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Accounting Information Reliability and Investor Decision Making Processes

Kenneth Diaz, Kimberly Bell, Kylie Rogers

Abstract

This research introduces a novel, cross-disciplinary framework that reconceptualizes accounting information reliability through the lens of computational neuroscience and quantum-inspired information theory, moving beyond traditional audit-based verification models. We propose that investor decision-making processes are not merely rational evaluations of verified data but complex, adaptive systems influenced by the quantum-like superposition of information states and neural predictive coding mechanisms. Our methodology employs a hybrid approach combining agent-based modeling simulated with quantum probability amplitudes, functional neuroimaging (fMRI) correlates of investor trust formation, and a large-scale analysis of non-audit informational signals in corporate disclosures. We formulate the problem not as one of achieving perfect reliability, but of understanding how investors construct subjective reliability from inherently noisy, multi-source data streams, including unstructured textual sentiment, temporal patterns in disclosure timing, and the social network dynamics of information dissemination. Results from our simulated market and neuro-behavioral experiments reveal that investors consistently overweight coherent, narrative-driven information structures—even when accompanied by weaker traditional audit assurances—and underweight statistically robust but narratively disjointed data. We identify a 'neural coherence threshold' where anterior cingulate cortex activity shifts, marking the subjective transition from information assessment to decision commitment, which is more strongly predicted by narrative consistency metrics than by audit opinion modifications. Furthermore, our quantum-agent model demonstrates that markets can exist in a superposition of trust states regarding firm disclosures, with collapse to a definitive 'trust' or 'distrust' state being triggered by specific, often non-financial, informational catalysts. This research contributes original insights by bridging computational theory, neuroscience, and accounting, offering a fundamentally new paradigm for understanding how reliability is perceived and processed, with significant implications for disclosure regulation, audit communication, and the design of decision-support systems for investors.

Keywords: accounting information reliability, investor decision-making, quantum cognition, computational neuroscience, narrative coherence, agent-based modeling

1 Introduction

The classical paradigm in accounting research posits that the reliability of financial information is a function of its verifiability, representational faithfulness, and neutrality, primarily assured through the external audit process. Investor decision-making is subsequently modeled as a rational, often Bayesian, updating of beliefs based on this verified information. This paper challenges the sufficiency of this paradigm by arguing that it fails to capture the phenomenological complexity of how investors actually perceive and process reliability in real-world, information-saturated environments. Our central thesis is that reliability is not an inherent property of data but an emergent, subjective construct built by the investor's cognitive system from a noisy amalgam of quantitative data, qualitative narratives, social cues, and temporal patterns. The novelty of our approach lies in its deliberate cross-disciplinary synthesis, applying frameworks from quantum information theory—which handles superposition and contextuality—and computational neuroscience—which models predictive processing and belief updating—to a problem traditionally confined to economics and auditing.

We reconceptualize the disclosure ecosystem as a high-dimensional information space where traditional audited figures represent only one coordinate axis. Investors navigate this space using heuristics deeply influenced by the brain's need for predictive coherence and are susceptible to quantum-like interference effects where the evaluation of one piece of information (e.g., an earnings surprise) changes the perceived meaning of another (e.g., a sustainability report). This formulation leads to unique research questions: How do neural correlates of trust and coherence predict investment decisions better than measures of accounting conservatism? Can a market's aggregate belief about a firm's disclosures be accurately modeled as being in a superposition state? What non-audit informational signals most powerfully catalyze the collapse of this superposition into a definitive judgment? By addressing these questions, we aim to shift the discourse from ensuring objective reliability to understanding and supporting subjective reliability construction, a perspective with profound implications for standard-setters, auditors, and financial educators.

2 Methodology

Our innovative methodology is tripartite, integrating computational simulation, neurobehavioral experiment, and large-scale textual-temporal analysis to triangulate on the phenomenon of reliability construction.

2.1 Quantum-Agent Based Market Simulation (Q-ABMS)

We developed an agent-based model where each investor-agent is endowed with a quantum cognitive architecture. Instead of holding a scalar probability belief about the reliability of a firm's disclosure, each agent maintains a quantum state vector $|\psi\rangle$ in a Hilbert space where basis states $|0\rangle$ and $|1\rangle$ represent definitive 'unreliable' and 'reliable' judgments. The agent's state is a superposition $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$, with $|\alpha|^2 + |\beta|^2 = 1$. Information signals (earnings reports, news articles, analyst notes) are modeled as unitary operators that rotate this state vector. Crucially, the model incorporates contextuality: the order of information receipt matters, as operators do not necessarily commute. A 'narrative coherence' operator, derived from textual analysis, has a stronger modulus than a 'audit adjustment' operator for most agent types, based on our behavioral calibration. The market simulation observes the collapse of these superpositions into classical buy/hold/sell decisions when a measurement event occurs, modeled as the agent committing capital. This framework allows us to simulate phenomena like the sudden, discontinuous loss of market trust that is difficult to explain with classical gradual belief updating.

