Title

Navigating the Matrix of Meaning: Transformation and the Accessibility–Accuracy Spectrum in Science Communication

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Abstract: This paper proposes a new theoretical model for understanding how scientific knowledge is transformed as it circulates from academic contexts to public-facing formats. While traditional frameworks focus on either accessibility or accuracy, this paper introduces the Accessibility–Accuracy (A/A) spectrum as a multidimensional tool for evaluating public science communication. The model draws from information science, media studies, and translation theory to define four key processes: translation, transmutation, transposition, and transformation. These categories illuminate how meaning is reshaped across platforms, formats, and audiences—not simply lost. Using case studies of epigenetics and Maslow's hierarchy of needs, the paper shows how scientific and quasi-scientific concepts are reframed to gain social relevance, often at the cost of epistemic stability. The A/A spectrum offers a method for mapping these shifts and their implications, proposing that transformation is not failure, but a condition of knowledge transfer.

Keywords: Science Communication, Epistemic Transformation, Public Understanding of Science, Media Ecology

I. Introduction

We are living through a crisis of legibility. Scientific claims are everywhere—in feeds, on stages, folded into policy decisions, branded into wellness protocols, stretched thin across media ecosystems optimized for frictionless shareability. Science now lives not only in the lab but in the meme, the infographic, the TikTok monologue. And yet, as public exposure to science expands, the ground beneath expertise trembles. What is considered valid knowledge? Who decides? What survives the transition from expert to public domain?

In this landscape, science communication is often called upon to repair what appears broken: misinterpretation, mistrust, misinformation. These calls typically follow a familiar logic. *If only the public understood the science, if only the message were clearer, more accessible, more engaging, the crisis could be averted.* Such thinking animates what have become the default frameworks of the field—the deficit model, the dialogue model, and the participatory model. Each offers a slightly different arrangement of roles between expert and layperson. But they share a foundational assumption: that scientific knowledge is something to be transmitted. Carried intact from source to destination. Maybe simplified, yes. But fundamentally preserved.

This paper begins from a different premise. Science, as it circulates, does not remain unchanged. It mutates, stretches, condenses. It is translated, not just linguistically but epistemologically—into new genres, new moral grammars, new institutional agendas. Scientific knowledge does not travel in a vacuum. It is always embedded, always filtered through aesthetic, ideological, and material constraints. The question is not whether science is transformed in communication. The question is how—and to what ends.

To foreground transformation is to acknowledge that communication is not simply the movement of ideas, but their ongoing reconstitution. Concepts are bent toward the constraints of form, modulated to fit audience expectations, embedded in the logics of platforms and institutions. Communication, in this view, is a site of epistemic labor. It does not merely deliver knowledge—it makes and remakes it.

To navigate this shifting terrain, this paper proposes the Accessibility-Accuracy spectrum, or A/A spectrum. At its core, the spectrum maps the tensions inherent in public-facing science: the pull toward clarity, the push for fidelity, and the fragile hope for something more durable. Accessibility refers to the capacity of a message to be understood, felt, or acted upon by those beyond the academy. Accuracy reflects the degree to which a representation remains tethered to the evidentiary and methodological commitments of its source. Epistemic stability marks the ability of an idea to maintain its meaning as it travels—through headlines, hashtags, lecture halls, and marketing decks.

These dimensions do not exist in neat alignment. A message can be accessible and accurate yet epistemically unstable. It can be stable but inaccurate. It can reach millions and still say very little. The A/A spectrum does not aim to police the boundaries of science or communication. It aims to trace the pressures under which meaning shifts, and to offer a vocabulary for thinking critically about those shifts.

Three questions guide this inquiry:

1. What happens to scientific meaning as it moves from expert contexts into public discourse?
2. How do rhetorical, visual, and institutional forces shape that movement?

3. What kinds of authority are gained—or lost—through transformation?

What follows is both a theoretical model and an invitation. To think of science not as a set of facts waiting to be delivered, but as a matrix of meaning always in motion. To see communication not as an afterthought, but as an epistemic site in its own right.

II. Literature Review and Theoretical Framework: Communication as Transformation

A. Revisiting Classical Communication Models

Debates over how science engages publics have evolved significantly over the past several decades. The deficit model, dominant through much of the 20th century, assumed that public misunderstanding stemmed from a lack of scientific knowledge, positioning the scientist as the transmitter and the public as a passive recipient (Wynne, 1992). This view has been widely critiqued for its top-down assumptions and failure to account for public values, skepticism, or experiential expertise. In response, dialogue models emerged in the 1990s, emphasizing two-way engagement between experts and non-experts (Bucchi & Trench, 2014). These models sought to foster mutual understanding but often retained institutional asymmetries in how authority was distributed. More recently, participatory and co-production models have argued that publics don't just receive science—they help shape it. These models stress collaboration in knowledge production, particularly in fields like citizen science, environmental monitoring, and patient advocacy (Irwin, 2008; Callon et al., 2009).

Yet across all three paradigms, the role of communicative form remains undertheorized. While participation frameworks focus on who gets to speak, they less frequently address how scientific meaning transforms through design choices, genre, platform, and media ecology. To better understand this dimension, we must revisit more fundamental theories of communication.

What does it mean for information to move? In foundational models of communication theory, the answer often seems deceptively simple. Claude Shannon's (1948) now-canonical diagram proposed a structure: a sender, a message, a channel, a receiver, and somewhere in between, noise. In this model, information is what gets transmitted. Meaning is what survives interference. Communication succeeds when the signal arrives intact.

This framework proved powerful, especially for thinking about technical systems and information flow. But when applied to human communication—particularly the circulation of scientific knowledge—its limitations become clear. Meaning is not always pre-formed. It does not exist independent of its mediation. Shannon himself acknowledged that his model had nothing to say about semantics. But it has nonetheless shaped decades of thought about science communication, where misunderstanding is often treated as a problem of delivery rather than interpretation.

Alternative approaches reframe the question. Marshall McLuhan (2003) argued that the medium is the message, suggesting that the form of communication shapes experience just as much as its content. Harold Innis (1951) proposed that different media privilege different orientations toward time and space. Oral communication fosters memory and continuity; print encourages abstraction and permanence. For both thinkers, media are not neutral vessels. They are environments that structure thought, values, and authority.

From this perspective, scientific communication cannot be reduced to clarity or accuracy alone. It must be understood as a process of transformation. When scientific ideas move between platforms, formats, or publics, they do not simply travel from point A to point B. They change. They are reframed, distilled, aestheticized, or moralized. They acquire new functions and new audiences. Meaning does not ride along behind the signal. It is produced through form and context.

Bruno Latour (1999) takes this argument further. Scientific facts, he suggests, are not created in laboratories and then transmitted to society. They are stabilized through networks of people, technologies, and institutions. Communication is not an afterthought—it is part of the fact-making process itself. Every instance of circulation is also an act of reassembly. To move is to be made again. In Latour's terms, science does not simply diffuse. It transforms.

This paper builds on these insights by extending the participation literature with a model of epistemic transformation via communicative form. It argues that not just access, but format, metaphor, and framing profoundly shape what science becomes as it moves. Scientific representations do not pass through the media untouched—they are remade by the very processes of design, repetition, and uptake. The Accessibility–Accuracy spectrum introduced in this paper provides a framework for tracking these shifts, making visible the epistemic labor performed by communication itself.

B. Transformation, Framing, and Situated Knowledge

This paper offers a conceptual toolkit for tracing these remakings—translation, transmutation, and transposition. Each names a different register of change. Together, they reveal that public science is not simply communicated. It is continuously negotiated, adapted, and rebuilt across media, institutions, and publics.

Translation is the most familiar of these terms. It involves adapting a scientific concept for audiences beyond its origin—rewording, simplifying, metaphorizing, or converting disciplinary jargon into narrative form. Translation is often framed as a necessary and even benevolent act. It allows complex knowledge to travel. But it also requires choices. What stays and what goes? What metaphors carry the weight of a theory without misleading? Even the most careful translation alters the architecture of meaning. It transforms not just the content, but how the concept feels, what it suggests, and whom it appears to address (Nida, 1964).

Transmutation deepens this transformation. It involves shifts in a concept's rhetorical or ideological function. This might occur when a probabilistic scientific claim is reframed as causal certainty in a headline, or when a medical framework is repurposed in service of corporate wellness programs. Transmutation often moves a claim into new value systems. A study on genetic inheritance may become a narrative of moral responsibility. A theory of trauma may be reshaped into a story of empowerment or self-improvement. These shifts do not simply clarify. They reorient what the knowledge is for (Hall, 1997; Haraway, 1988).

Transposition captures a more structural movement. Here, a scientific concept is relocated from one institutional or discursive domain to another. A psychological theory becomes part of business strategy. A biological mechanism becomes central to educational policy. In this process, knowledge is not only reframed. It is realigned with different goals, audiences, and evaluative criteria. What counts as rigorous in a lab may be taken as inspirational in a public talk. What was once a tentative model becomes a guiding framework for action. This movement between domains adds a layer of institutional transformation to the conceptual shifts described above (Latour, 1999).

These three terms—translation, transmutation, and transposition—do not describe separate stages. They often operate simultaneously, layered and compounding. A concept may be translated for clarity, transmuted for resonance, and transposed into a new context all in the same gesture. Together, they compose what this paper calls transformation: the accumulation of changes that occur as scientific knowledge travels. Transformation is not a signal degraded by noise. It is a complex, creative, and contested process through which meaning is made.

This view finds support in the work of Stuart Hall, who reminds us that representation is not a mirror of reality. It is a cultural practice that constructs meaning through codes, language, and form. Scientific knowledge becomes meaningful not simply by being correct, but by being situated—by being framed in ways that connect with lived experience, institutional expectations, and public values (Hall, 1997).

