Prototyping Positive Cascades

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Abstract

The preceding work in this series has established cascades as processes in which propagation and closure are co-produced, and has positioned design as a practice for detecting and modulating these dynamics. The present article extends that framework by examining cascades as a generative resource. It introduces a complementary orientation in which design contributes to the formation and continuation of trajectories that expand optionality, strengthen coordination, and sustain recoverability over time.

The paper develops the concept of positive cascades as patterns of propagation in which alignment supports the viability of future action rather than constraining it. Rather than defining positivity through external evaluation, the framework situates it in the relation between propagation and the preservation of alternative pathways. Cascades are analyzed in terms of uptake, reinforcement, extension, and sustained openness, with attention to how these processes unfold across technical, social, and institutional systems.

Prototyping is re-specified as a set of interventional practices for initiating and cultivating such trajectories. Prototypes are treated not only as instruments for detection or modulation, but as seeds that establish conditions for beneficial propagation. Subsequent strategies support the reinforcement and extension of emerging patterns while maintaining permeability to variation. The coordination of these strategies across cascade phases introduces a compositional approach to design, in which interventions are arranged to guide how trajectories develop over time.

The article further identifies the role of representation in making propagation visible and in supporting distributed participation in the cultivation of cascades. By maintaining multiple trajectories in view, representational tools enable evaluation of interventions in relation to their downstream effects and their contribution to system adaptability.

Together with the preceding papers on cascade detection and modulation, this work completes a three-part framework for design in the age of cascades. By treating cascades as both constraint and resource, it provides a basis for engaging complex systems in motion, supporting design practices oriented toward the stewardship of trajectories rather than the production of isolated solutions.

Keywords: cascade dynamics, positive cascades, systemic design, prototyping, complex systems, trajectory stewardship, recoverability, distributed agency

WHAT COUNTS AS A POSITIVE CASCADE

A small change in a system sometimes travels farther than expected. A revised interface reduces friction in one step of a workflow, and users begin to complete adjacent steps more reliably. A brief follow-up call after hospital discharge increases patient confidence, and that confidence supports adherence, which in turn stabilizes recovery trajectories. A temporary reallocation of curb space creates a pocket of safety, and pedestrian movement reorganizes around it, altering how the street is used beyond the initial intervention.

These situations share a common structure. An initial displacement propagates through the system, interacting with existing conditions and producing effects that extend beyond its point of origin. The propagation is not random. It follows pathways shaped by dependencies, incentives, and patterns of attention already present within the system, consistent with network-based accounts of cascade behavior (Watts, 2002; Barabási, 2016). What distinguishes these cases is that the resulting trajectories expand the system's capacity to act. They support coordination, reinforce beneficial behaviors, or preserve flexibility under changing conditions.

Within the present framework, such situations can be described as positive cascades.

The designation does not rely on a fixed evaluation external to the system. It emerges from the relation between propagation and optionality. A cascade contributes positively when the trajectories it reinforces increase the

range or viability of subsequent actions. This may take the form of improved recoverability, where the system can adjust more readily to disturbance. It may appear as sustained coordination, where actors align in ways that support collective activity without foreclosing variation. It may also involve the stabilization of practices that reduce fragility, allowing the system to absorb shocks without disproportionate disruption. Diffusion research suggests that such stabilization depends on alignment with existing practices while preserving the capacity for adaptation (Rogers, 2003).

This orientation situates positive cascades within the same analytic structure developed in the preceding papers. Cascades remain processes in which propagation and closure are co-produced. Alignment still occurs, and certain trajectories become more likely than others. The difference lies in how that alignment interacts with the system's capacity to sustain alternatives. In positive cascades, alignment consolidates conditions that keep multiple pathways available or that make desirable pathways more robust without eliminating variation elsewhere. This view aligns with accounts of distributed agency in which outcomes emerge through the interaction of heterogeneous elements rather than centralized control (Bennett, 2010).

