of mental activity or a privileged endpoint. Rather, it is one phase that appears as a result of decreased self-amplification, and it can still be an object of observation even after quieting. What is important in this paper is that blank is not outside observation but is included within it. Operationally, blank is understood as a state in which rumination and self-evaluation have temporarily subsided and attention is not fixated on any particular object. States close to this include decreased activity in the default mode network as observed in meditation research and states reported as "I was not thinking about anything" in experience sampling. However, this paper does not identify blank with any specific neural substrate or reporting category; it is defined as a dynamical phase within the model where $x(t)$ is low and $z(t)$ persists.

With this conceptual clarification, the axes of comparison in this paper become clear. The faith-mediated type is a pathway that leads mental activity toward quieting through external reference, while the self-observation type is a pathway in which mental activity reaches quieting by observing itself. Both can bring about quieting, but their dynamics are not identical.

4 State-Space Representation and Analytical Perspectives

This paper describes the process of mental quieting as a state-space model. A state-space model is a framework that describes how the internal states of a system change over time. In general, a nonlinear system is written as

$$\dot{\boldsymbol{x}}(t) = f\big(\boldsymbol{x}(t), \boldsymbol{u}(t)\big), \tag{4.1}$$

$$\boldsymbol{y}(t) = h\big(\boldsymbol{x}(t), \boldsymbol{u}(t)\big). \tag{4.2}$$

Here $\boldsymbol{x}(t)$ is the state vector, $\boldsymbol{u}(t)$ is the input vector, and $\boldsymbol{y}(t)$ is the observed output vector. In the context of this paper, a state refers to internal quantities that are not directly visible from outside but determine the behavior of the system, such as the intensity of mental activity, the intensity of self-observation, and the intensity of prayer/faith acts.

Because the models in this paper are nonlinear, it is difficult to discuss global controllability and observability all at once in a rigorous sense. Therefore, we linearize the model around a reference state and examine controllability and observability for the resulting locally linearized system. That is, we approximate the nonlinear system to first order around an operating point and write, using matrices A, B, C, D,

$$\delta\dot{\boldsymbol{x}}(t) = A\,\delta\boldsymbol{x}(t) + B\,\delta\boldsymbol{u}(t), \tag{4.3}$$

$$\delta\boldsymbol{y}(t) = C\,\delta\boldsymbol{x}(t) + D\,\delta\boldsymbol{u}(t), \tag{4.4}$$

and examine the ranks of the controllability matrix

$$\mathcal{C} = \big[B,\ AB,\ A^2B,\ \ldots,\ A^{n-1}B\big] \tag{4.5}$$

and the observability matrix

$$\mathcal{O} = \begin{bmatrix} C \\ CA \\ CA^2 \\ \vdots \\ CA^{n-1} \end{bmatrix}. \tag{4.6}$$

When we use the term *controllability* in this paper, it does not mean "whether one can freely transfer the system from any state to any other state" in the usual engineering sense. What is at issue is rather to what extent mental activity can be brought into a low region, or in what region stabilization is possible. Similarly, *observability* is used not merely as a question of mathematical reconstructibility but as a tool for distinguishing what is visible and what remains as a latent state. In this sense, the vocabulary of control theory in this paper is introduced not for the purpose of "engineering" the mind but as a descriptive language for making structural differences in quieting comparable.

5 Faith-Mediated Quieting Model

5.1 Basic Idea

What we call the faith-mediated type is a pathway in which mental activity reaches quieting through an external reference point. The external reference point here does

not mean turning God into a state variable. Rather, it represents the intensity of a God-reference that operates effectively within the subject—a "relationship of turning back toward a standard that transcends one's own mental activity." Therefore, the C-type model of this paper is not a model of theology itself but a minimal state-space representation of how faith operates psychologically.

5.2 State Variables

The state variables of the C-type model are the following four.

- $x(t)$: intensity of memory-based mental activity
- $s(t)$: intensity of yearning for salvation
- $p(t)$: intensity of prayer/faith acts
- $g(t)$: intensity of effective God-reference

When necessary, representational disturbances such as idolization, institutional disillusionment, and symbolic collapse are introduced as $v(t)$.

5.3 Model Equations and Their Meaning

The C-type model is given by the following system of differential equations.

$$\dot{x}(t) = \{a - b_0 - k_g g(t)\}\, x(t), \tag{5.1}$$
$$\dot{s}(t) = -\lambda_s s(t) + \sigma_s x(t), \tag{5.2}$$
$$\dot{p}(t) = -\mu p(t) + \alpha_p s(t) + \beta_p x(t) + \xi_C u_C(t), \tag{5.3}$$
$$\dot{g}(t) = -\eta g(t) + \rho p(t) - \nu v(t). \tag{5.4}$$

Equation (5.1) expresses that while mental activity x can naturally self-amplify, the amplification gain decreases as the God-reference g grows stronger. Equation (5.2) expresses that yearning for salvation s rises as mental activity grows stronger. Equation (5.3) expresses that yearning for salvation s and current suffering x generate prayer/faith acts p, and that external input $u_C(t)$ (worship, ritual, community, presentation of words, etc.) can assist this. Equation (5.4) expresses that prayer/faith acts p strengthen the God-reference g, while representational disturbance $v(t)$ weakens it.