Robert Entman helps us unpack this further. Framing, he argues, is the process of selecting certain aspects of a perceived reality and making them more salient. A frame may define a problem, diagnose its causes, make moral judgments, and suggest remedies. In science communication, this means that how a claim is framed affects not just understanding, but trust, legitimacy, and urgency. A study can be framed as evidence, as controversy, or as a call to action. Each frame invites a different form of engagement (Entman, 1993).

Yet framing is not neutral. It carries weight. It shapes responsibility. It directs attention and deflects critique. This is why transformation must be taken seriously as an epistemic process. It is not just about communication style. It is about how knowledge functions in the world.

Donna Haraway makes this point with clarity and force. All knowledge, she writes, is situated. There is no view from nowhere. Science communication is not exempt from this condition. When a concept moves into the public sphere, it is not leaving a positionless lab and entering a field of ideology. It is moving from one situated context to another. Each site of communication carries its own assumptions, commitments, and constraints. Haraway invites us to look closely at where knowledge speaks from, and who is listening (Haraway, 1988).

Together, Hall, Entman, and Haraway offer a theoretical lens through which transformation becomes not only visible but analytically legible. They help us see that science communication is never just about getting the facts right. It is about navigating systems of meaning, power, and representation.

C. Visual Form, Translation Theory, and the Grounding of the A/A Spectrum

Scientific meaning does not move through words alone. It is shaped by form, image, rhythm, and structure. In a media environment increasingly defined by multimodality, the visual and aesthetic dimensions of communication play a central role in how science becomes public. Meaning emerges not only through what is said, but through how it is seen, heard, and encountered.

The work of Kress and van Leeuwen (2006) offers a foundational framework for thinking about visual communication. They argue that images follow their own grammar, one that conveys relationships of power, salience, and legitimacy through composition and design. Layouts organize meaning. Gaze and color establish emphasis. Scientific ideas, when visualized, are not simply illustrated. They are rearticulated. A bar chart, a pyramid, or a stylized genome does more than present information. It encodes assumptions about hierarchy, sequence, and epistemic confidence.

Lev Manovich (2001) extends this analysis into the realm of new media. In his account, digital environments are defined by modularity, variability, and reconfigurability. Scientific content within these environments becomes fluid. It is broken into fragments, optimized for platform-specific formats, and reassembled in ways that may prioritize aesthetic appeal over evidentiary complexity. A concept that once appeared in a peer-reviewed article may now surface as an animated loop, a swipeable infographic, or a brief voiceover set to music. These formats do not merely repackage ideas. They participate in shaping their legibility and authority.

In this context, scientific meaning must be evaluated not only by its content, but by its compositional affordances. Design choices shape comprehension, but they also shape perception. A concept framed visually as linear may obscure cyclical or recursive dynamics. An illustration that implies causality may override textual qualifiers. Even silence or absence—what is not represented—can carry rhetorical weight. As Edward Tufte (1983) reminds us, every design is an argument.

These shifts in form and medium echo longstanding debates in translation studies. Eugene Nida's (1964) theory of dynamic equivalence argues that translation should prioritize communicative function over literal fidelity. A good translation, in his view, is one that elicits the same response in the target audience as the original does in its native context. This principle has guided many efforts in science communication to make knowledge more relatable and actionable. But it also raises crucial questions. What is lost in the pursuit of fluency? What happens when resonance replaces rigor?

Lawrence Venuti (1995) offers a sharp critique of this pursuit. He warns that fluency and transparency often mask the interpretive labor that makes translation possible. The more a translated text feels natural, the more invisible its mediating choices become. In science communication, this is especially salient. Messages that feel effortless or intuitive may in fact involve extensive reconfiguration. When this work is hidden, the resulting message may appear authoritative, even as it moves further from the evidentiary and conceptual scaffolding of the original.

Together, these theories clarify a central tension. Science communication must navigate between the desire for accessibility and the demands of accuracy. But these are not the only concerns. There is a third, often overlooked dimension: epistemic stability. This refers to the capacity of a representation to maintain its core meaning as it circulates, fragments, and is reframed across media and publics.

The Accessibility-Accuracy spectrum, or A/A spectrum, emerges from these conditions. It offers a model for mapping how scientific ideas move, and what happens to them in the process. Accuracy refers to the methodological and conceptual fidelity of a representation. Accessibility reflects its clarity, emotional resonance, and cultural legibility. Epistemic stability tracks the resilience of meaning across transformations—its ability to retain coherence as it is rephrased, reposted, or repurposed.

This paper proposes that the A/A spectrum is not only a conceptual tool. It is an analytical lens that captures the stakes of transformation. In a world where scientific claims must compete for attention, legitimacy, and narrative clarity, this model helps us understand what is gained, what is lost, and what remains in flux.

D. Clarifying the Frame: Temporal, Historical, and Controversial Dimensions

Scientific transformation does not occur in a vacuum—it unfolds across time, through media, and within social fields shaped by interpretive flexibility. The Accessibility–Accuracy spectrum proposed in this paper is not a universal template, but a historically situated analytic. It is designed to trace how scientific knowledge moves from specialized academic contexts into public-facing discourse, where institutional stakes, media infrastructures, and cultural narratives converge.

This framework is particularly well-suited to disciplines such as health sciences, psychology, sociology, and education—fields where scientific authority frequently intersects with political urgency, moral reasoning, and the aesthetic demands of communication. These are domains in which knowledge must not only be accurate, but socially actionable. As a result, they are especially vulnerable to transformation—not merely simplification, but reframing, realignment, and ideological reconstitution.

The A/A spectrum must therefore be understood as temporally contingent and media-sensitive. Concepts transform differently depending on when they emerge and through what communicative infrastructure they circulate. Temporality introduces variation in epistemic stability: older concepts often accumulate reinterpretations, cultural remixes, and counterfindings, which may result in semantic drift, narrative solidification, or conceptual fragmentation. Media form shapes these trajectories. Each era—print, broadcast, social, and synthetic—imposes different constraints and affordances on how knowledge is made public. In the print era, dissemination was linear, slow, and curated through expert gatekeeping. High accuracy and epistemic stability were common, but accessibility was low. In the mass-media era, knowledge was condensed for mass appeal. Centralized editorial control enabled broad accessibility with some stability, though simplification introduced distortion.

The social media era fractured this model, privileging virality, affective resonance, and rapid reassembly. Knowledge became fragmented, accessible, and volatile.

We are now entering an AI-driven era, characterized by algorithmic rewriting, synthetic media, and platform-native reconfiguration. Here, auto-generated summaries, decontextualized data visualizations, and deepfakes accelerate epistemic drift, potentially decoupling all three axes of the spectrum.

These temporal contexts are not peripheral—they structure the conditions under which science becomes public. Figures 1 and 2 together map these dynamics: Figure 1 spatially charts transformation types across media forms and historical depth, while Figure 2 models the shifting relationships among accessibility, accuracy, and epistemic stability across these media eras.

To understand scientific transformation, then, we must attend not only to what is communicated, but to when, how, and through what medium. The trajectory of a concept—its accessibility, accuracy, and epistemic stability—is never intrinsic. It is shaped by the media ecology and historical moment through which it travels.

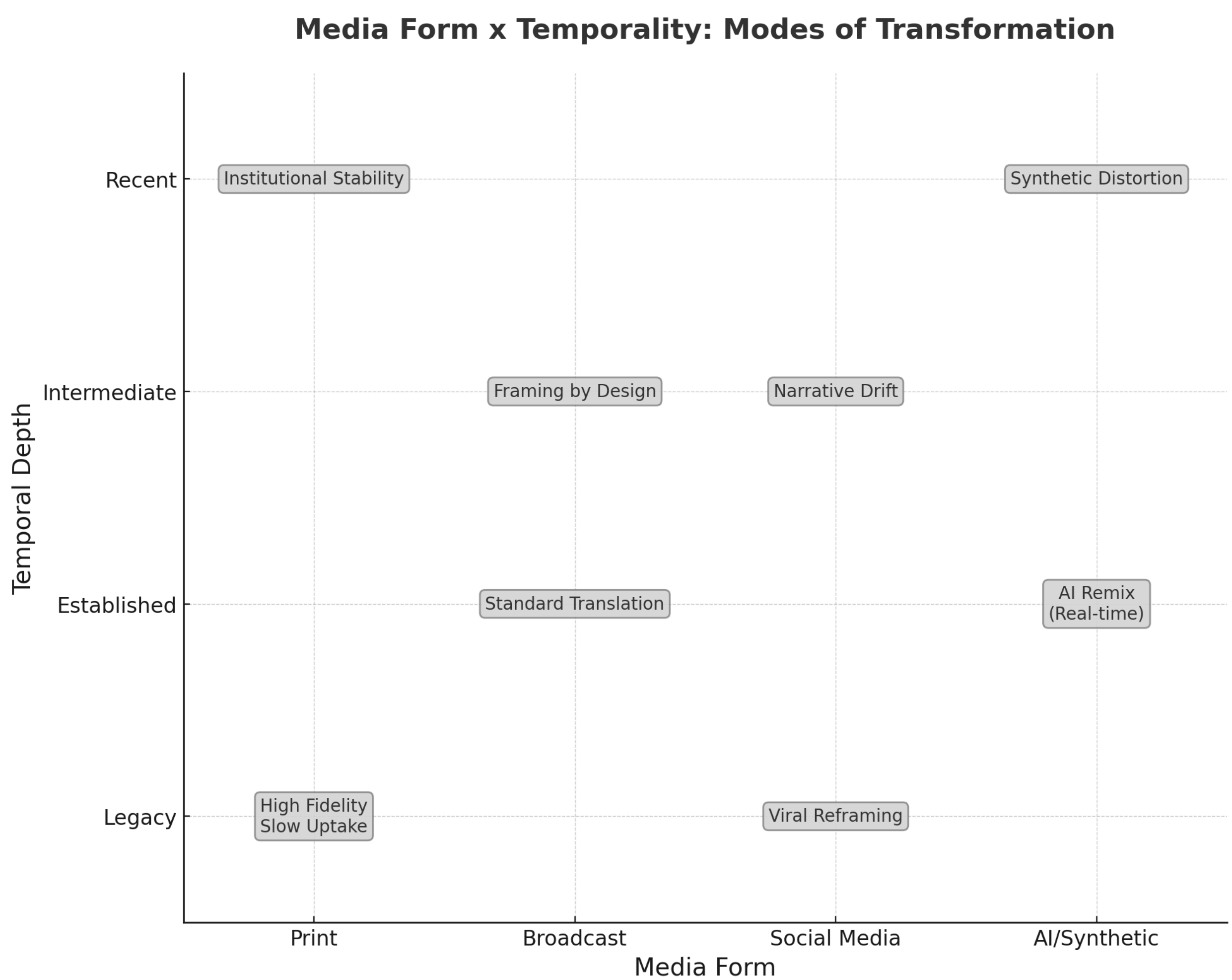

Figure 1. Media Form × Temporality: Modes of Transformation

This diagram situates dominant transformation patterns within a media–temporality matrix. As communication moves from print to synthetic AI and from legacy to real-time platforms, the prevailing mode of transformation shifts from institutional stability to viral reframing and automated distortion.