The distinction becomes clearer when considered alongside cases in which cascades reduce optionality. A navigation system that directs all users toward the same optimal route produces efficient travel under stable conditions, yet it narrows the system's capacity to adapt when disruptions occur. A communication platform that standardizes response options simplifies interaction while limiting expressive range. In each case, propagation is effective, yet the contraction of alternatives introduces vulnerability, reflecting how alignment can override distributed information in informational cascades (Bikhchandani, Hirshleifer, & Welch, 1992). Positive cascades operate differently. They reinforce patterns that remain permeable to variation. A design that improves legibility within a system may enable users to navigate more effectively without prescribing a single path. A coordination mechanism that aligns activity across actors may do so while preserving local autonomy. The resulting trajectories exhibit coherence without rigidity, supporting ongoing adaptation rather than foreclosing it. Such trajectories resemble generative processes in which repeated interaction produces stability without eliminating variation (DeLanda, 2006; Simondon, 1958).

The difficulty lies in recognizing such cascades while they are forming. Early stages often resemble any other propagation process. Effects are dispersed, and their downstream implications are not yet visible. The difference becomes apparent over time, as certain pathways demonstrate a capacity to sustain or expand optionality while others lead toward contraction. This temporal dimension complicates evaluation, as interventions must be assessed not only in terms of immediate outcomes but in relation to the trajectories they initiate.

For design practice, this introduces a shift in attention. The task is not to label cascades as positive or negative in advance, but to engage with the conditions under which propagation supports or diminishes the system's capacity to act. This involves observing how initial displacements interact with existing structures, identifying pathways that extend beneficial patterns, and reinforcing those pathways without accelerating closure. In this respect, prototyping participates directly in the formation of trajectories rather than merely representing them (Roberts-Smith, Ruecker, & Radzikowska, 2021).

The sections that follow develop this approach by examining how prototypes can be constructed to initiate and support such cascades. The emphasis moves from containment to cultivation, specifying how design can contribute to the formation of trajectories that carry forward conditions worth sustaining.

LITERATURE REVIEW

Research on cascades across sociology, network science, and complex systems has established propagation as a fundamental property of interconnected systems. Local interactions can produce effects that extend beyond their point of origin, often through processes of alignment that reinforce particular trajectories (Bikhchandani et al., 1992; Granovetter, 1978; Watts, 2002). Work in network science further demonstrates how these processes unfold across structured connections, where the position of an intervention within a network influences its capacity to spread (Barabási, 2016). These accounts provide a stable foundation for understanding how change travels. They describe the conditions under which propagation occurs, how it accelerates, and how it may produce large-scale transformation.

A complementary line of research examines not only how effects propagate, but how they are taken up. Diffusion studies have shown that the spread of practices depends on the interaction between an innovation and the social system into which it is introduced (Rogers, 2003). Adoption is shaped by perceived advantage, compatibility with existing practices, and the ability of actors to experiment and adapt. More recent work emphasizes that propagation is often

contingent on network structure and reinforcement dynamics. Centola (2010) demonstrates that behaviors requiring coordination spread differently from those that can be adopted independently, while Pentland (2014) shows how patterns of social interaction influence the movement of ideas and practices. These perspectives shift attention from transmission to uptake, highlighting that propagation depends on conditions that support repetition, adaptation, and extension.

Work on innovation and distributed production extends this account by showing how new practices emerge and stabilize across networks of participants. Von Hippel (2005) describes how users contribute to the development and spread of innovations, while Benkler (2006) analyzes how decentralized collaboration produces shared resources that can be extended by others. In design for social innovation, Manzini (2015) identifies how small-scale initiatives can generate wider change when they align with local capabilities and values. These approaches converge on a view of systems as generative fields in which value is produced through the interaction of multiple actors, each contributing to the continuation and transformation of emerging trajectories.

Philosophical accounts of assemblage and individuation provide further grounding for this generative perspective. DeLanda (2006) and Deleuze and Guattari (1987) describe systems as composed of heterogeneous elements whose relations give rise to emergent properties. Simondon (1958) situates the development of technical objects within processes of ongoing individuation, where structures evolve through interaction with their environment. These perspectives support an understanding of propagation as a process in which trajectories are not simply transmitted but are continuously reconfigured as they move. Stability arises through repetition, yet variation remains intrinsic to the system's development.