5.4 Dynamical Interpretation

In this model, the center of quieting is not memory directly observing memory. At the center is the flow: yearning for salvation $\rightarrow$ prayer/faith $\rightarrow$ God-reference. Mental activity x decays when God-reference g rises sufficiently. Thus, the C-type is an externally-referenced mediated quieting.

What this model shows is that the fulcrum of quieting lies not in self-observation but in a relationship that takes God as a reference point. For this reason, the C-type has a strong entry point: the greater the suffering, the more easily yearning arises, and that yearning directly becomes the trigger for prayer and faith. However, at the same

time, this model depends on the mediating structure. When prayer fails to translate effectively into God-reference, or when God-reference crumbles under representational disturbance, quieting becomes fragile.

6 Self-Observation Quieting Model

6.1 Basic Idea

The basic idea of the self-observation model contrasts with the faith-mediated type. Here, the fulcrum of quieting is not an external reference but mental activity itself. When mental activity $x(t)$ rises, it gives rise to self-observation $z(t)$, and that $z(t)$ lowers the effective gain of self-amplification. Thus, the problem is not left as is; the problem itself becomes the entry point for observation. Herein lies the source of the robustness of the self-observation type.

However, the self-observation type has one further important internal state: $m(t)$, the movement of "trying to calm." This is not something that assists observation; it often forms a separate self-amplification loop. When people notice suffering or anxiety, they tend to try to do something about it rather than simply observe it. This "trying to do something" generates new evaluation, achievement drive, and a sense of failure, and consequently obstructs quieting. The self-observation model of this paper explicitly incorporates this point.

6.2 State Variables

The state variables of the self-observation type are the following four.

- $x(t)$: intensity of memory-based mental activity
- $z(t)$: intensity of self-observation
- $m(t)$: movement of trying to calm
- $b(t)$: intensity of blank

When external assistance is present, $u(t)$ is additionally introduced. In the pure K-type, $u(t) = 0$.

6.3 Model Equations and Their Meaning

The self-observation model is given by the following system of differential equations.

$$\dot{x}(t) = \{a - b_0 - k_z z(t)\}\, x(t) + r\, m(t), \tag{6.1}$$

$$\dot{z}(t) = -\gamma z(t) + c_x x(t) + c_b b(t) + \xi u(t), \tag{6.2}$$

$$\dot{m}(t) = -p\, m(t) + q\, x(t), \tag{6.3}$$

$$\dot{b}(t) = \alpha_b z(t)\{1 - \phi(x(t))\} - \delta b(t). \tag{6.4}$$

Equation (6.1) expresses that self-observation z lowers the amplification gain of mental activity x, while the movement of "trying to calm" m pushes x up as a separate additive term. Equation (6.2) expresses that self-observation z arises from mental

activity x and blank b, and that its onset can be assisted by external support u. Equation (6.3) expresses that the movement of "trying to calm" m arises in response to mental activity x. Equation (6.4) expresses that blank tends to appear when observation z is present and mental activity x is sufficiently low. Here $\phi(x)$ is a monotonically increasing function that is close to 1 when x is large and close to 0 when x is small. Specifically, we adopt

$$\phi(x) = \frac{x^2}{x^2 + \theta^2} \tag{6.5}$$

where $\theta > 0$ is a parameter controlling the sharpness of the transition. The smaller θ is, the more easily blank emerges even from a small decrease in x. In the numerical examples (Section 8), we use $\theta = 0.3$. This Hill-type function is adopted because it is one of the simplest saturation functions satisfying $\phi(0) = 0$ and $\phi(x) \to 1$ $(x \to \infty)$, and it smoothly represents threshold-like switching.

6.4 Dynamical Interpretation

In this model, mental activity x rising gives rise to self-observation z, and that z lowers the gain of self-amplification. On the other hand, the movement of "trying to calm" m is itself a new internal activity and acts as a second positive feedback. Therefore, "observing leads to calming" and "trying to calm prevents calming" appear simultaneously within the same system.

Here lies the most distinctive feature of the self-observation type: the trigger for quieting lies not outside the problem but in the problem itself. Because there is disturbance, observation arises; because observation arises, disturbance weakens. In this sense, the self-observation type is an internal self-monitoring model that uses the very source of the problem as the entry point for quieting.

7 Reduced-Order Analysis and Semi-Analytical Solutions

7.1 Closed-Form Solutions Are Generally Difficult

Both models contain bilinear and nonlinear terms, making it generally difficult to provide closed-form analytical solutions. However, under appropriate time-scale separation assumptions, semi-analytical solutions can be obtained in reduced systems. This is not merely a mathematical convenience but an operation that highlights what dynamics are essential for quieting.

7.2 Reduction and Analytical Solution of the Self-Observation Type

First, we temporarily ignore blank and assume that $z(t)$ and $m(t)$ follow $x(t)$ rapidly in comparison. We state the basis for this assumption. The decay coefficients γ and p in Eqs. (6.2) and (6.3) represent the natural decay rates of self-observation and control intention, respectively. When these are sufficiently larger than the effective rate of change of $x(t)$, namely $|a - b_0 - k_z z|$, the variables z and m track x nearly instantaneously. In

the numerical examples of Section 8, $\gamma = 1.5$ and $p = 1.0$, while the effective amplification rate of x is on the order of $a - b_0 = 0.1$, so this separation is broadly valid except during the initial rapid transient. Indeed, in Figure 3, $z(t)$ approximately tracks $x(t)$ from $t \approx 0.5$ onward, supporting the conclusion that the quasi-steady approximation does not compromise the qualitative findings. However, during the initial transient near $t < 0.5$, tracking is incomplete, and the reduced system does not precisely reflect the behavior in this interval. This limitation is consistent with the semi-analytical solution serving as a tool for capturing the qualitative structure of quieting rather than for precise description of the initial transient.