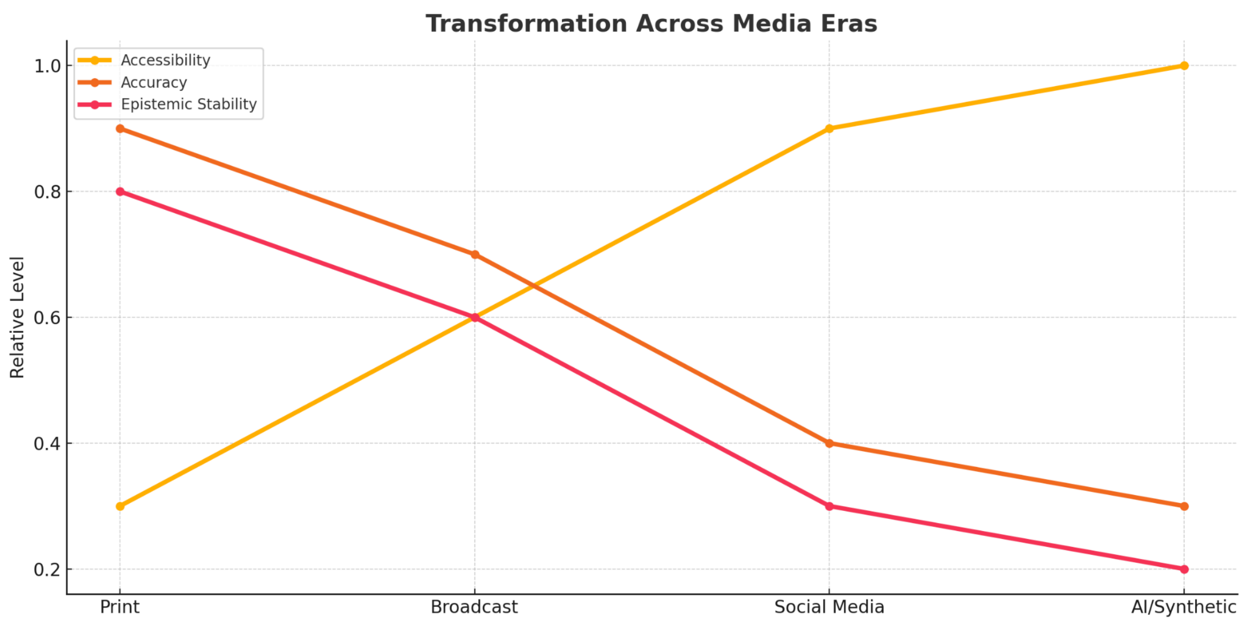

Figure 2. Transformation Across Media Eras

This line chart models relative changes in accessibility, accuracy, and epistemic stability as dominant media forms shift over time. The print era favors high fidelity and epistemic closure; broadcast media balances accessibility with moderate stability; social media amplifies accessibility while destabilizing meaning; and AI/synthetic media risk decoupling all three axes through automated, decontextualized reconstruction.

Transformation is also shaped by who communicates science. Different agents occupy different institutional positions and are incentivized to engage distinct modes of transformation.

Academic scientists often prioritize translation, aiming for fidelity and nuance, while influencers and therapists may gravitate toward transmutation, embedding science within affective or ideological frames. Table 1 outlines these roles, linking agent types to dominant modes of transformation and identifying the typical communicative fields they inhabit. The goal is not to assign blame or valorize any one mode but to clarify how transformation emerges as a structural outcome of social positioning.

Table: Agents of Scientific Transformation

Agent	Primary Transformation	Typical Target Field	Example
Academic Scientists	Translation	Peer-reviewed journals	Weaver et al. (2004) study on maternal care
Science Journalists	Translation / Transposition	Popular science magazines, blogs	*Scientific American*, TED Talks
PR / Communications Teams	Transposition	Press releases, university websites	Institutional announcement of findings
Educators / Curriculum	Transposition	Textbooks, slides, LMS platforms	Maslow pyramid in classroom materials
Influencers / Content Creators	Transmutation	Social media, podcasts, YouTube	Trauma TikToks referencing epigenetics
Therapists / Coaches	Transmutation / Transposition	Self-help, wellness, UX design	Epigenetics in coaching or trauma healing
Policymakers / Funders	Transposition	Policy briefs, funding narratives	Childhood trauma funding initiatives

Table 1. Agents of Scientific Transformation

Each agent type is associated with a dominant mode of transformation and typical communicative targets. This mapping reveals how professional roles shape epistemic outcomes not simply through intention but through systemic affordances and institutional logics.

Another layer of complexity arises when scientific fields are marked by controversy, frequent counterfindings, or a lack of disciplinary consensus. In such cases, accuracy becomes inherently unstable—not because communicators fail, but because the epistemic ground itself is shifting. Within this model, controversy exerts a force on the spectrum: it reduces epistemic stability and complicates the work of representation. A finding that appears accurate today may be overturned tomorrow; a framework once considered robust may be discredited through critique or reanalysis. These dynamics intensify the risk of transformation, particularly in public contexts where nuance is often lost in favor of legibility or emotional resonance.

In this sense, the A/A spectrum is not symmetrical. It responds differently depending on the epistemic volatility of the concept in question. The model performs best in domains where scientific claims are already subject to negotiation—where meaning is fluid, contested, and mediated across discursive frames. In contrast, highly technical or specialized fields that rarely leave academic circulation may be less susceptible to the pressures this model describes. The theory is strongest where science meets narrative—where knowledge must compete for trust, attention, and narrative coherence in the public sphere.

This framing clarifies the scope and function of the A/A spectrum. It is not a universal grid for evaluating truth, but a diagnostic tool for mapping the transformations that emerge when specialized information is made public. It allows us to ask not only what is being communicated, but who is doing the communicating, under what conditions, and with what consequences. These variables—the historical era, the communicative agent, the media form, and the epistemic volatility of the field—all shape how knowledge is reframed, stabilized, or destabilized.

Controversy functions as a dynamic modifier within the A/A spectrum, accelerating transformation by destabilizing epistemic authority and fracturing consensus. In scientific contexts, controversy often reflects zones of active inquiry or methodological uncertainty—domains where accuracy is still under negotiation. But in public discourse, controversy can serve a very different function. It increases accessibility and virality, often amplifying visibility precisely because the science remains unresolved. These diverging pressures generate distinct representational paths, pulling a concept toward wide uptake even as its epistemic footing remains fragile.

This tension exposes a critical temporal dimension of transformation. When a concept achieves public traction and is later met with counterfindings or methodological critique, these challenges often surface after the narrative has stabilized in public view. In such cases, counterfindings operate not simply as corrections, but as temporal markers of epistemic drift—signposts of how far a concept has traveled from its origin. What begins as a speculative model or provisional claim may, through repetition and uptake, acquire the coherence of fact. When new data emerge that challenge this narrative, institutions may opt to preserve coherence by reframing meaning rather than revising it—redirecting emphasis, shifting metaphors, or embedding the concept within new normative or moral frameworks.

In this way, controversy does more than disrupt accuracy. It reshapes epistemic stability. It compels scientific claims to evolve, fracture, or entrench depending on the discursive field and institutional demands. Rather than treating controversy as an aberration or breakdown, this model positions it as a structural force—a vector that accelerates transformation and marks the boundary between epistemic volatility and public narrative closure.

What follows is a formalization of this dynamic. In the next section, the A/A spectrum is rendered as a three-axis model, capable of tracing not just points on a map, but the directional forces that pull scientific meaning into new configurations.

III. The Accessibility–Accuracy Spectrum

If transformation is the condition of public science, then we need conceptual tools that do not merely diagnose distortion or celebrate clarity, but instead help us understand the dynamics of meaning as it shifts. The Accessibility–Accuracy spectrum responds to this need. It offers a model for analyzing how scientific concepts are reconfigured through circulation, and how those reconfigurations affect both the authority of knowledge and its capacity to act in the world.

The A/A spectrum is built around three intersecting axes: accessibility, accuracy, and epistemic stability. These are not mutually exclusive properties, nor are they points on a single continuum. Rather, they describe communicative pressures that act simultaneously on any given representation of science. Their tensions are structural, not accidental.

A. Accessibility

Accessibility refers to the degree to which scientific information can be understood, emotionally resonant, or actionable for audiences outside the original research context. It encompasses rhetorical clarity, narrative form, genre choice, visual legibility, and affective tone. It also includes more subtle dimensions, such as metaphoric framing and intertextual familiarity.

A message is accessible when it offers an interpretive foothold—something to hold onto, follow, or feel (Nisbet & Scheufele, 2009; Bucchi, 2008).