Within design research, prototyping has increasingly been understood as a means of engaging with such processes. Early accounts framed prototypes as representations of proposed artifacts to be evaluated for performance (Houde & Hill, 1997). Subsequent work expanded this role, treating prototypes as instruments for inquiry, communication, and exploration (Sanders & Stappers, 2014). In participatory and infrastructuring contexts, prototypes contribute to the development of ongoing systems, supporting practices that evolve over time rather than resolving into fixed solutions (Hillgren, Seravalli, & Emilson, 2011; Karasti, 2014). Research-through-design approaches further position prototypes as interventions whose effects unfold within the systems they engage (Zimmerman, Stolterman, & Forlizzi, 2010).

Roberts-Smith, Ruecker, & Radzikowska (2021) consolidates this shift by demonstrating how prototyping operates across domains as a generative practice. Contributions within the collection show prototypes functioning as catalysts that bring possible futures into relation with present conditions, enabling actors to engage with emerging trajectories. Prototyping, in this sense, participates directly in the formation of pathways that may extend beyond the initial intervention.

Science and technology studies provide a parallel account of how such pathways develop. Latour (2008) describes action as a chain of mediations in which each step transforms what is carried forward, while Suchman (2007) situates these transformations within situated practices that evolve through interaction. Bennett (2010) extends this perspective by emphasizing the distributed nature of agency across human and non-human assemblages. Together, these accounts support a view of systems in which propagation occurs through ongoing transformation, with outcomes emerging from the interaction of multiple elements rather than from centralized control.

Across these strands, a consistent theme emerges. Propagation depends on conditions that support uptake, repetition, and adaptation. Trajectories persist when they align with existing structures while remaining capable of variation. Systems exhibit generative capacity when they sustain multiple pathways through which such trajectories can develop.

The present work builds on this foundation by specifying how these conditions can be engaged through design. It introduces the concept of positive cascades to describe propagation that expands the range of viable future actions. Rather than treating cascades solely as processes to be contained, the framework examines how design can contribute to their formation and continuation. By treating prototypes as instruments for seeding, reinforcing, and extending trajectories, the approach situates design within the generative dynamics of complex systems, extending prior work on prototyping and systemic intervention into a domain oriented toward cultivation.

PROTOTYPING FOR INITIATION

If positive cascades depend on the establishment of conditions that support beneficial propagation, then prototyping acquires an additional role. Beyond detection and modulation, prototypes can be constructed to initiate trajectories that have the potential to extend through the system in ways that expand optionality, strengthen coordination, or increase recoverability.

This role requires a different orientation toward displacement. In earlier formulations, prototypes were introduced to reveal system behavior or to alter emerging cascade dynamics. Here, prototypes are designed to seed propagation. The initial displacement is configured not only to produce a local effect, but to interact with existing structures in a way that makes further alignment more likely along particular pathways.

The design of such displacements depends on identifying configurations within the system where small changes can be taken up, repeated, or extended by other actors and processes. These configurations are often characterized by partial alignment, where patterns are present but not yet stabilized. A prototype introduced at such a location does not impose a trajectory. It amplifies a tendency that the system is already capable of sustaining, consistent with accounts of generative processes in complex systems where local interactions produce emergent order (DeLanda, 2006).

One way to understand this is through the notion of uptake. A displacement produces a positive cascade when it is taken up by the system in forms that extend beyond the original intervention. Uptake may occur through imitation, where actors adopt a new practice because it proves workable. It may occur through reinforcement, where the displacement aligns with incentives or constraints that increase its persistence. It may also occur through transformation, where the initial intervention is adapted as it moves, producing variations that remain compatible with the underlying trajectory. Diffusion research has shown how such processes depend on compatibility, observability, and trialability within the adopting system (Rogers, 2003).

Prototyping for initiation therefore involves designing for uptake. The prototype must be legible enough to be recognized, accessible enough to be adopted, and flexible enough to be adapted without losing its core effect. These conditions are not properties of the artifact alone. They emerge from the relation between the prototype and the system into which it is introduced. Work in research-through-design emphasizes this relational character, where prototypes function as situated interventions rather than isolated objects (Zimmerman, Stolterman, & Forlizzi, 2010).

