

# Mediated Interaction in a Shared Dynamical Environment: A Mechanistic Extension of the Principle of Dynamical Sensitivity

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Author: Martin Kafara  
ORCID: 0009-0001-0941-650X

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## Abstract

The first paper, *The Principle of Dynamical Sensitivity of Structures within a Shared Physical Environment*, introduced the Principle of Dynamical Sensitivity as a conceptual proposal according to which structures emerging within a shared dynamical physical environment inherit sensitivity to its dynamical properties. The second paper, *Operationalizing the Principle of Dynamical Sensitivity: Response, Coupling, and Cross-Scale Interaction*, operationalized this principle through a response-based framework distinguishing environmental excitation, system sensitivity, realized response, and threshold-dependent effective interaction. The present work extends this program by addressing a further open question: how dynamically effective interaction may become mediated through emergent intermediate regimes within the same shared environment. [8,9]

The proposed framework interprets mediated interaction, chained resonance, and sequential coupling as possible higher-order consequences of realized response. In this perspective, response need not remain a purely local or isolated event, but may under suitable conditions become stabilized, propagated, or reorganized through intermediate dynamical structures. These structures are treated not as new entities or forces, but as emergent regimes of organized response embedded in the same shared dynamical background. [1-3,6-9]

A minimal schematic form of mediated response is introduced to distinguish latent channels from dynamically effective ones and to clarify how weak, transient, or sub-threshold mediation may persist without becoming observable interaction. The present paper does not propose a new physical force and does not yet formulate a theory of information transfer. Its contribution lies in providing a mechanistic extension of the existing framework and in clarifying how shared dynamical environments may support

the emergence, persistence, and failure of mediated interaction across different dynamical regimes and scales. [1-3,6-9]

## **1. Introduction**

The first paper, *The Principle of Dynamical Sensitivity of Structures within a Shared Physical Environment*, introduced the Principle of Dynamical Sensitivity as a conceptual proposal according to which structures emerging within a shared dynamical physical environment inherit sensitivity to its dynamical properties. The second paper, *Operationalizing the Principle of Dynamical Sensitivity: Response, Coupling, and Cross-Scale Interaction*, operationalized this principle through a response-based framework distinguishing environmental excitation, system sensitivity, realized response, and threshold-dependent effective interaction. [8,9]

While this response-based formulation clarified how latent sensitivity may become dynamically effective under suitable conditions, it did not yet specify how interaction may be sustained, mediated, or sequentially organized beyond direct response alone. The present paper addresses this open question by examining whether shared dynamical environments may support emergent intermediate regimes through which interaction becomes structured, propagated, or reinforced. [9]

Under this perspective, realized response is not treated only as a transient local effect. It may also contribute, under some conditions, to the emergence of intermediate dynamical structures that remain embedded in the same shared environment and may themselves inherit sensitivity to its dynamical properties. This possibility motivates the present mechanistic extension of the Principle of Dynamical Sensitivity. [6-9]

The aim of this work is not to introduce a new physical force, nor yet to formulate a theory of information transfer or communication. Its purpose is narrower and more explicit: to explore how mediated interaction, chained resonance, and emergent intermediate regimes may be understood as further dynamical consequences of the same shared environment already invoked in the two preceding papers. [8,9]

## **2. From Realized Response to Mediated Interaction**

While Paper II treated realized response primarily as the direct outcome of system sensitivity to structured environmental excitation, such response need not always remain an isolated local event. Within a shared dynamical background, certain response patterns may persist, overlap, or stabilize in ways that allow interaction to become mediated rather than merely direct. [4-9]

In this sense, the shared dynamical environment is not treated as a new force, but as the common condition within which realized responses may acquire further dynamical

organization. This possibility motivates the transition from direct response to mediated interaction. [4-7,9]

### **3. Chained Resonance and Sequential Coupling**

Resonance need not be restricted to an isolated compatibility between two directly interacting systems. Within a shared dynamical environment, realized responses may under some conditions become sequentially linked, so that the response of one structure contributes to the excitation, stabilization, or modulation of another. [1-3,7,9]