Accessibility is often treated as a communicative virtue. In public science campaigns, outreach efforts, and media reporting, clarity is frequently positioned as a proxy for ethical responsibility. The imperative to "make science accessible" structures everything from open-access publishing to YouTube explainers. But accessibility is not neutral. It always operates within cultural and ideological frames. What feels clear to one audience may feel alienating or overly technical to another (Hall, 1997; Haraway, 1988). Visual conventions, language choices, and narrative rhythms all draw from culturally situated norms that shape both engagement and exclusion.

Efforts to increase accessibility often rely on strategies such as analogies, simplification, or visual translation. These choices make science more available, but they also reshape what science is. A DNA sequence described as a "blueprint" or a "code" becomes something different in public discourse than it is in the lab. These metaphors frame what counts as important, what feels knowable, and what kinds of agency are implied (Nelkin, 1995; Nerlich et al., 2002).

B. Accuracy

Accuracy, in contrast, refers to the extent to which a representation preserves the epistemic content of its source. This includes methodological specificity, evidentiary constraints, statistical uncertainty, and disciplinary context. Accurate science communication does not just present facts. It presents claims with appropriate qualifiers, interpretive boundaries, and acknowledgments of complexity (Fischhoff, 2013; Jamieson & Hardy, 2014).

Yet accuracy is not always legible to a public audience. Scientific conventions often rely on hedging, nested clauses, and careful limitations. What counts as accuracy within a peer-reviewed article may seem evasive or confusing outside it. A finding described as "suggestive but not conclusive" may appear indecisive. A model with a wide confidence interval may seem untrustworthy, even if its probabilistic nuance is precisely what gives it rigor. Here, the communicative needs of the discipline and the expectations of the audience may conflict.

Accuracy is also not monolithic. A representation might be factually correct but misleading in implication. A graph may use statistically valid data while suggesting a causal relationship that the study itself does not support. Fidelity to content does not guarantee fidelity to meaning. This is why accuracy must be considered alongside form, genre, and frame.

C. Epistemic Stability

Epistemic stability is the most often overlooked dimension, yet arguably the most important in an era of rapid media circulation. It refers to the ability of a scientific representation to maintain its interpretive coherence as it moves through different platforms, publics, and rhetorical forms. A message may be accurate and accessible in its initial state, but become unstable as it is excerpted, recontextualized, or redeployed. Stability is what allows a concept to survive fragmentation without collapsing into contradiction or distortion (Latour, 1999; Callon, 1986).

This dimension becomes especially salient in environments shaped by algorithmic curation, participatory reconfiguration, and platform-driven reframing. A simplified metaphor may be useful in one context and dangerous in another. A striking image may invite engagement but also fuel misinformation. Epistemic instability often emerges not from a failure of intent, but from a mismatch between the communicative design and the paths of circulation it sets in motion (boyd, 2010; Marres, 2018).

To communicate science effectively, then, is not merely to balance clarity and precision. It is to anticipate how a message might fragment, mutate, or be taken up in unexpected ways. Stability requires more than fact-checking. It requires attention to how form shapes meaning over time.

D. Using the Spectrum

The Accessibility–Accuracy spectrum provides a framework for locating scientific representations within a multidimensional space. Rather than labeling communication as good or bad, accurate or inaccurate, the model invites a more nuanced analysis: How accessible is this message, and for whom? How accurate is it, and by what disciplinary standard? How stable is its meaning as it circulates?

This framework also allows for comparative analysis across formats and publics. A museum exhibit, a press release, and a podcast may each represent the same research, yet emphasize different dimensions of the spectrum. A tweet may prioritize accessibility and emotional resonance, while a white paper may score higher on accuracy and stability. Neither is inherently superior. Each reflects different communicative goals, constraints, and affordances (Trench, 2008; Davies & Horst, 2016).

This comparative orientation also lends itself to visualization. The A/A spectrum can be modeled as a radar chart, with each axis—accessibility, accuracy, and epistemic stability—radiating from a central point. Specific communicative instances can then be plotted as polygons within the chart, creating a profile of how a piece balances its competing demands. A podcast designed for a general audience may stretch far toward accessibility but require sacrifices in technical depth. A scholarly infographic may balance accuracy and stability but reach only a narrow audience. Visualizing these trade-offs helps communicators chart the optimal configuration of a message relative to its purpose, audience, and constraints. It does not prescribe a perfect balance but invites reflexive assessment. The goal is not to maximize all three dimensions, but to align them with the epistemic and ethical requirements of a given situation.

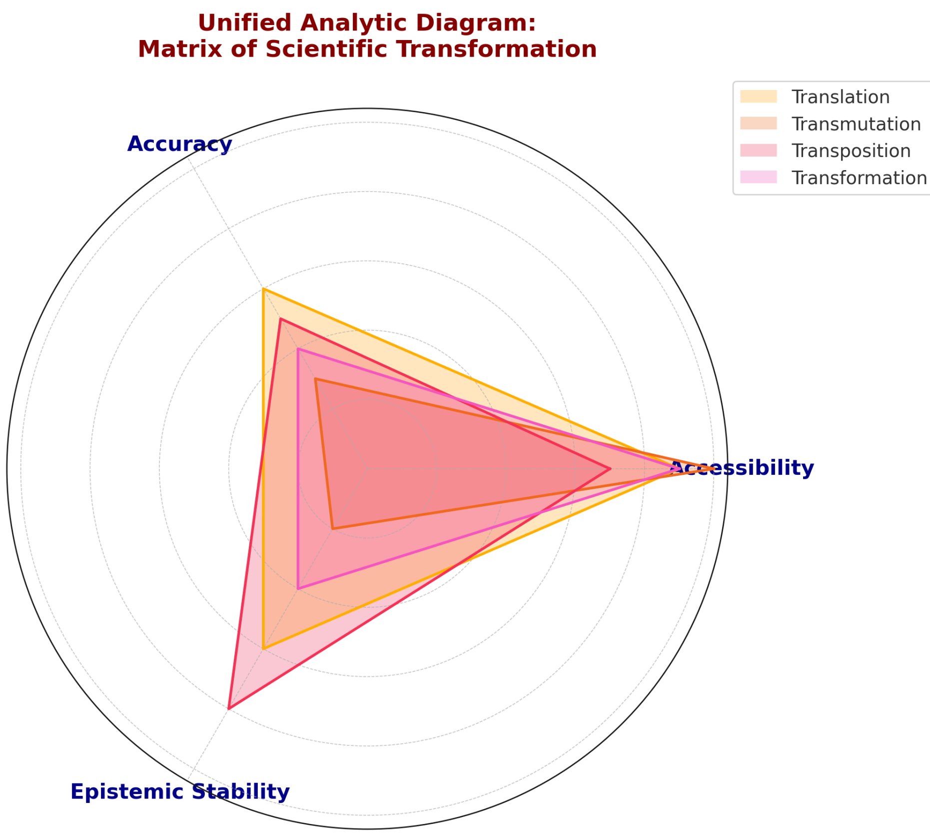

Figure 4. Unified Analytic Diagram: Matrix of Scientific Transformation.
This composite radar chart visualizes average positions for each mode of transformation across the A/A spectrum. Translation maintains relative epistemic integrity while increasing accessibility; transmutation privileges accessibility with greater epistemic risk; transposition shifts emphasis toward institutional integration. Transformation as a category aggregates these dynamics across contexts.

Ultimately, the A/A spectrum invites us to treat science communication not as a pipeline, but as a field of epistemic labor. It helps us see communication as an active site of meaning-making, where knowledge is translated, framed, and reframed through multiple lenses. In the sections that follow, this model will be applied to two illustrative cases: epigenetics and Maslow's hierarchy of needs. Each offers a different configuration of the spectrum, and each reveals how meaning is made—and remade—through the practices of public science.

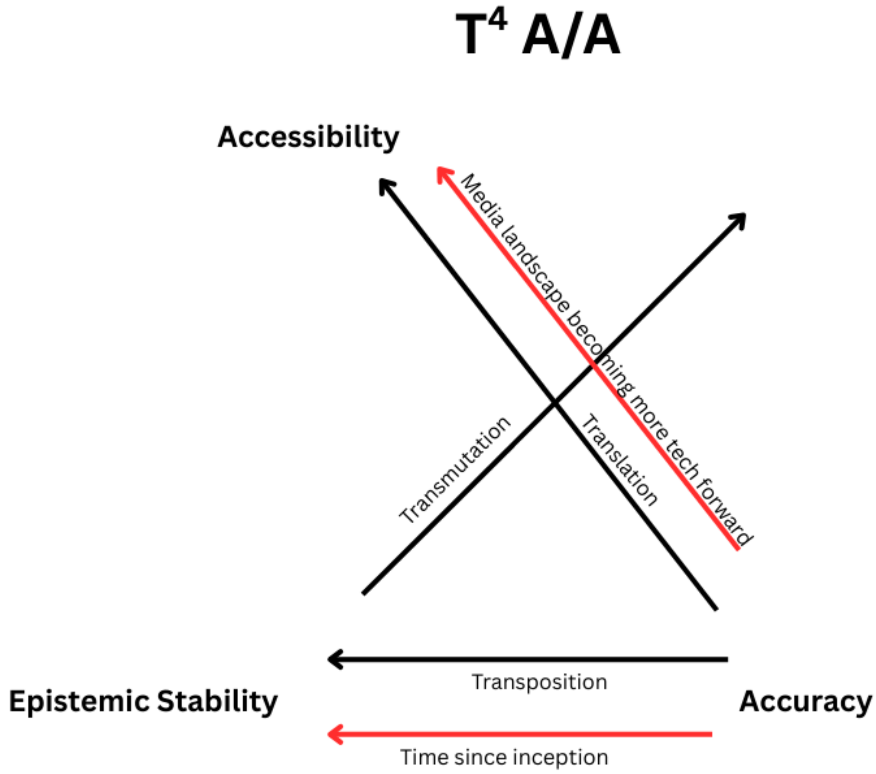

Figure 3. T⁴ A/A Diagram: Axes of Scientific Transformation.