A curbside intervention that designates a small area for pedestrian use may initiate a positive cascade if it is easily understood, if it aligns with existing patterns of movement, and if it can be extended by adjacent actors. Pedestrians begin to occupy the space, businesses adjust their use of the frontage, and drivers modify their behavior in response. The initial displacement is taken up in ways that reorganize activity beyond its boundaries.

In a clinical context, a simplified discharge instruction may initiate a cascade if it improves patient comprehension in a way that supports adherence. As patients follow instructions more reliably, follow-up interactions become more effective, reinforcing the initial improvement. The prototype does not enforce behavior. It creates conditions under which desired behavior becomes easier to sustain, aligning with value-sensitive and practice-oriented approaches to design intervention (Friedman, Kahn, & Borning, 2002).

These examples illustrate that initiation does not guarantee propagation. Many displacements remain localized, either because they fail to align with system conditions or because they encounter constraints that limit uptake. The task of design is therefore not to produce isolated successes, but to construct prototypes that are situated within pathways capable of extension.

This requires attention to timing. Early-stage conditions, where trajectories are still forming, offer greater opportunity for initiation. At later stages, where alignment has already consolidated, new displacements may be absorbed without wider effect or may encounter resistance that limits their propagation. Initiation is most effective when it occurs at points where the system is already in motion but has not yet stabilized into a fixed pattern, consistent with threshold-based models of cascade formation (Granovetter, 1978; Watts, 2002). The role of representation remains central. Prototypes that make their effects visible increase the likelihood of uptake, as actors can recognize the consequences of adoption. Visibility operates not only at the level of the artifact but at the level of the system, where the propagation of effects can be observed and understood. Representations that reveal how a small change leads to broader improvements support further extension of the trajectory, echoing the role of prototypes as communicative and persuasive devices in design research (Roberts-Smith, Ruecker, & Radzikowska, 2021).

Prototyping for initiation does not replace other forms of engagement with cascades. It operates in coordination with

modulation and recovery strategies. A trajectory that has been successfully initiated may later require amplification, dampening, or redirection as conditions change. The distinction lies in the point of intervention. Initiation focuses on the early formation of cascades, where the direction of propagation is still open.

By treating prototypes as seeds rather than probes, this approach extends systemic prototyping into a generative domain. The aim is not only to understand how systems behave, but to contribute to the emergence of trajectories that carry forward conditions worth sustaining. The sections that follow examine how such trajectories can be reinforced and extended once they begin to take hold.

REINFORCING AND EXTENDING POSITIVE CASCADES

Once a trajectory has been initiated and taken up within a system, the design task shifts from seeding to support. Early propagation establishes a direction, yet without reinforcement, that direction may dissipate, fragment, or be overtaken by competing alignments. Positive cascades persist when the conditions that enabled their initial uptake are stabilized and extended across additional contexts.

Reinforcement operates through alignment with existing structures. A trajectory strengthens when it becomes easier to continue than to abandon. This ease may arise from multiple sources. Incentives may support continuation by rewarding behaviors that align with the emerging pattern. Social recognition may validate adoption, increasing the likelihood that others will follow. Material or infrastructural adjustments may reduce friction, allowing the trajectory to embed itself within routine activity. Such embedding reflects how practices stabilize through repetition and integration into socio-technical systems (Latour, 2008).

A small change in workflow that reduces the time required to complete a task may be adopted initially for its immediate benefit. If subsequent adjustments align surrounding processes with that change, the new pattern becomes the default. What began as a local improvement becomes a stable pathway through the system. Reinforcement, in this sense, consolidates propagation without imposing uniformity from outside. Extension involves the movement of a trajectory beyond its initial domain. A cascade extends when the conditions that support it become recognizable and reproducible in adjacent contexts. This movement is not a simple replication. As trajectories travel, they encounter variations in structure, constraint, and practice. Successful extension depends on the capacity of the initial pattern to adapt while maintaining its functional coherence, a dynamic consistent with diffusion across heterogeneous networks (Rogers, 2003; Barabási, 2016).