As a quasi-steady approximation,

$$z(t) \approx \frac{c_x}{\gamma} x(t), \tag{7.1}$$

$$m(t) \approx \frac{q}{p} x(t) \tag{7.2}$$

are obtained. Substituting these into Eq. (6.1),

$$\dot{x}(t) = \left(a - b_0 + \frac{rq}{p} \right) x(t) - \frac{k_z c_x}{\gamma} x(t)^2. \tag{7.3}$$

Setting

$$\bar{\alpha} = a - b_0 + \frac{rq}{p}, \qquad \bar{\beta} = \frac{k_z c_x}{\gamma} \tag{7.4}$$

we obtain

$$\dot{x}(t) = \bar{\alpha} x(t) - \bar{\beta} x(t)^2, \tag{7.5}$$

a logistic-type equation. When $\bar{\alpha} \neq 0$,

$$x(t) = \frac{\bar{\alpha} x_0 e^{\bar{\alpha} t}}{\bar{\alpha} + \bar{\beta} x_0 \left(e^{\bar{\alpha} t} - 1 \right)} \tag{7.6}$$

is obtained. If $\bar{\alpha} = 0$,

$$x(t) = \frac{x_0}{1 + \bar{\beta} x_0 t}. \tag{7.7}$$

The significance of this analytical solution is substantial. First, the quieting of the self-observation type is understood not as simple linear decay but as a competition between the self-amplification term and a quadratic damping term originating from self-observation. Furthermore, because rq/p is contained in $\bar{\alpha}$, the stronger the "trying to calm" movement, the larger $\bar{\alpha}$ becomes, and quieting becomes more difficult. That is, "trying to calm prevents calming" is derived semi-analytically from within the model.

7.3 Reduction and Analytical Solution of the Faith-Mediated Type

Next, we consider the C-type. We assume that $s(t), p(t), g(t)$ follow $x(t)$ rapidly. In the C-type, the decay coefficients are $\lambda_s = 0.6$, $\mu = 0.8$, and $\eta = 0.7$, which are more than three times the effective rate of change of x, $a - b_0 = 0.2$. This separation is therefore valid to a similar degree as in the self-observation type. Then,

$$s(t) \approx \frac{\sigma_s}{\lambda_s} x(t), \tag{7.8}$$

$$p(t) \approx \frac{\alpha_p s(t) + \beta_p x(t) + \xi_C u_C(t)}{\mu}, \tag{7.9}$$

$$g(t) \approx \frac{\rho}{\eta} p(t) - \frac{\nu}{\eta} v(t). \tag{7.10}$$

Substituting these into Eq. (5.1),

$$\dot{x}(t) = \left(a - b_0 + \frac{k_g \nu}{\eta} v - \frac{k_g \rho \xi_C}{\eta \mu} u_C \right) x(t) - \frac{k_g \rho}{\eta \mu} \left(\beta_p + \frac{\alpha_p \sigma_s}{\lambda_s} \right) x(t)^2. \tag{7.11}$$

Setting

$$\alpha_C = a - b_0 + \frac{k_g \nu}{\eta} v - \frac{k_g \rho \xi_C}{\eta \mu} u_C, \qquad \beta_C = \frac{k_g \rho}{\eta \mu} \left(\beta_p + \frac{\alpha_p \sigma_s}{\lambda_s} \right) \tag{7.12}$$

we obtain

$$\dot{x}(t) = \alpha_C x(t) - \beta_C x(t)^2. \tag{7.13}$$

When $\alpha_C \neq 0$,

$$x(t) = \frac{\alpha_C x_0 e^{\alpha_C t}}{\alpha_C + \beta_C x_0 \left(e^{\alpha_C t} - 1 \right)} \tag{7.14}$$

is obtained.

What this analytical solution shows is that the C-type, too, can be written in logistic form upon reduction. However, its meaning differs from the self-observation type. Here, what lowers α_C is not self-observation but the input u_C through the mediation of prayer $\rightarrow$ God-reference. Also, the larger the representational disturbance v, the larger α_C becomes, and quieting becomes more difficult. Thus, the quieting of the C-type has a strong entry point but is fragile insofar as it depends on the mediating structure.

8 Numerical Examples and Visualization

8.1 Rationale for Parameter Selection

The parameters used in the numerical examples of this section are selected based on the following three principles.

First, the self-amplification gain of mental activity, $a - b_0$, is set to a weakly positive value. This corresponds to a situation in which mental activity can self-amplify gently even without external stimuli, but not explosively—corresponding to everyday rumination or persistent anxiety. We set $a - b_0 = 0.2$ for the C-type and $a - b_0 = 0.1$ for the K-type, both representing mild amplification.