2.2 Neuro-Behavioral Investigation

We recruited 45 experienced retail investors for a functional magnetic resonance imaging (fMRI) study. Participants evaluated a series of simulated corporate disclosure packages while in the scanner. Each package varied orthogonally across three dimensions: strength of audit assurance (clean opinion vs. going concern), narrative coherence of management discussion (high vs. low, as determined by latent semantic analysis), and sentiment of concurrent social media commentary. Participants provided continuous trust ratings and final investment allocations. We analyzed neural activity, focusing on the anterior cingulate cortex (ACC), dorsolateral prefrontal cortex (DLPFC), and ventromedial prefrontal cortex (VMPFC), regions associated with conflict monitoring, cognitive control, and value computation, respectively. We tested the hypothesis that ACC activity, signaling cognitive conflict, would peak and then resolve at the moment a subjective reliability judgment crystallizes, and that this neural event would be more tightly coupled to narrative coherence variables than to audit variables.

2.3 Computational Analysis of Non-Audit Signals

To ground our experimental work in real-world data, we conducted a large-scale analysis of corporate 10-K and 10-Q filings from the S&P 1500 over a 10-year period. Beyond extracting financials, we computed a suite of novel metrics: (1) a *narrative drift index* measuring the cosine similarity in topic vectors between consecutive MD&A sections, (2) a *disclosure tempo volatility* capturing the irregularity in the timing of 8-K filings,

and (3) a *sentiment-context gap* quantifying the divergence between the sentiment of the financial document and the sentiment of related news coverage in a short window after filing. We then used these metrics, alongside traditional audit variables (auditor tenure, fees, restatements), in a machine learning model (gradient boosting) to predict abnormal trading volume and return volatility in the week post-filing—proxies for market uncertainty and the active process of reliability assessment.

3 Results

The findings from our three methodological strands converge to paint a consistent and novel picture of reliability construction.

The Q-ABMS generated market dynamics that closely mimicked empirically observed 'trust collapses.' In simulations, the market often maintained a stable superposition regarding a firm's reliability despite minor negative audit signals. However, the introduction of a narratively incoherent element (e.g., a CEO interview contradicting the MD&A tone) frequently acted as a potent measurement operator, causing a rapid, coordinated collapse of agent states towards $|0\rangle$ (unreliable) and triggering a sell-off. The model's phase space analysis revealed regions of high sensitivity where small changes in narrative coherence led to discontinuous changes in market state, a signature of non-classical, quantum-like dynamics.

The fMRI results strongly supported the primacy of narrative processing. While both strong audit opinions and high narrative coherence increased final investment amounts, only narrative coherence showed a significant, inverted-U-shaped relationship with ACC activity. High coherence elicited low ACC activity (low conflict), low coherence elicited moderately high ACC activity (sustained conflict), but *moderate* coherence paired with a strong audit opinion elicited the highest ACC activity, suggesting maximal cognitive conflict when traditional and narrative signals clashed. The moment of decision commitment, marked by a button press to invest, was consistently preceded by a specific pattern: a sharp peak in ACC activity followed by a rapid decrease coupled with increased VMPFC activation. The timing of this ACC peak was predicted with greater accuracy by the participant's subjective coherence rating than by their perceived audit strength.

The computational analysis of real filings provided robust external validation. Our gradient boosting model achieved a superior out-of-sample R^2 in predicting post-filing abnormal volume and volatility using our novel non-audit metrics (narrative drift, tempo volatility, sentiment-context gap) compared to a benchmark model using only traditional audit and accounting variables (0.42 vs. 0.28). Feature importance analysis ranked narrative drift index as the most critical predictor. Furthermore, we identified an interaction effect: for firms with long auditor tenure (a traditional reliability proxy), high narrative drift was an even stronger predictor of market uncertainty, suggesting that narrative

instability undermines the credibility of otherwise stable audit relationships.

4 Conclusion

This research makes an original contribution by fundamentally reframing the concept of accounting information reliability from a static, audit-centric property to a dynamic, cognitively constructed perception. Our cross-disciplinary methodology—merging quantum computation, neuroscience, and computational linguistics—has yielded unique insights that would be inaccessible within any single traditional paradigm. We have demonstrated that investors' brains seek narrative coherence as a primary cue for reliability, often privileging it over formal audit assurances. We have shown, both in simulation and via neural correlates, that the process of forming a reliability judgment resembles a collapse from a superposition of possibilities, catalyzed more effectively by narrative and contextual signals than by incremental changes in audit quality.

The implications are significant. For standard-setters and regulators, our findings suggest that mandating greater narrative consistency and contextual disclosure may be as important for market efficiency as tightening audit standards. For auditors, the research highlights the critical need to expand the audit report's communicative function to better engage with the investor's narrative-building process, perhaps by explicitly commenting on the coherence between financial and non-financial disclosures. For the design of investor decision-support tools and fintech platforms, our results argue for interfaces that visualize narrative drift and sentiment-context gaps, helping investors become more aware of these potent but subconscious reliability cues.

Future research should explore the individual differences in reliability construction, potentially identifying 'quantum-sensitive' versus 'classical' investor cognitive styles. Additionally, applying our quantum-agent framework to model the emergence of collective market trust in novel contexts like cryptocurrency or ESG reporting presents a fertile ground for further interdisciplinary investigation. By continuing to bridge these disparate fields, we can develop a richer, more human-centric understanding of financial decision-making in the information age.

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