In urban settings, a pedestrian-priority intervention that proves effective on one block may extend to others if the underlying conditions are sufficiently similar. The extension may require modification to account for differences in traffic flow, land use, or user behavior. The cascade persists not because the intervention is copied exactly, but because its operative principles can be reconfigured to fit new conditions.

In institutional contexts, a practice that improves coordination within one department may extend across an organization if it aligns with broader processes. The extension may involve translation into different terminologies, integration with existing systems, or adjustment to local constraints. Each adaptation contributes to the trajectory while altering its form.

The distinction between reinforcement and extension is analytic. In practice, they operate together. A trajectory that is reinforced locally becomes more visible and credible, increasing the likelihood that it will be extended. Extension, in turn, introduces variation that can strengthen the trajectory by making it more robust across conditions. The cascade develops through this interplay, accumulating both stability and adaptability.

Design can support this process through targeted prototyping strategies. Reinforcement prototypes operate by reducing friction along an emerging pathway, aligning incentives, or increasing the visibility of beneficial effects. These prototypes do not introduce entirely new displacements. They build upon existing trajectories, making continuation more likely.

Extension prototypes operate by translating a trajectory into new contexts. They test how the underlying pattern performs under different conditions, identifying the elements that must remain stable and those that can vary. Each extension generates a new systemic map, contributing to an understanding of how the cascade behaves across domains, consistent with research-through-design approaches that treat prototypes as knowledge-generating interventions (Zimmerman et al., 2010).

The timing of these interventions is critical. Reinforcement introduced too early may accelerate alignment before sufficient variation has been explored, leading to premature closure. Extension attempted too late may encounter resistance from stabilized patterns that limit adaptation. Effective design practice attends to the state of the cascade,

introducing support when trajectories demonstrate potential for sustained propagation.

A further consideration concerns the interaction of positive cascades with existing system dynamics. Cascades do not unfold in isolation. They intersect with other trajectories, some of which may compete for the same resources or attention. Reinforcement and extension must therefore account for these interactions, ensuring that support for one trajectory does not inadvertently suppress others that contribute to overall system flexibility.

The role of representation continues to be significant. As trajectories extend, their effects may become less visible at any single point within the system. Representational tools that trace propagation across contexts support coordination among actors who participate in different parts of the cascade. These tools allow designers and stakeholders to recognize how local actions contribute to broader patterns, reinforcing the coherence of the trajectory.

Positive cascades that are successfully reinforced and extended begin to exhibit durability. They persist not as fixed structures, but as patterns that can be enacted across varying conditions. This durability does not eliminate the need for further engagement. Changes in the system may alter the conditions that support the cascade, requiring ongoing adjustment.

The sections that follow examine how such trajectories can be sustained over time without producing the forms of closure that limit adaptability, addressing the conditions under which positive cascades remain open to variation while maintaining their beneficial effects.

SUSTAINING POSITIVE CASCADES WITHOUT PREMATURE CLOSURE

As positive cascades extend across a system, a new tension emerges. The same processes that support persistence can also accelerate alignment to the point where variation diminishes. A trajectory that becomes highly successful may begin to dominate the field, reducing the presence of alternatives that contribute to long-term adaptability. Sustaining positive cascades therefore involves maintaining their beneficial effects while preventing the contraction of optionality that accompanies unchecked consolidation, a dynamic consistent with accounts of lock-in and path dependence in complex systems (Arthur, 1989).

This condition can be understood as managed alignment. A trajectory is allowed to strengthen, yet its expansion is shaped so that it does not eliminate the diversity of pathways on which system resilience depends. The task is not to limit success, but to structure it in ways that remain permeable to variation.

One way this is achieved is through distributed reinforcement. Instead of concentrating support on a single configuration, reinforcement is applied across multiple instances of a trajectory, each adapted to local conditions. The resulting pattern exhibits coherence without uniformity. Practices that share a common orientation may differ in execution, preserving the system's capacity to adjust when conditions change. This form of variation within alignment reflects the capacity of complex adaptive systems to maintain stability through diversity (Holland, 1995).

In urban environments, pedestrian-priority initiatives that vary in form across neighborhoods create a network of related practices rather than a single standardized solution. Each instance supports safe and accessible movement, yet differences in design allow the system to respond to local constraints. The cascade persists through a family of variations rather than through replication of a fixed model.