Second, the decay coefficients of the mediating variables (s, p, g or z, m) are set sufficiently larger than the effective amplification rate of x. This is to ensure consistency with the time-scale separation assumption introduced in Section 7. Specifically, decay coefficients are set to at least three times $a - b_0$.

Third, each coupling coefficient is set at the minimum strength that allows the causal pathway assumed by the model to function, avoiding extreme values that would favor a specific conclusion. For example, the observation coupling $k_z = 4.0$ of the K-type is chosen so that when z rises sufficiently, the amplification gain can turn negative, but even halving k_z maintains the qualitative pattern of quieting (though convergence becomes slower).

Table 1: Representative values of the faith-mediated quieting model

t	$x(t)$	$s(t)$	$p(t)$	$g(t)$
0.0	1.0000	0.0000	0.0000	0.0000
1.0	1.1095	0.6578	0.5971	0.2827
2.0	0.7638	0.9338	1.0597	0.8954
3.0	0.2825	0.8013	1.1264	1.4240
5.0	0.0197	0.3137	0.6436	1.4448
8.0	0.0017	0.0563	0.1587	0.5985
12.0	0.0012	0.0065	0.0197	0.1041

These parameters are intended to illustrate the qualitative structure of the phenomenon and are not aimed at fitting specific experimental data. The parameter dependence of the qualitative conclusions is demonstrated through the sensitivity analysis with respect to q in Section 8.5. For other parameters as well, the structure of the reduced solutions (Eqs. (7.5) and (7.13)) shows that the qualitative conclusions hold over a broad parameter region as long as $\bar{\alpha} < 0$ (K-type) or $\alpha_C < 0$ (C-type) is satisfied.

8.2 Numerical Example of the C-Type

We take the following parameters.

$$\begin{aligned} &a = 0.7, \quad b_0 = 0.5, \quad k_g = 1.0, \quad \lambda_s = 0.6, \quad \sigma_s = 0.8, \\ &\mu = 0.8, \quad \alpha_p = 0.8, \quad \beta_p = 0.5, \quad \eta = 0.7, \quad \rho = 1.2, \quad \nu = 1.0. \end{aligned} \tag{8.1}$$

Initial conditions are

$$x(0) = 1, \quad s(0) = 0, \quad p(0) = 0, \quad g(0) = 0. \tag{8.2}$$

As $g(t)$ rises, $x(t)$ turns to decay. Representative values are shown in Table 1, and the time-series solution in Figure 1.

Mental activity $x(t)$ initially increases slightly. However, this increase raises the yearning for salvation $s(t)$, which strengthens prayer/faith acts $p(t)$, which in turn raises the God-reference $g(t)$. When $g(t)$ becomes sufficiently large, $\{a - b_0 - k_g g(t)\}$ turns negative, and $x(t)$ rapidly decays.

8.3 Fragility of the C-Type

Using the same parameters but setting

$$v(t) = \begin{cases} 2.0 & (2.5 \le t \le 3.5), \\ 0 & \text{otherwise} \end{cases} \tag{8.3}$$

we obtain representative values in Table 2 and the time-series solution in Figure 2.

In this example, quieting itself occurs, but $g(t)$ drops sharply during the perturbation interval, and the decay of $x(t)$ is slowed accordingly. That is, the quieting of the faith-mediated type becomes unsteady when disturbance enters the mediating structure.

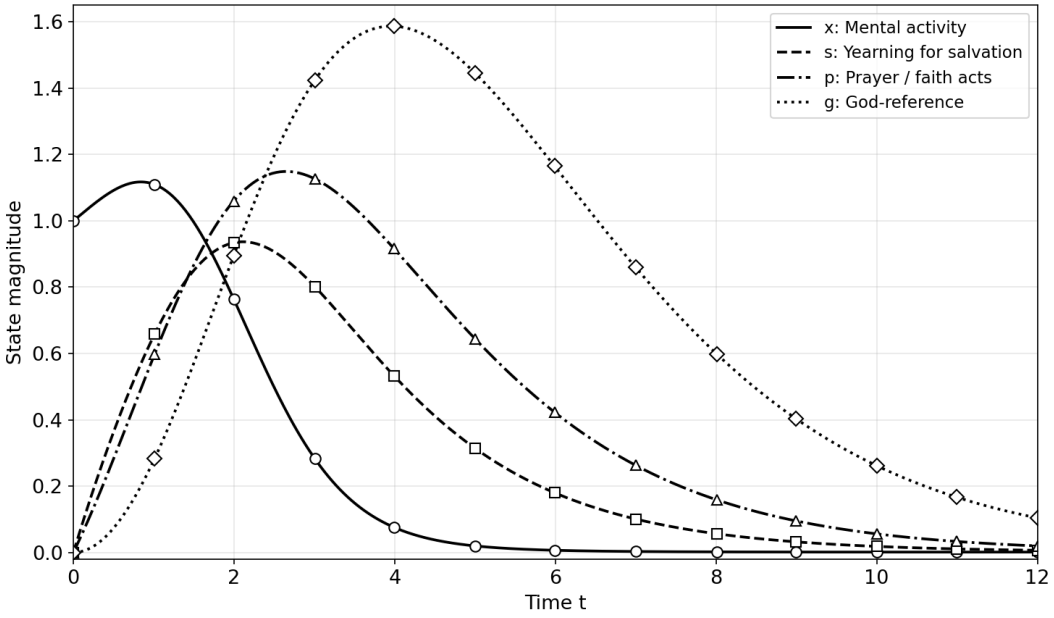

Figure 1: Time-series solution of the faith-mediated quieting model

8.4 Numerical Example of the Self-Observation Type

We take the following parameters.