In this sense, interaction is not treated as a purely direct event, but may also be understood as a sequentially organized process distributed across multiple dynamical stages. This motivates the concept of chained resonance, in which compatible response regimes do not merely coexist, but participate in a structured propagation of dynamical influence, potentially including its selective reinforcement across compatible frequency ranges. [1-3,7]

Sequential coupling may therefore be interpreted as a regime in which dynamically compatible responses become linked through intermediate stages rather than through immediate mutual contact alone. Such linkage does not imply universal transmission or automatic amplification. It remains selective, threshold-dependent, and conditioned by the persistence of compatibility across the chain. [1-3,7,9]

Under this perspective, chained resonance is not introduced as a new category of interaction, but as a possible dynamical consequence of the same shared environment already assumed in Papers I and II. What changes is not the basic principle, but the level of organization through which realized response may become effective beyond its original local occurrence. [8,9]

### **4. Emergent Intermediate Dynamical Structures**

Once emergent intermediate regimes acquire sufficient stability, they need not be treated merely as passive transitional effects. They may themselves become dynamically sensitive structures embedded in the same environment, thereby extending the original logic of inherited sensitivity to newly formed mediating regimes. Under suitable conditions, such regimes may also participate in feedback processes that generate additional pathways of coupling, allowing new mediated connections to emerge within the same shared dynamical environment. [6-9]

Under some conditions, intermediate dynamical regimes may fail to remain stable. Excessive excitation, environmental fluctuation, or loss of compatibility may lead to their destabilization, thereby reopening the dynamical background to further reorganization and the emergence of new response structures. [1,6,7]

## 5. Thresholds, Weak Channels, and Latent Mediation

If mediated interaction is to become dynamically effective, the existence of an intermediate regime alone is not sufficient. The relevant responses must remain compatible across the chain, and the mediated pathway must persist long enough for dynamical influence to propagate beyond its original local occurrence. [1-3,7,9]

In minimal schematic form, such mediation may be represented as

$$R_1(\omega) \rightarrow M(\omega) \rightarrow R_2(\omega)$$

where  $R_1(\omega)$  denotes an initial realized response,  $M(\omega)$  an intermediate mediating regime, and  $R_2(\omega)$  the response that becomes dynamically accessible through this intermediate stage. This scheme is not introduced as a complete model, but as a minimal formal sketch of how realized response may become chained rather than purely direct. [9]

Not all such mediated pathways become effective. Some remain weak, transient, or sub-threshold, so that the chain does not stabilize into observable coupling or sustained resonance. In such cases, mediation may remain latent: dynamically present in principle, yet insufficiently organized to produce a clearly detectable interaction. [1-3,7,9]

Conversely, if compatibility persists and the intermediate regime remains sufficiently stable, mediated influence may be reinforced and propagated further. The threshold thus separates not the existence from the non-existence of mediation, but latent channels from dynamically effective ones. [1-3,7,9]

Under some conditions, intermediate pathways may also fail to remain stable. Environmental fluctuation, excessive excitation, or loss of compatibility may destabilize the chain, reopening the dynamical background to reorganization rather than sustained transmission. This possibility indicates that mediated interaction should be understood not as a guaranteed outcome, but as a dynamically selective regime. [1,6,7,9]

## 6. Cross-Scale Implications

If mediated pathways and chained response regimes can emerge within a shared dynamical environment, then cross-scale interaction becomes more intelligible as a structured rather than purely direct possibility. The present framework does not imply that weak excitation at one scale must generate strong observable effects at another. It suggests instead that cross-scale influence may remain latent, weak, or dynamically

negligible unless sufficient compatibility, reinforcement, or mediation is established. [4-9]

In this sense, the absence of observable large-scale response does not imply the absence of dynamical sensitivity. A system may remain sensitive in principle to weak or distant structured influence even when no measurable macroscopic effect follows directly. Under more favorable conditions, however, mediated compatibility across scales may allow such influence to become selectively effective. [4-9]

This perspective is especially relevant for cases in which harmonically compatible regimes or intermediate pathways may selectively bridge otherwise distant dynamical scales. Cross-scale interaction is therefore not treated here as a universal transmission principle, but as a constrained and threshold-dependent possibility within the same shared dynamical background. [4-7,9]

## **7. Limitations**

The present extension should not be interpreted as introducing a new physical force, a universal transmission mechanism, or a general theory of communication across scales. It remains a conceptual and mechanistic refinement of the framework developed in Papers I and II, aimed at clarifying how mediated interaction may emerge within a shared dynamical environment. [8,9]

Several limitations follow directly from this scope. First, the present framework does not provide a full predictive model of how mediated channels arise, stabilize, or decay in specific physical systems. It identifies possible regimes and relations, but does not yet derive their complete dynamics from first principles.