A schematic diagram of the Accessibility-Accuracy (A/A) spectrum, incorporating epistemic stability as a third axis. Three transformational operations are defined: translation, transmutation, and transposition. Arrows indicate directional tendencies over time and media change, illustrating how scientific ideas move across epistemic and communicative dimensions.

E. The A/A Spectrum in Motion: Transformation Vectors and the Triangular Diagram

To visualize how scientific meaning shifts across public contexts, this paper introduces a unified analytic diagram: a model that integrates the Accessibility–Accuracy (A/A) spectrum with the four modes of transformation—translation, transmutation, transposition, and transformation. This diagram serves both as a conceptual map and an analytic scaffold. It captures how scientific representations move across the triadic field of accessibility, accuracy, and epistemic stability, and how each transformation vector reshapes the epistemic contours of knowledge in circulation.

Rather than defaulting to a radar chart see (Fig. 4) from the outset, the diagram draws on a triangular vector model (see Fig. 3) that represents the A/A spectrum as a multi-axial field of tension. The three axes—accessibility, accuracy, and epistemic stability—form a triangular space within which each mode of transformation can be charted as a directional vector. These vectors trace how specific communicative acts pull representations toward different poles, generating predictable patterns of epistemic consequence.

F. Axis Definitions

- Accessibility refers to a message's clarity, interpretability, affective resonance, and reach across non-expert publics.
- Accuracy indexes the degree to which representations preserve methodological, evidentiary, and conceptual fidelity.
- Epistemic Stability denotes the capacity of a representation to maintain its core meaning as it circulates across platforms, formats, and rhetorical frames.

G. Transformation Vectors

Each transformation mode operates as a distinct directional force within this space:

- Translation Vector
    - Movement: Primarily pulls toward accessibility.

    - Effect: Often involves metaphor or simplification, which may reduce accuracy; epistemic stability varies depending on how carefully core meanings are retained.
    - Typical Landing Zone: High accessibility, moderate accuracy, variable stability.
- Transmutation Vector
    - Movement: Leans strongly toward accessibility, reframed by narrative or ideological logic.
    - Effect: Epistemic stability often degrades significantly as meaning is reshaped through affect or cultural resonance.
    - Typical Landing Zone: Very high accessibility, significantly lower accuracy, lowest epistemic stability.
- Transposition Vector
    - Movement: Shifts primarily across institutional domains (e.g., lab to clinic, research to marketing).
    - Effect: Accuracy may decline, but meaning often re-stabilizes within the new domain's logics and goals.
    - Typical Landing Zone: Moderate accessibility, reduced accuracy, high stability *within* the new context.
- Transformation Vector
    - Movement: A layered vector composed of translation, transmutation, and transposition operating simultaneously.
    - Effect: Produces compounding shifts across all three axes, often resulting in significant reconfigurations of meaning.

    - Typical Landing Zone: High accessibility, low-to-moderate accuracy, variable but frequently diminished stability.

This model enables both general theorization and specific analytic tracing. While the triangular form anchors the theoretical diagram, in practice, the three axes can be modeled using radar charts to compare specific instances—such as texts, visuals, or platform-native content. These radar profiles make it possible to visualize the distinct epistemic configurations that emerge as scientific concepts circulate.

H. Case Applications

For example, the case of epigenetics reveals a progressive shift across the transformation vectors:

- Scientific Origin (Weaver, 2004): Low accessibility, very high accuracy, high epistemic stability.
- Translated in media: High accessibility, moderate accuracy, reduced stability.
- Transmuted in trauma discourse: Very high accessibility, low accuracy, low stability.
- Transposed into therapy or parenting frameworks: High accessibility, moderate-to-low accuracy, but re-stabilized meaning within therapeutic paradigms.

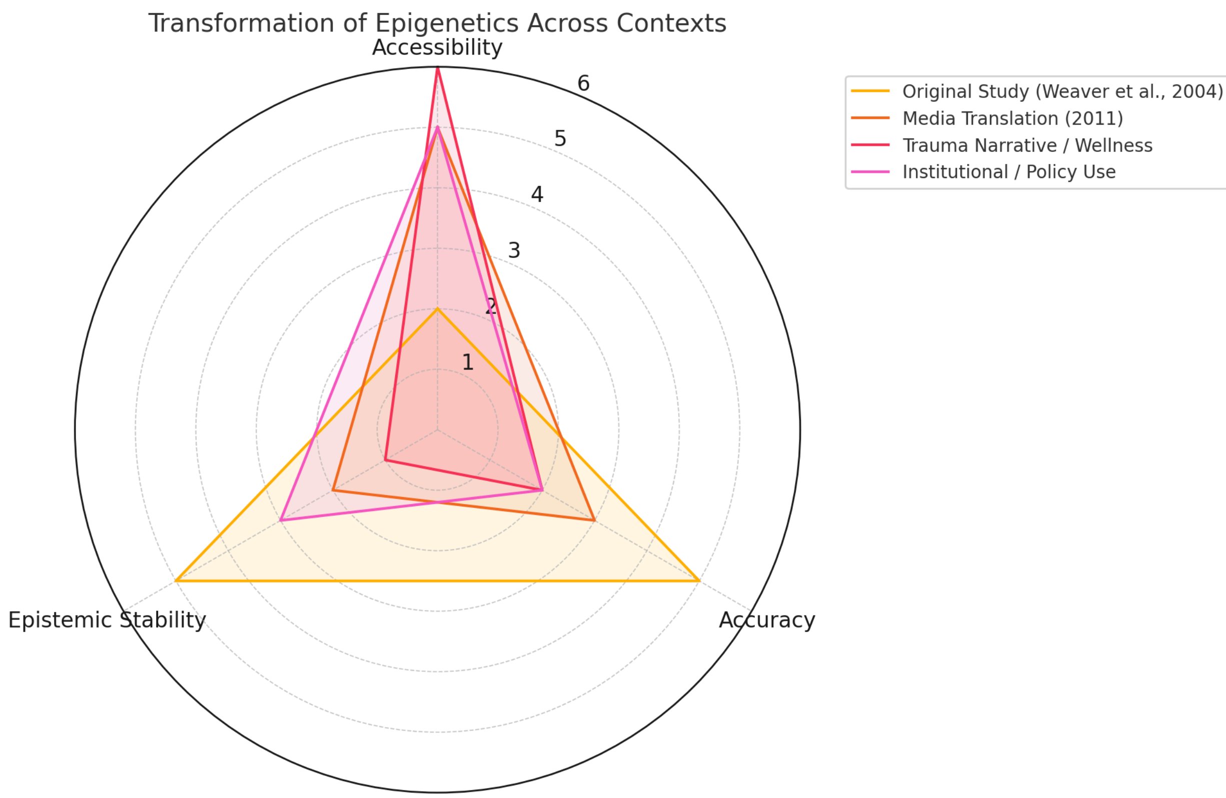

Figure 5. Transformation of Epigenetics Across Contexts.

This radar chart visualizes the shift in accessibility, accuracy, and epistemic stability across four discursive contexts for the original 2004 epigenetics study by Weaver et al. Scores reflect qualitative coding and interpretive analysis, with the original study maintaining high epistemic stability and accuracy, while later popular and policy adaptations prioritize accessibility at the cost of accuracy and stability.

In contrast, Maslow's hierarchy of needs exemplifies a reverse configuration:

- Original theory: Moderate accessibility, speculative accuracy, moderate stability.
- Translated visually into a pyramid diagram: High accessibility, low accuracy (via oversimplification), but increased epistemic stability through visual repetition.

- Transmuted in business or motivational contexts: Very high accessibility, low accuracy, high stability through institutional repetition.
- Transposed into education or UX design: High accessibility, very low accuracy, but persistent stability due to embeddedness in professional schemas.

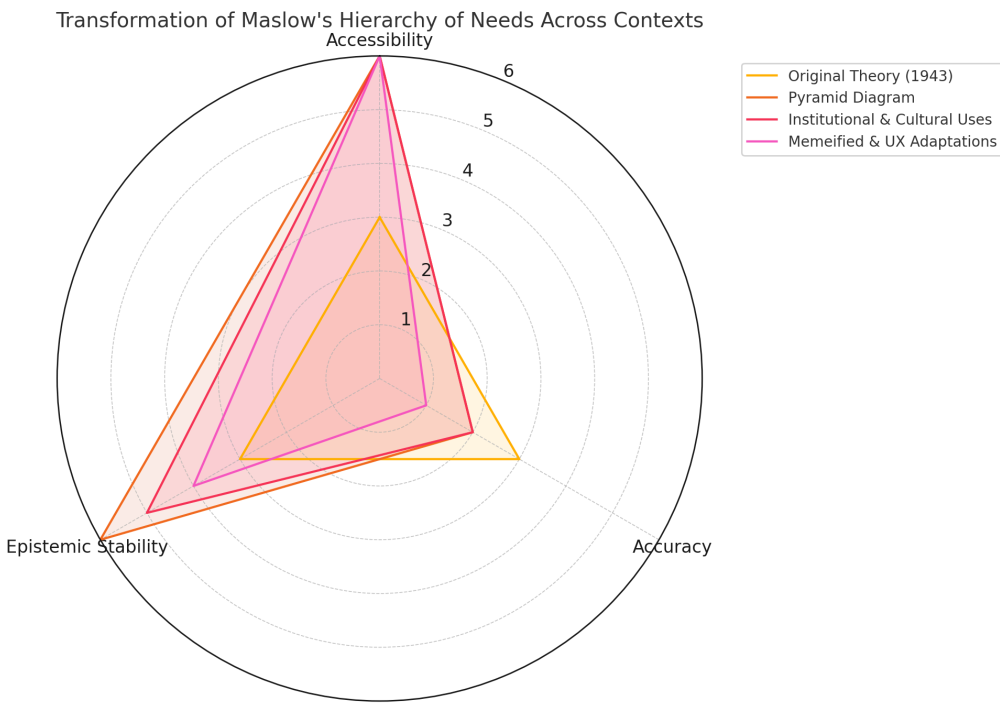

Figure 6. Transformation of Maslow's Hierarchy of Needs Across Contexts.