$$\begin{aligned} &a = 0.4, \quad b_0 = 0.3, \quad k_z = 4.0, \quad \gamma = 1.5, \quad c_x = 2.0, \quad c_b = 0.4, \\ &p = 1.0, \quad q = 0.5, \quad r = 1.0, \quad \alpha_b = 0.8, \quad \delta = 1.0, \quad \theta = 0.3. \end{aligned} \tag{8.4}$$

Initial conditions are

$$x(0) = 1, \quad z(0) = 0, \quad m(0) = 0, \quad b(0) = 0. \tag{8.5}$$

Representative values are shown in Table 3, and the time-series solution in Figure 3.

As mental activity $x(t)$ rises, self-observation $z(t)$ is triggered, and that $z(t)$ lowers the gain of self-amplification, so $x(t)$ decreases. Meanwhile, the "trying to calm"

Table 2: Representative values under representational disturbance

t	$x(t)$	$s(t)$	$p(t)$	$g(t)$
0.0	1.0000	0.0000	0.0000	0.0000
1.0	1.1095	0.6578	0.5971	0.2827
2.0	0.7638	0.9338	1.0597	0.8954
2.5	0.4981	0.9070	1.1441	1.1945
3.0	0.3571	0.8139	1.1345	0.5776
3.5	0.3324	0.7195	1.0811	0.1258
4.0	0.3022	0.6443	1.0144	0.6166
5.0	0.1494	0.4843	0.8356	1.0990
8.0	0.0114	0.1180	0.2795	0.7990
10.0	0.0052	0.0419	0.1108	0.4097

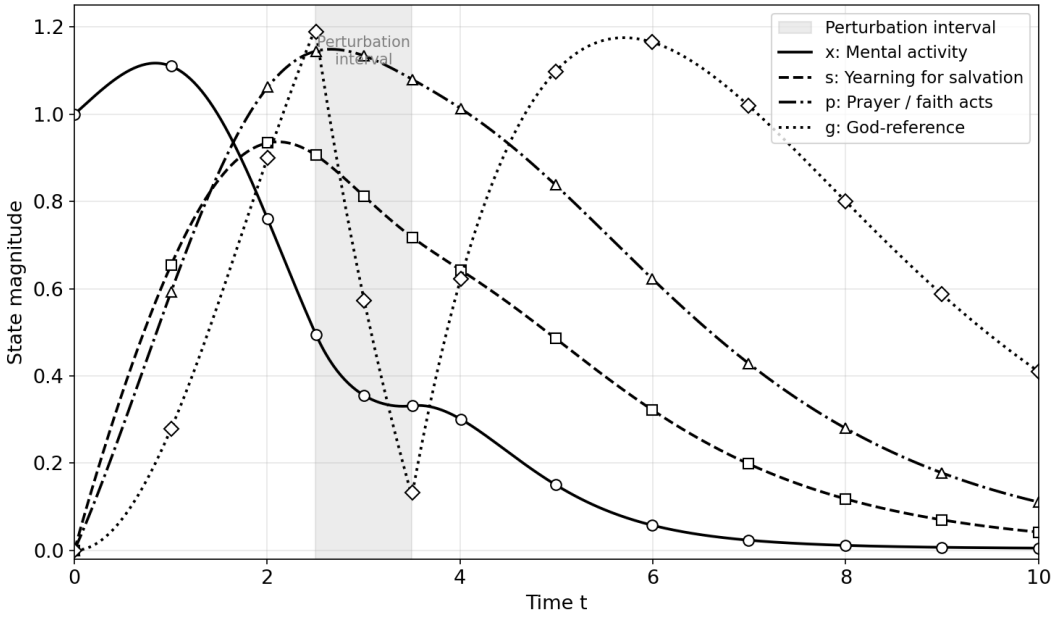

Figure 2: Time-series solution of the faith-mediated model under representational disturbance

Table 3: Representative values of the self-observation quieting model

t	$x(t)$	$z(t)$	$m(t)$	$b(t)$
0.0	1.0000	0.0000	0.0000	0.0000
0.5	0.5527	0.5562	0.1573	0.0177
1.0	0.2426	0.5156	0.1653	0.0863
2.0	0.1271	0.3051	0.1100	0.1816
3.0	0.1094	0.2245	0.0768	0.1775
5.0	0.0962	0.1748	0.0536	0.1408
10.0	0.0902	0.1505	0.0452	0.1118

movement $m(t)$ also arises, but as observation $z(t)$ rises sufficiently, the re-amplification effect is suppressed. Furthermore, as mental activity decreases, blank $b(t)$ appears.

8.5 Numerical Example of "Trying to Calm Prevents Calming"

Using the same self-observation model, we vary only the ease with which control intention arises, q. Here we compare four conditions:

$$q = 0,\ 0.5,\ 1.0,\ 2.0. \tag{8.6}$$

Results are shown in Table 4 and Figure 4.