Second, the existence of a mediated pathway does not imply that interaction will become observable or dynamically effective. Intermediate regimes may remain weak, transient, or sub-threshold, and may fail to persist under environmental fluctuation, excessive excitation, or loss of compatibility. In such cases, the chain may destabilize before any sustained higher-order interaction emerges. [1,6,7,9]

Third, the present work does not claim that all scales are equally connectable through mediated interaction. Cross-scale influence is treated here as selective, constrained, and threshold-dependent. The possibility of mediation depends on the persistence of compatible regimes, not on a universal openness of all systems to all others. [4-9]

Finally, while mediated interaction may under some conditions support more structured forms of dynamical transmission, the present paper does not yet address information transfer in the stronger analytical sense. That question requires a further step beyond mediated response itself and belongs to a later stage of the broader research program.

These limitations do not weaken the Principle of Dynamical Sensitivity. Rather, they specify the level at which the present paper operates: not as a complete theory of transmission, but as an attempt to clarify how shared dynamical environments may support the emergence, persistence, and failure of mediated interaction. [8,9]

## **8. Discussion**

The present paper extends the program initiated in the two preceding papers by introducing a mechanistic layer between realized response and dynamically effective interaction. While the first work formulated the Principle of Dynamical Sensitivity and the second operationalized it through a response-based framework, the present study explores how mediated pathways, chained resonance, and emergent intermediate regimes may further organize the propagation of dynamical influence within a shared environment. [8,9]

In this sense, Paper III does not replace the response-based formulation introduced earlier. Rather, it deepens it by suggesting that realized response need not remain a purely local or isolated event. Under suitable conditions, response may become stabilized, chained, and mediated through intermediate regimes that remain dynamically embedded in the same shared background. [8,9]

A central contribution of the present paper is therefore the clarification that mediated interaction may itself possess different degrees of weakness, persistence, and organization while leaving inherited sensitivity intact. Not every chain becomes effective, not every intermediate regime remains stable, and not every cross-scale relation becomes observable. This preserves the fundamental distinction, already established in Paper II, between general dynamical sensitivity and selectively effective interaction. [9]

This clarification is important because it allows the broader hypothesis to remain both ambitious and disciplined. The shared dynamical environment is treated neither as a passive background nor as a newly postulated force, but as the common physical condition within which sensitivity, response, mediation, and possible higher-order organization may emerge. [4-9]

At the same time, the present work deliberately stops short of a full theory of information transfer. It suggests that mediated interaction may create conditions under which more structured dynamical transmission becomes thinkable, but the analytical treatment of information itself requires a further step. In this way, the current paper closes one conceptual gap while leaving the next stage of the research program clearly defined. [8,9]

## 9. Conclusion

The present paper suggests that shared dynamical environments may support not only direct response, but also mediated and sequentially organized interaction. By introducing emergent intermediate regimes into the existing framework, it extends the Principle of Dynamical Sensitivity toward a more explicit account of how dynamical influence may persist, propagate, or fail within a common physical background. [8,9]

In this perspective, mediated pathways are not treated as new forces or as universal channels of transmission, but as dynamically selective regimes whose emergence depends on compatibility, stability, and threshold-dependent organization. This preserves the central distinction of the earlier papers: inherited sensitivity may remain present even where mediated interaction does not become observable or effective. [8,9]

The contribution of the present work is therefore not to complete a theory of information transfer, but to close an intermediate conceptual gap between response and transmission. In this sense, Paper III does not depart from Papers I and II, but deepens their original line and prepares the ground for a more rigorous treatment of structured transmission in future work. [8,9]

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