A radar chart mapping shifts in accessibility, accuracy, and epistemic stability across four phases of Maslow's theory. While the original theory emphasizes conceptual rigor, later stages—particularly memeified and UX adaptations—favor accessibility, accompanied by a loss of epistemic nuance and accuracy.

I. Integration and Utility

The unified analytic diagram thus provides a method for tracking how scientific representations morph in the wild. It clarifies not only *what* is changed but *how* and *why*. As a conceptual frame, it supports theoretical reflection on the politics and poetics of knowledge transformation. As an analytic tool, it invites systematic comparison across cases, formats, and genres.

In this way, the diagram extends the A/A spectrum beyond metaphor, offering a flexible infrastructure for mapping the circulation of scientific meaning—its amplification, distortion, stabilization, and loss—as it traverses the contemporary media ecology.

IV. Analytical Illustrations: Epigenetics and the hierarchy of needs

These examples do not aim to represent the totality of public discourse, nor to adjudicate the correctness of specific communicative acts. Rather, they function as ideal types—a term borrowed from Max Weber to describe heuristic models that isolate recurring features without attempting to represent empirical reality in full. These ideal types exist as analytic constructions that distill the central features of transformation along the Accessibility–Accuracy spectrum. They sharpen contrasts, reveal tensions, and make visible the logics that structure transformation (Weber, 1949). Each case illustrates a different configuration of the spectrum, and each foregrounds the stakes of making knowledge public in distinct ways.

A. Epigenetics: From Biological Nuance to Public Metaphor

Epigenetics refers to the study of heritable changes in gene expression that do not involve alterations to the underlying DNA sequence. It explores how environmental exposures, stress, diet, and social conditions can influence how genes are expressed or suppressed—and how these changes might persist across generations. Within the scientific community, epigenetics is marked by methodological complexity and cautious interpretation. Studies often rely on intricate laboratory techniques, longitudinal designs, and context-sensitive probabilistic claims. The field operates under the weight of its own epistemic modesty: findings are framed with caveats, and the language of causality is typically avoided in favor of influence, likelihood, and correlation (Jablonka & Lamb, 2005; Meloni, 2016).

A landmark 2004 study by Weaver et al. exemplifies this restraint. Published in Nature Neuroscience, the study demonstrated that maternal behavior in rats—specifically licking and grooming—could alter DNA methylation patterns at the promoter of the glucocorticoid receptor (GR) gene in the hippocampus, affecting stress responses in offspring. The findings were robust yet carefully contextualized: framed within the limits of rodent models, grounded in behavioral and biochemical evidence, and explicitly non-deterministic. Terms like "epigenetic programming" were used with caution. The authors avoided sweeping claims, emphasizing that effects were reversible and highly context-dependent.

The first transformation occurred through translation. By 2011, the "rat licking" study had entered popular science venues: TED Talks, science blogs, and articles with titles like "Can trauma be inherited?" or "How your mother's love rewires your genes." These versions distilled the science into emotionally resonant metaphors—replacing methylation assays and receptor pathways with phrases like "love changes your DNA" or "trauma leaves a mark on your genes" (Nerlich et al., 2012; Gibbons, 2015). While these translations made the science accessible, they also shifted its epistemic coordinates. Complex, contingent claims were reshaped into legible, affective narratives.

This framing deepened into transmutation, where metaphor became story. The “rat licking” study evolved into a cultural parable, cited in therapy trainings, social work literature, public health campaigns, and TikTok explainer videos (Richardson et al., 2014; Waggoner & Uller, 2015). Epigenetics became shorthand for the intergenerational transmission of trauma—a biologized narrative of suffering that resonated with identity discourses, particularly in trauma-informed and equity-focused fields. Yet this public epigenetics often reversed the field’s original insights: rather than destabilizing genetic determinism, it reinforced a new kind of biological essentialism. Emotional experiences were portrayed as molecular inscriptions, defining identity and fate.

Transposition followed. Epigenetics crossed into institutional discourses—early childhood education, wellness culture, public health messaging, and parenting literature—where it served as a flexible framework to justify interventions or explain disparities. In these contexts, the concept moved from research finding to rhetorical resource. In corporate wellness or trauma therapy branding, “epigenetics” became a floating signifier of credibility, often detached from any specific study or evidentiary basis (Lappé, 2016; Dupras & Ravitsky, 2016). Scientific citations lingered at the margins, if at all; what remained was the symbolic authority of biology as moral proof.

Throughout this trajectory, epistemic stability eroded. The term “epigenetics” came to mean different things in different arenas—scientific process, identity narrative, therapeutic metaphor, policy rationale. Meanwhile, counterfindings began to accumulate. Scholars raised concerns about the replicability of methylation effects across species, the reversibility and instability of epigenetic markers, and the difficulty of drawing causal lines from molecular shifts to human behavior (Heijmans & Mill, 2012; Meloni, 2018). These critiques were taken seriously within the scientific community but rarely entered the public discourse. The field's epistemic modesty was overwritten by the narrative logic of inherited trauma.

On the Accessibility–Accuracy radar chart, this trajectory traces a progressive shift across the transformation vectors. The 2004 study sits in a high-accuracy, high-stability, low-accessibility zone. Media versions circa 2011 move toward high accessibility and moderate accuracy. Trauma-informed discourse amplifies accessibility further while diminishing both accuracy and stability. Institutional and wellness applications stabilize a simplified version of the concept, producing moderate epistemic stability despite lingering inaccuracies.

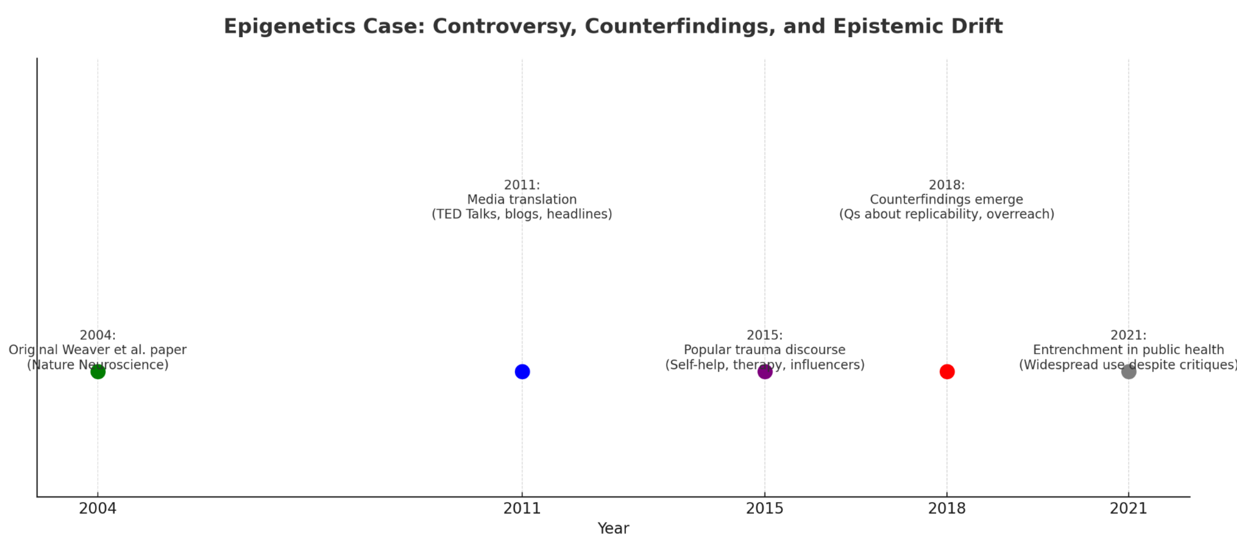

Figure 7. Epigenetics Case: Controversy, Counterfindings, and Epistemic Drift.

A timeline illustrating the discursive and epistemic trajectory of the 2004 epigenetics study, tracking key moments of media translation, popular uptake through trauma discourse, critical counterfindings, and institutional entrenchment. This sequence maps the temporal unfolding of transformation across scientific, public, and institutional domains.

What makes epigenetics a revealing ideal type is precisely this configuration: it succeeds in public not by preserving complexity, but by adapting to frameworks of meaning, inheritance, and emotional resonance. It becomes a case of narrative overdetermination—a concept that circulates widely precisely because of its capacity to be refashioned. The A/A spectrum makes this movement legible not as a failure of communication, but as a systematic transformation shaped by platform logics, genre demands, and institutional incentives.

This transformation reveals what is often lost—scientific nuance, conceptual contingency—but also what is gained: symbolic power, affective accessibility, and cultural uptake. It demonstrates how science becomes public not by remaining intact, but by being made meaningful. In the next case, we turn to an almost inverse configuration: a speculative model with little empirical support that nonetheless maintains remarkable epistemic stability through visual abstraction and institutional repetition. This is the case of Maslow's hierarchy of needs.

B. Maslow's hierarchy of needs: From Speculative Psychology to Cultural Iconography

If epigenetics exemplifies an ideal type of unstable transformation, Maslow's hierarchy of needs represents its inverse. It is a model that began as speculative, gained traction through visual abstraction, and has since achieved broad epistemic stability despite a weak empirical foundation. Unlike epigenetics, which circulates widely but often unravels conceptually, the hierarchy of needs remains visually intact and rhetorically durable across formats and institutions. It is an ideal type of representational resilience.

The theory first appeared in Abraham Maslow's 1943 article A Theory of Human Motivation in Psychological Review. There, Maslow proposed that human needs tend to follow a general progression—from physiological survival, to safety, love and belonging, esteem, and finally, self-actualization (Maslow, 1943). Yet Maslow was clear about the speculative and flexible nature of his model. “Any motivated behavior,” he wrote, “usually is motivated simultaneously by more than one basic need” (p. 370), and he explicitly rejected the idea of a strict sequence or universal structure. The framework emerged from clinical observation and humanistic psychology—not experimental science—and was framed with epistemic caution.