A second approach involves maintaining zones of variation within aligned systems. These zones function as spaces where alternative configurations can continue to develop even as a dominant trajectory gains strength elsewhere. They may be intentional, such as pilot programs or experimental districts, or they may arise through differences in institutional or material conditions. Their presence ensures that the system retains the capacity to generate new trajectories when existing ones encounter limits, echoing calls within design research to sustain exploratory spaces alongside stabilized practice (Gaver, 2012).

In clinical settings, maintaining parallel care pathways for different patient groups allows for adaptation as conditions evolve. Even as one pathway demonstrates effectiveness, others remain available for cases that do not conform to the dominant pattern. The system avoids complete alignment, preserving flexibility within its structure.

A third mechanism involves periodic re-opening of stabilized trajectories. Over time, patterns that have become routine may no longer align with current conditions. Reintroduction of variation through targeted interventions allows the system to reassess and adjust. These interventions may take the form of revised protocols, updated representations, or exploratory prototypes that test alternative configurations. This process resonates with iterative models of inquiry in which stability is periodically re-examined in light of new conditions (Dewey, 1938).

This process can be understood as cyclical recalibration. The cascade is not reversed, but it is made responsive to changing conditions. Each recalibration introduces a degree of uncertainty that enables the system to adapt without requiring full disruption.

Representation plays a central role in sustaining openness. As cascades develop, their effects may become normalized and less visible to participants. Tools that make trajectories explicit allow actors to recognize the extent of alignment and the presence or absence of alternatives. Such representations support informed decisions about when to reinforce, when to diversify, and when to introduce new variation, aligning with infrastructural accounts of classification and visibility (Bowker & Star, 1999).

A further consideration concerns the interaction between positive cascades and institutional structures. Systems that formalize successful practices through policy or infrastructure may increase stability while also reducing flexibility. Sustaining positive cascades in such contexts requires designing institutional mechanisms that allow for adjustment. This may involve modular policies, adaptable standards, or governance processes that incorporate ongoing feedback, consistent with transition design approaches that emphasize long-term adaptability (Irwin, 2015).

The maintenance of recoverability remains central. A system that sustains positive cascades while preserving its capacity to shift trajectories retains the ability to respond to unforeseen conditions. This capacity depends on the continued presence of alternative pathways, the visibility of system dynamics, and the availability of mechanisms for introducing variation.

Design practice, within this context, operates as an ongoing engagement with balance. Interventions are introduced to support trajectories that extend beneficial conditions, while parallel efforts maintain the openness required for adaptation. The work does not resolve into a final configuration. It proceeds through continuous adjustment, guided by observation of how cascades evolve over time.

The final section considers how these practices can be integrated into design workflows, addressing how initiation, reinforcement, extension, and sustained openness can be coordinated within a coherent approach to cultivating positive cascades.

IMPLICATIONS FOR DESIGN PRACTICE: CULTIVATING TRAJECTORIES

The treatment of cascades as a generative resource introduces a shift in how design practice is organized and sustained. Earlier formulations emphasized detection and modulation, positioning design as a means of maintaining system responsiveness under conditions of accelerating closure. The present extension adds a complementary orientation in which design participates in the formation, reinforcement, and continuation of trajectories that extend beneficial conditions across a system.

This shift does not require a new process. It reconfigures the intent within existing practices. Framing identifies not only problems but latent pathways where beneficial propagation may take hold. Prototyping introduces displacements that seed those pathways. Evaluation attends to how trajectories develop over time, considering not only immediate outcomes but the patterns of alignment they initiate. Iteration becomes a means of supporting propagation, adjusting conditions so that desirable trajectories remain viable as they encounter variation, consistent with reflective practice accounts of design activity (Schön, 1992).

Workflows organized in this way operate through accumulation rather than resolution. Each intervention contributes to a growing set of systemic maps that record how trajectories behave under particular conditions. These maps support comparison across instances, allowing designers to recognize patterns that indicate where propagation is likely to extend, where it may dissipate, and where it risks consolidating too quickly. The accumulation functions as a working memory, enabling decisions that are informed by prior engagements without requiring reduction to a single model.