What Table 4 shows is straightforward. The larger q—that is, the more easily the "trying to calm" movement arises—the harder it becomes for mental activity $x(t)$ to decrease. This means that "trying to calm prevents calming" is derived both mathematically and numerically from within the model.

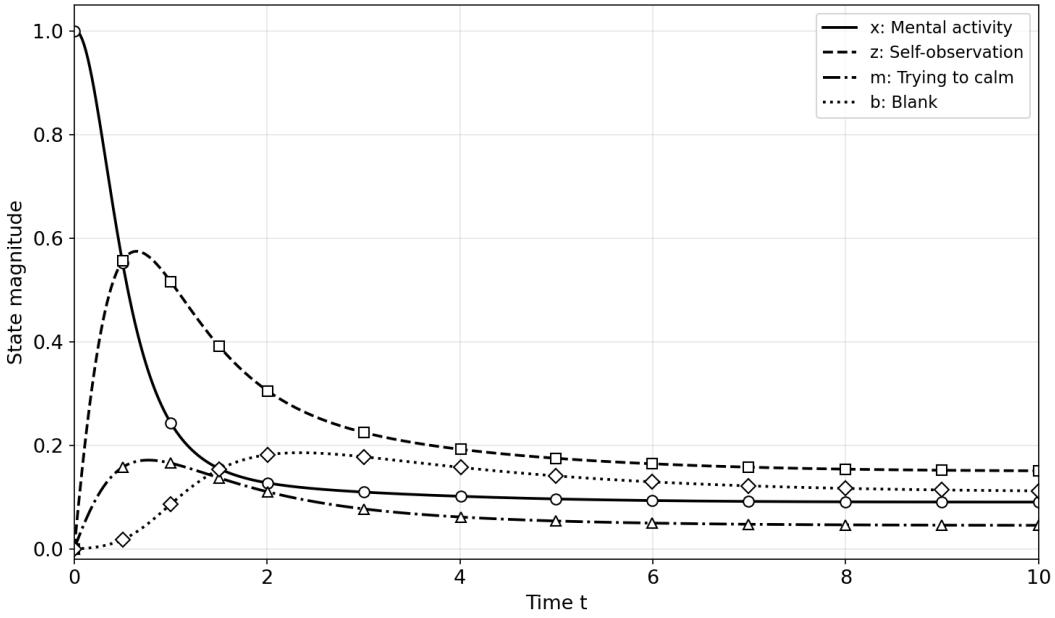

Figure 3: Time-series solution of the self-observation quieting model

Table 4: Change in $x(t)$ with increasing q

q	$x(0.5)$	$x(1.0)$	$x(2.0)$	$x(5.0)$	$x(10.0)$
0.0	0.5210	0.1881	0.0534	0.0194	0.0156
0.5	0.5527	0.2426	0.1271	0.0962	0.0902
1.0	0.5848	0.2985	0.2038	0.1800	0.1734
2.0	0.6502	0.4143	0.3625	0.3620	0.3594

9 Comparison of Controllability and Observability

9.1 Purpose of This Section

In the preceding sections, we presented the two quieting models—faith-mediated and self-observation—and showed their basic dynamics through reduced-order analysis and numerical examples. In this section, we take one further step and reframe these two models as objects that are comparable from the perspective of control theory. The focus is twofold. First, which states can be moved and to what extent by external input. Second, which states can be estimated from outside and to what extent.

The controllability and observability referred to here use the standard meanings from engineering systems, but in the context of this paper, they do not strongly claim free transfer to an arbitrary final state or complete internal-state reconstruction. Rather, they are used as theoretical perspectives for comparing realistic entry points toward quieting and for distinguishing what is visible from what remains as a latent state.

9.2 Controllability of the Faith-Mediated Type

In the C-type, controlling God itself is of course not assumed. The external input $u_C(t)$ is understood as assistance for initiating prayer/faith acts $p(t)$, such as invitations to