The now-iconic pyramid diagram, however, did not originate with Maslow. It was developed later by educators, consultants, and designers who sought to visualize the theory in ways that would be legible and teachable. (Bridgman, Cummings, & Ballard, 2019) The resulting image—five stacked layers suggesting linear progression and developmental inevitability—was not present in the original text. This act of translation condensed a discursive and contingent model into geometric fixity. In doing so, it transformed the theory's communicative function. The pyramid did not merely illustrate the model; it reconstituted it, enabling replication, rapid uptake, and the appearance of coherence.

This visual logic facilitated a broader process of transposition. By the 1960s and 70s, the pyramid began appearing in business trainings, classroom materials, management literature, and motivational seminars. In these settings, the image served as a strategic framework: a tool for designing incentives, structuring policy, or guiding employee behavior. Its appeal lay in its simplicity, intuitiveness, and lack of jargon—qualities that allowed it to be embedded across institutions, despite its limited empirical foundation. The pyramid was not only accessible; it was useful.

Over time, this transposition enabled transmutation. The model's core idea—human progress through stages of need—was adapted for new ideological purposes. In UX and product design, it became a rationale for user satisfaction flows. In management seminars, it justified performance incentives. In public education, it structured assumptions about motivation and support. On the internet, it was meme-ified into jokes about coffee, WiFi, or emotional needs. These appropriations bore little resemblance to Maslow's original theory, but they preserved the image. The pyramid's shape carried its authority. The structure substituted for explanation.

What makes the hierarchy of needs so durable is not its scientific rigor, but its visual coherence and institutional repetition. It appears in psychology textbooks, curriculum plans, corporate decks, and wellness branding. It is instantly legible, emotionally resonant, and rarely questioned. Critics have long challenged its cross-cultural validity, universalist assumptions, and methodological imprecision (Wahba & Bridwell, 1976; Neher, 1991). Later psychologists proposed more dynamic models of motivation grounded in evolutionary theory and social context (Kenrick et al., 2010). Yet none of these revisions have meaningfully displaced the original. The pyramid persists not because it is confirmed, but because it is seen.

On the Accessibility–Accuracy radar chart, Maslow's original 1943 text sits in a middle zone: moderate accessibility, moderate accuracy (as a speculative theory), and moderate epistemic stability. The pyramid image, however, shifts dramatically: very high accessibility, low accuracy, but extremely high epistemic stability. That stability is not maintained through debate or evidence, but through repetition. It is a product of design, not discovery. The more it circulates, the more authoritative it becomes—a feedback loop of epistemic legitimacy reinforced through visibility.

This configuration stands in sharp contrast to the case of epigenetics, where a scientifically robust concept became fragmented through metaphor and cultural uptake. Where epigenetics stretches toward accessibility but risks distortion, Maslow's hierarchy remains fixed in its iconic form, despite conceptual thinness. One dissolves under pressure; the other crystallizes. One becomes unstable through narrative proliferation; the other is stabilized through visual shorthand and institutional inertia.

Together, these cases illustrate the diagnostic utility of the A/A spectrum. They show that science communication is not simply a matter of truth or clarity, but of uptake, design, and rhetorical durability. They reveal how different kinds of transformation produce different epistemic outcomes—not because of content alone, but because of how form, format, and repetition mediate meaning across publics, platforms, and purposes.

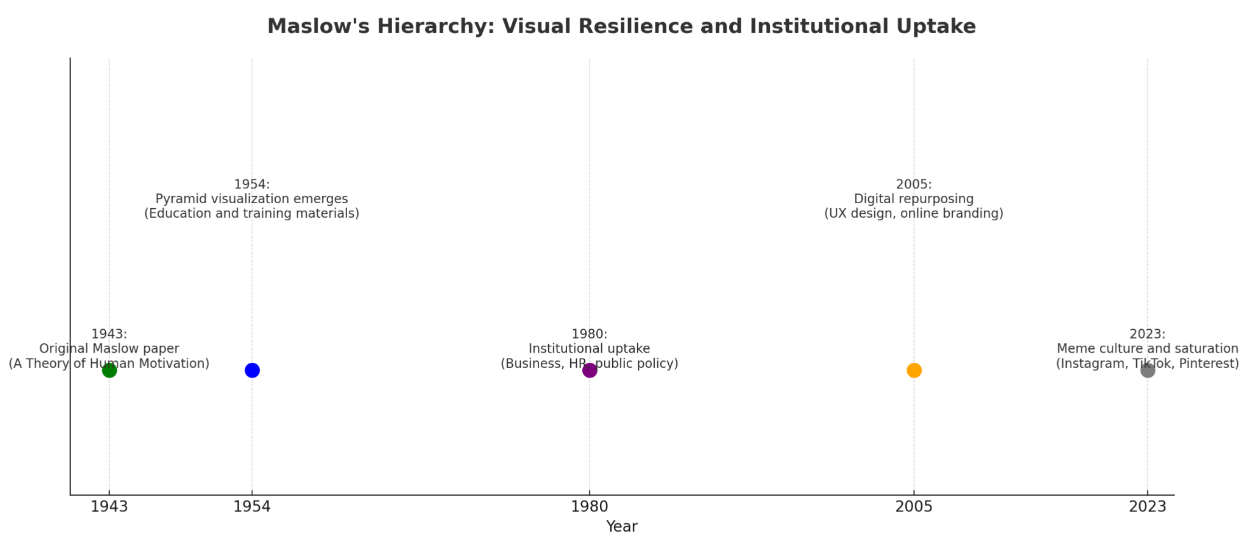

Figure 8. Maslow's Hierarchy: Visual Resilience and Institutional Uptake.

This timeline traces the evolving uptake of Maslow's original theory of human motivation (1943), highlighting the emergence of the pyramid visualization, institutional repurposing, and its contemporary saturation in digital and meme culture. The visual resilience of the pyramid format facilitates sustained transformations across media and time.

V. Discussion: Mapping the Risks and Possibilities of Transformation

A. Operationalizing the Metric: A Method for Mapping Scientific Transformation

To evaluate how scientific knowledge shifts across the Accessibility–Accuracy spectrum, This study employs a three-part analytic method combining textual features, genre tracking, and reception history. Weaver et al.'s (2004) article "Epigenetic programming by maternal behavior" functions as an initial prototype, and from there 75 to 100 downstream representations of its core findings between 2011 and 2021 are traced, spanning TED Talks, wellness blogs, trauma-informed therapy guides, TikTok videos, and science journalism. Each version was coded across three dimensions:

Accessibility: assessed via Flesch-Kincaid readability scores, genre (e.g., short-form video vs. academic abstract), and metaphor usage (e.g., "rat licking" as a proxy for generational trauma). Accuracy: measured through comparison of key claims (e.g., methylation reversibility, GR expression, cross-fostering) with the original article, noting omission or distortion of central mechanisms (e.g., histone acetylation, NGFI-A binding). Epistemic Stability: gauged by tracking semantic drift, visual mutations, and whether citations remained tied to the original article or were recontextualized into unrelated domains (e.g., therapy models with no reference to rats or neuroscience).

Each version was then placed on the radar chart to visualize its position within the spectrum. The cumulative trajectory across these instances revealed the process of transmutation (affective reframing into trauma discourse), transposition (migration into therapeutic and influencer contexts), and eventual transformation of meaning beyond its scientific origin.

Having established a conceptual framework that accounts for both semantic shifts and representational dynamics, the next section illustrates how this model applies in practice. Through the use of selected case studies, this paper puts theoretical distinctions to work, using idealized examples to reveal the layered nature of scientific transformation. The case studies of epigenetics and the hierarchy of needs illuminate two distinct configurations on the Accessibility–Accuracy spectrum. Each reveals how scientific knowledge is transformed not only through simplification or distortion, but through deeper processes of rhetorical adaptation, institutional circulation, and visual abstraction. Together, these cases function as analytic models that clarify how different trade-offs manifest when science becomes public.

Epigenetics exemplifies a form of transformation in which a concept becomes culturally resonant but epistemically unstable. The language of gene expression is reframed through metaphor and narrative, allowing the concept to migrate into domains as diverse as trauma therapy, parenting discourse, and wellness marketing. This configuration maximizes accessibility and emotional engagement, but often at the cost of evidentiary accuracy and interpretive coherence. Meaning stretches across contexts but does not always hold. The concept succeeds rhetorically by adapting to cultural desires, not by preserving scientific specificity.

Maslow’s hierarchy of needs, by contrast, exemplifies a different configuration. Here, a speculative theory has become stabilized through visual simplification and institutional repetition. The pyramid model is widely recognized, broadly applicable, and easily reproduced, yet its empirical foundations remain weak. It offers clarity, but the clarity is illusory. It holds together not through ongoing engagement with research, but through design, uptake, and repetition. In this configuration, epistemic stability is achieved without accuracy.

These cases suggest that science communication cannot be understood as a simple balancing act between precision and clarity. Instead, it operates within a multidimensional field shaped by cultural expectations, visual grammars, institutional infrastructures, and platform dynamics. The Accessibility–Accuracy spectrum offers a way to map this field. It helps us recognize how different communicative strategies perform epistemic work, and how meaning is remade in the process of circulation.

More importantly, the spectrum draws attention to the conditions under which scientific representations gain authority. Accuracy alone does not guarantee trust or uptake. Accessibility does not necessarily entail distortion. Epistemic stability can result from repetition and familiarity just as much as from rigor and replication. These conditions are not universal. They vary across audiences, genres, and media environments. What appears clear in one context may feel obscure or unconvincing in another. What counts as accurate may depend on disciplinary norms. What holds together as stable may do so through force of habit rather than conceptual integrity.