The role of prototyping expands accordingly. Prototypes are constructed not only to test possibilities or redirect emerging cascades, but to cultivate conditions under which uptake, reinforcement, and extension can occur. Some prototypes act as seeds, establishing initial displacements that align with existing tendencies. Others act as supports, reducing friction or increasing visibility along developing pathways. Still others maintain openness, preserving variation through buffering structures or periodic recalibration. This expanded role aligns with research-through-design traditions that treat prototypes as instruments of both inquiry and transformation (Zimmerman et al., 2010; Roberts-Smith et al., 2021).

Coordination across these roles becomes a central concern. Positive cascades develop unevenly, requiring simultaneous attention to initiation in some areas, reinforcement in

others, and diversification where alignment has intensified. Design practice operates through composition, arranging interventions so that they interact constructively across phases of cascade development. The effectiveness of any single intervention depends on its relation to others within this evolving configuration.

Participation assumes increased importance within this orientation. Cascades extend through the actions of multiple actors, each contributing to the continuation or transformation of a trajectory. Engaging those actors in the design process supports recognition of pathways that may not be visible from a single position. It also increases the likelihood of uptake, as interventions are aligned with practices that participants are able to sustain and adapt. Design becomes a distributed activity, where the cultivation of trajectories involves coordination across roles, contexts, and perspectives (Bødker, 1987; Hillgren et al., 2011).

Evaluation criteria also shift. Success is understood in terms of the trajectories that interventions support. A design may be considered effective when it enables propagation that increases optionality, strengthens coordination, or improves recoverability. Conversely, interventions that produce immediate gains while narrowing future possibilities require reconsideration. This evaluative frame extends existing measures by incorporating the temporal and systemic consequences of design activity.

The temporal dimension of practice becomes more explicit. Interventions are introduced with an awareness of their position within unfolding cascades. Early actions focus on seeding and variation. Subsequent efforts support reinforcement and extension. Later interventions maintain openness or reintroduce variation where alignment has intensified. The sequence is not fixed. It responds to the state of the system, requiring ongoing observation and adjustment.

The designer's role, within this framework, can be understood as the cultivation of trajectories. The work involves recognizing where beneficial propagation may occur, introducing conditions that support its development, and maintaining the openness required for continued adaptation. This role balances alignment and variation, supporting coherence without eliminating the diversity on which resilience depends.

Taken together, these implications position design as an ongoing engagement with systems in motion. The focus moves from producing discrete outcomes to shaping how change unfolds over time. By integrating initiation, reinforcement, extension, and sustained openness within a single approach, design practice can contribute to the formation of cascades that carry forward conditions worth sustaining while preserving the capacity for future transformation.

CONCLUSION

This article has extended the cascade-oriented framework by introducing cultivation as a complementary mode of engagement. Where earlier work emphasized detection and modulation, the present account has examined how design can participate in the formation and continuation of trajectories that extend beneficial conditions across systems.

Prototyping has been re-specified as a means of initiating, reinforcing, and extending such trajectories. The strategies developed—seeding for uptake, supporting reinforcement, enabling extension, and sustaining openness—provide a basis for engaging cascades as generative processes. Their coordination across phases of development allows design to influence how propagation unfolds without imposing fixed outcomes.

The examples and conceptual development have shown that positive cascades are not defined by isolated success, but by their capacity to expand optionality, strengthen coordination, and maintain recoverability over time. This capacity depends on the interaction of interventions with existing system dynamics, requiring attention to timing, placement, and the conditions under which trajectories are taken up and sustained.

Situated alongside the preceding papers on cascade detection and modulation, this work completes a three-part articulation of design in the age of cascades. The combined framework positions design as a practice that makes cascade dynamics legible, engages them through targeted intervention, and cultivates trajectories that carry forward conditions worth sustaining.

The contribution lies in providing a coherent approach to working within systems characterized by ongoing propagation and transformation. By treating cascades as both a source of constraint and a resource for generation, the framework supports forms of design practice that engage complexity without reducing it, enabling deliberate participation in the unfolding of systemic change.

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