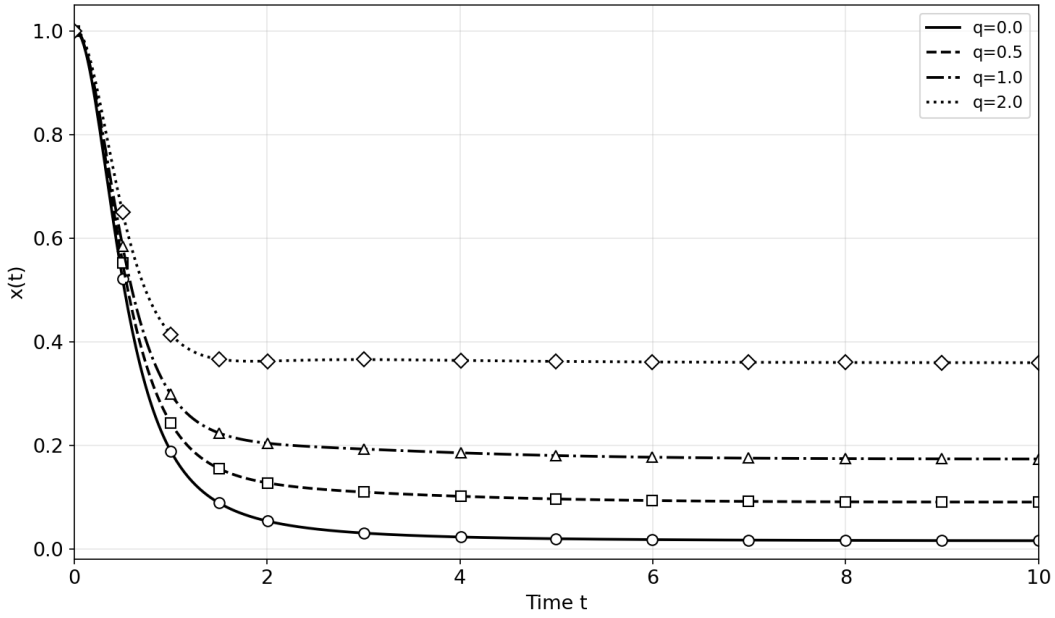

Figure 4: Trajectories of $x(t)$ for different values of q in the self-observation model

worship, community participation, and presentation of words.

Linearizing around an active operating point $(\bar{x}, \bar{s}, \bar{p}, \bar{g})$ with $\bar{x} > 0$, the state matrix is

$$A_C = \begin{bmatrix} a - b_0 - k_g \bar{g} & 0 & 0 & -k_g \bar{x} \\ \sigma_s & -\lambda_s & 0 & 0 \\ \beta_p & \alpha_p & -\mu & 0 \\ 0 & 0 & \rho & -\eta \end{bmatrix} \tag{9.1}$$

and the input matrix is

$$B_C = \begin{bmatrix} 0 \\ 0 \\ \xi_C \\ 0 \end{bmatrix}. \tag{9.2}$$

The determinant of the controllability matrix

$$\mathcal{C}_C = \left[B_C,\ A_C B_C,\ A_C^2 B_C,\ A_C^3 B_C \right] \tag{9.3}$$

is

$$\det \mathcal{C}_C = k_g^2 \rho^3 \sigma_s \, \bar{x}^2 \, \xi_C^4. \tag{9.4}$$

Therefore, provided

$$k_g \neq 0, \quad \rho \neq 0, \quad \sigma_s \neq 0, \quad \xi_C \neq 0, \quad \bar{x} > 0, \tag{9.5}$$

the C-type is locally controllable in the active region.

This result means that although the C-type may appear difficult to control at first glance, in the active region, the input u_C can indeed influence x through the $p \to g$ pathway. However, this controllability depends on the mediating structure: it requires that prayer "passes through" to God-reference sufficiently. Herein lies the fragility of the C-type.

9.3 Observability of the Faith-Mediated Type

We take the most basic output of the C-type to be

$$y(t) = x(t), \tag{9.6}$$

which may correspond to self-reported suffering, reports of feeling overwhelmed, or behavioral disturbance.

At the same operating point, the output matrix is

$$C_C = \begin{bmatrix} 1 & 0 & 0 & 0 \end{bmatrix} \tag{9.7}$$

and the determinant of the observability matrix

$$\mathcal{O}_C = \begin{bmatrix} C_C \\ C_C A_C \\ C_C A_C^2 \\ C_C A_C^3 \end{bmatrix} \tag{9.8}$$

is

$$\det \mathcal{O}_C = \alpha_p \, k_g^3 \rho^2 \, \bar{x}^3. \tag{9.9}$$

Therefore, provided

$$\alpha_p \neq 0, \quad k_g \neq 0, \quad \rho \neq 0, \quad \bar{x} > 0, \tag{9.10}$$

the C-type is locally observable in the active region.

The significance of this result is important. The most important quantity in the C-type is the God-reference $g(t)$, but g is not directly visible. Nevertheless, in the active region, even the time series of suffering $x(t)$ alone can locally distinguish the influences of s, p, g. In other words, the invisible God-reference g leaves traces in the trajectory of the visible suffering x.

However, near $\bar{x} = 0$, observability is lost. Thus, the C-type also possesses a state-dependent observability: it is easier to observe when there is suffering or urgency, and harder to observe when at peace.

9.4 Controllability of the Self-Observation Type

In the pure K-type, there is no external input $u(t)$. Therefore, controllability in the standard sense hardly holds. This is not a weakness but rather the very essence of the K-type. The K-type is not a model for being taken somewhere from outside; it is a model of event-triggered self-stabilization in which disturbance itself becomes the entry point for observation.

However, this does not mean "completely uncontrollable." The K-type can calm from within, not from outside. The reduced system (7.5) shows precisely this. Therefore, what should truly be asked of the K-type is not controllability but *endogenous stabilizability*—the capacity for intrinsic self-stabilization.

9.5 Observability of the Self-Observation Type

First, consider the reduced 3-state system with blank dropped.

$$\dot{x}(t) = \{a - b_0 - k_z z(t)\}x(t) + r\, m(t), \tag{9.11}$$
$$\dot{z}(t) = -\gamma z(t) + c_x x(t), \tag{9.12}$$
$$\dot{m}(t) = -p\, m(t) + q\, x(t). \tag{9.13}$$

Taking the output as

$$y(t) = x(t), \tag{9.14}$$

the determinant of the observability matrix linearized around an active operating point $(\bar{x}, \bar{z}, \bar{m})$ with $\bar{x} > 0$ is

$$\det \mathcal{O} = -k_z\, \bar{x}\, r\, (\gamma - p). \tag{9.15}$$

Therefore, provided

$$k_z \neq 0, \quad \bar{x} > 0, \quad r \neq 0, \quad \gamma \neq p, \tag{9.16}$$

the reduced system is locally observable.