Understanding these dynamics requires a shift in how science communication is evaluated. Rather than assessing messages solely in terms of correctness or clarity, the A/A spectrum encourages us to ask deeper questions. What epistemic functions does a message perform? What audiences does it presume or produce? What institutional and visual strategies stabilize its authority? What risks of appropriation or mutation does it invite?

These are not questions that can be answered through fact-checking alone. They require an account of transformation—of how knowledge moves, who moves it, and what happens in the process. They require attention not only to the content of science, but to its composition, mediation, and performative effects.

The cases presented here point to both the risks and the possibilities of transformation. Epigenetics shows how a powerful metaphor can become a double-edged tool, enabling resonance while inviting overreach. The hierarchy of needs shows how a compelling visual form can preserve stability even in the absence of empirical robustness. Both reveal the stakes of communication, and both suggest that transformation is not a failure, but a structural condition of making science public.

VI. Gaps in Literature and Future Directions

A significant gap in the Information Studies literature lies in its lack of clearly defined frameworks for evaluating how information transforms—rather than merely circulates—across different social, technological, and institutional contexts. Information scholars have long examined how knowledge moves through infrastructures of classification, metadata, and institutional design (Bowker & Star, 1999; Lampland & Star, 2009). Science communication research has focused on models of public participation, moving from the deficit model to dialogue and deliberation frameworks (Trench, 2008; Irwin, 2008). These paradigms have generated robust insights into how publics engage with science—but few have directly modeled epistemic transformation through communicative form.

This paper builds on that lineage while shifting focus to the aesthetic and narrative processes that reshape scientific meaning as it circulates. By foregrounding transformation as both a formal and epistemic phenomenon, this project complements work in the public understanding of science while introducing new analytic tools for tracking how meaning stabilizes, mutates, or dissolves across media environments.

While Information Studies has developed robust approaches to classification, infrastructure, and access, it has yet to offer tools for tracing the epistemic consequences of communicative mediation. Much of the existing work on science communication focuses on misinformation, risk perception, or behavioral nudges, often using simplified models of message distortion or content fidelity. These approaches rarely account for how meaning is reconstituted in response to audience framing, genre, or media form. Bowker and Star's (1999) foundational work on classification systems illustrates how seemingly neutral systems of knowledge organization are shaped by historical, social, and institutional contexts—insights that can and should be extended into the domain of representation and transformation. The framework developed in this paper brings those insights into conversation with rhetorical theory, translation studies, and media studies, offering a new lens for analyzing how scientific information becomes culturally legible and epistemically authoritative—or unstable—through transformation.

What is missing is a sustained framework for analyzing how scientific meaning is made and remade through multimodal form, institutional uptake, and public reinterpretation. The literature has offered important critiques of the deficit model and has explored how publics engage with science in dialogic and participatory ways (Bucchi & Trench, 2014; Irwin, 2008). However, less attention has been paid to how scientific representations are reshaped not just through misunderstanding or misuse, but through the normal, everyday pressures of mediation.

The concept of transformation—particularly as articulated through the Accessibility–Accuracy spectrum—offers a way to address this gap. It invites new research questions that go beyond whether science is correctly communicated to ask how knowledge shifts across genres, audiences, and institutions. It reframes communication not as the endpoint of research but as a constitutive part of knowledge production.

To develop this approach, science communication research will need new methods. The A/A spectrum offers a conceptual foundation, but it must be operationalized through empirical study. This includes qualitative methods, such as critical discourse analysis, which can trace how scientific terms change meaning across media contexts. It also includes computational approaches, such as natural language processing and semantic modeling, which can identify patterns of metaphor, framing, and epistemic drift at scale.

Future research might examine how particular scientific concepts cluster across platforms like Twitter, YouTube, and mainstream journalism, and how their communicative forms shape public understanding. It might explore how infographics and visual explainers encode ideological assumptions. It might analyze how institutional constraints—such as the funding priorities of think tanks or the genre conventions of TED Talks—shape the epistemic trajectories of scientific claims.

Equally important is the need to study imagined publics—the audiences that communicators presume, invoke, or construct through their representational choices. Research could examine how communicators balance accessibility and accuracy when addressing different communities, and how these balances shift depending on whether the intended audience is a policymaker, a journalist, a funder, or a general public.

This work will require interdisciplinary collaboration. Scholars from science and technology studies, media theory, design, rhetoric, computational linguistics, and digital humanities can contribute distinct methods and perspectives to the shared question of how scientific meaning travels. The A/A spectrum offers a common language through which these approaches might be coordinated. It provides a way to describe what is happening at the intersection of message, medium, and audience.

What emerges is a research agenda not only concerned with correcting error or measuring belief, but with mapping the life of scientific ideas as they are transformed, reinterpreted, and made to matter across public life.

VII. Significance and Applications

The Accessibility–Accuracy spectrum is not only a theoretical model. It is a practical tool for thinking critically and reflexively about the conditions under which science becomes public. By naming and differentiating between accessibility, accuracy, and epistemic stability, the spectrum gives communicators, educators, journalists, and designers a framework for assessing how scientific meaning is being shaped, and how it might shift in circulation.

In professional settings, the spectrum can support deliberate communicative choices. Rather than defaulting to simplified formats or assuming fidelity through citation, practitioners can ask targeted questions: What kind of accessibility is required in this context? What forms of accuracy must be preserved to maintain epistemic integrity? How likely is this message to retain its meaning as it travels beyond its initial audience? These questions reframe communication not as delivery but as design—a process that demands ongoing negotiation between clarity, complexity, and conceptual coherence.

The spectrum also invites pedagogical application. In classrooms, it can be used to teach students not just how to write or speak about science, but how to reflect on the rhetorical, visual, and ethical dimensions of that act. Assignments might involve charting different media representations of a single scientific concept and locating them within the spectrum. This exercise foregrounds the idea that meaning is not static, and that communicators make epistemic decisions—often implicitly—with every choice of word, image, or format.

For researchers, the spectrum offers a way to map public discourse without relying on binary categories like misinformation versus truth. It allows for analysis of science communication that considers trade-offs rather than failures, and makes room for the complexities of audience context, institutional pressure, and platform logic. It can be adapted to qualitative case studies, quantitative media analysis, and design-focused projects that seek to improve science literacy or engagement.

Underlying this model is a broader claim: that science communication is a form of epistemic labor. It is not a neutral act of transmission. It is work that reshapes meaning through composition, framing, and circulation. Like all labor, it is shaped by structural constraints. It is influenced by attention economies, funding priorities, media norms, and public expectations. To communicate science is to enter into a complex terrain of power, trust, aesthetics, and interpretation.

This framing has significant implications for how we think about literacy, trust, and public understanding. If transformation is the rule rather than the exception, then trust cannot be built solely on accuracy. It must also be grounded in transparency about the communicative process itself. Literacy, in this model, is not only the ability to comprehend scientific terms. It is the capacity to recognize how scientific meaning is shaped, and to critically engage with its visual, rhetorical, and institutional dimensions.

In an era defined by algorithmic mediation, participatory media, and synthetic content, this kind of literacy becomes even more urgent. The A/A spectrum offers one step toward that literacy—not by prescribing how science should be communicated, but by providing a way to think about what science communication does, and what it might do differently.

This paper has argued that science communication must be understood not as the delivery of stable meaning, but as a site of transformation—where knowledge is restructured through translation, transmutation, and transposition. It has introduced the Accessibility–Accuracy spectrum as a theoretical model for analyzing how these transformations unfold, and how they shape what science becomes as it circulates across media, institutions, and publics.

The A/A spectrum makes three key contributions. First, it names the distinct but interrelated dimensions of accessibility, accuracy, and epistemic stability, offering a language for evaluating how knowledge is made intelligible, how it remains tethered to evidence, and how it survives fragmentation and reinterpretation. Second, it reframes the goals of science communication, shifting attention from clarity and correctness alone to the broader field of epistemic labor involved in shaping and sustaining meaning. Third, it provides a flexible framework for research and practice, one that can be adapted across formats, disciplines, and analytical scales.

VIII. Conclusion

Through the case studies of epigenetics and Maslow's hierarchy of needs, the paper has demonstrated how different configurations of the A/A spectrum produce distinct communicative effects. Epigenetics shows how accessibility can drive public uptake even as stability falters. The hierarchy of needs reveals how visual coherence and institutional repetition can confer legitimacy on a model that lacks empirical grounding. These cases are not isolated examples. They clarify broader patterns in how science is reconstituted through public discourse.

Recognizing transformation as a structural feature of communication invites a shift in research priorities. It calls for interdisciplinary methods that can map the life of scientific ideas across platforms, publics, and institutional infrastructures. It demands reflexive attention to the forms and norms through which knowledge gains its authority. And it opens up new questions: What does it mean for a concept to succeed in public? What kinds of epistemic values are prioritized through design, genre, or repetition? How might communication be practiced differently if transformation were assumed from the start?

These questions suggest that the Accessibility–Accuracy spectrum is not only a framework for analysis. It is an invitation to reimagine science communication as a dynamic and negotiated practice, one that acknowledges its own power to shape what counts as knowledge. As the landscape of public science continues to shift, this model offers a path toward more grounded, critical, and imaginative forms of engagement.

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Declaration of Interest

The author declares no conflicts of interest related to the research, authorship, or publication of this article.

Biographical Note

Sophia Toubian is a PhD student in the Department of Information Studies at the University of California, Los Angeles. Her research explores how scientific and technical knowledge is translated, transformed, and visualized as it moves between specialized and public contexts. Drawing from information studies, science and technology studies (STS), and media theory, her work investigates the epistemic consequences of communicative form in contemporary science communication—particularly through AI-generated content, visual media, and platform logics. She is affiliated with the AI and Cultural Heritage lab at UCLA and has taught interdisciplinary courses on neuroscience, data modeling, and critical code studies. Her current projects examine how metrics, metaphors, and media infrastructures shape the public legibility of complex scientific ideas. She holds dual degrees from UCLA and is especially interested in methodological innovation that bridges qualitative interpretation with computational approaches to meaning.

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