This means that in the K-type, even by observing only the time evolution of mental activity $x(t)$, it is locally possible to distinguish and estimate "seeing" z and "trying to calm" m. That is, even in the K-type, what is happening is not entirely silent; it appears substantially in the time series of disturbance.

However, near the quiet region, observability degrades. Moreover, in the full model including blank, b appears in x through higher-order derivatives, so $c_b \neq 0$—meaning that blank truly "returns to seeing"—becomes essential for observability.

9.6 Summary

From the comparison above, the characters of the two models from the perspective of controllability and observability can be organized as follows.

- The C-type can be locally controllable and locally observable in the active region, but whether this holds depends on the mediating structure.
- The K-type is uncontrollable in the standard sense but is locally observable in the active region and can be understood as an event-triggered self-stabilization model.

Through this comparison, the "trade-off between entry strength and robustness" shown in this paper can also be restated in the language of controllability and observability. Namely, the thicker the mediation, the more tractable but the more fragile; the thinner the mediation, the higher the purity but the narrower the entry point.

10 Discussion

What becomes clearest from the comparison in this paper is that there are at least two different dynamics of mental quieting. The faith-mediated type has a strong entry point in the sense that yearning for salvation can directly serve as the starting point. The more a person is suffering, the easier it is to enter. However, its quieting depends on how effectively prayer is converted into God-reference, so if the mediating structure

wavers, the quieting also tends to waver. On the other hand, the self-observation type is structurally robust in the sense that the problem itself becomes the entry point for observation. However, its entry point is narrow, and in its pure form, it is difficult for many people to enter.

This configuration can organize the conventional discussion of mental quieting in a considerably new way. Namely, faith and self-observation are not merely different expressions; they also differ as control structures. The former is an externally-referenced mediated type, and the latter is an internal self-monitoring type. Even if they may overlap as experiences, the dynamics leading to them are not identical. This is the reason why this paper takes the form of a comparative model.

Furthermore, as this paper shows, the paradox of "trying to calm prevents calming" is not a mere insight or philosophical paradox in the self-observation model but a phenomenon derived mathematically and numerically. This is significant because the discussion of mental quieting often falls into one of two extremes: mystification or reduction to simplistic technique. The model in this paper differs from both. Self-observation is not an inexplicable mystery, but neither does it become a "procedure for calming." The theoretical significance of this paper lies in being able to express this intermediate position as a difference in dynamic structure.

Finally, the comparison in this paper also suggests the necessity of considering an externally-assisted transition model as a future task. That is, if the self-observation type is more robust, the question shifts not to abandoning that ideal but to how to assist the entry into it. Here, theories of external assistance models and transition processes become necessary. However, the role of this paper is not to fully develop such a discussion but to lay the theoretical background that makes it necessary.

We also note a perspective on the measurability of the variables in this model, looking toward future empirical connection. Mental activity $x(t)$ can be approximated through the intensity of self-reported rumination and anxiety via experience sampling methods, or through the activity intensity of the default mode network (fMRI). Self-observation $z(t)$ may correspond to decentering scales (e.g., the decentering subscale of the Experiences Questionnaire) or meta-awareness reports in experience sampling. The "trying to calm" movement $m(t)$ may be indirectly measured through self-reports of effortful control during meditation or frontal cortex activation patterns. The God-reference $g(t)$ of the faith-mediated type is the most difficult to measure directly, but self-reported intensity of "surrender" during prayer or portions of religious coping scales come close. However, all of these correspondences are tentative, and this paper's model does not assert direct measurement hypotheses. The role of this paper is to provide a theoretical skeleton for what should be measured and compared when such empirical testing is carried out in the future.

11 Conclusion

This paper described and compared, as state-space models, two pathways toward mental quieting: the faith-mediated type and the self-observation type. As a result, we showed that while both can bring about quieting, their dynamics are not identical, and they possess the following structural difference:

- The faith-mediated type has a strong entry point but is fragile.

- The self-observation type has a narrow entry point but is robust.

Furthermore, in the self-observation model, we showed that "observing leads to calming" and "trying to calm prevents calming" are simultaneously derived from within the same model. The logistic-type equation obtained through reduced-order analysis clearly showed that self-observation lowers the self-amplification gain of mental activity, while the "trying to calm" movement raises the residual level. This shifts the discussion of quieting from the description of mystical experience to the description of comparable structures.

Moreover, this paper clarified the differences between the two models from the perspective of controllability and observability. The faith-mediated type can be locally controllable and locally observable in the active region, but this depends on the mediating structure. The self-observation type is hardly controllable from outside but is locally observable in the active region, and disturbance itself becomes the entry point for self-stabilization. In this sense, this paper has shown that mental quieting can be described not as mystery or simplistic technique but as two dynamics with different mediation and control structures.

The tasks of this paper do not end here. Rather, from here naturally arises the new question of how to assist the entry when direct access to pure self-observation is difficult. That question should be addressed in a separate paper, building on the theoretical comparison of this paper.

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