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## Alexa, Reshape My Supply Chain: How Voice Commerce Alters Demand Forecasting, Fulfillment Speed, and Marketing Messaging

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### Abstract

*This study investigates how voice commerce reshapes supply chain management through accelerated demand volatility, hyperlocal fulfillment requirements, and audio-centered marketing strategies. Using a multi-method approach, the research integrates analysis of 812,473 voice transactions and 1.5 million matched digital transactions, laboratory-based behavioral experiments involving 427 participants, and agent-based logistics simulations. The findings reveal that voice commerce generates significant "voice shock" demand spikes, particularly during evening emergency purchasing periods, with same-day delivery expectations increasing by 73% compared to conventional e-commerce channels. Results further demonstrate that single-item voice orders intensify warehouse inefficiencies, increase expedited shipping costs, and require the deployment of micro-fulfillment centers to maintain operational responsiveness. Experimental evidence confirms that urgency-oriented auditory messaging significantly increases conversion rates and delivery expectations, while excessive persuasive prompts heighten post-purchase dissonance and ethical vulnerability. The novelty of this study lies in the development of an integrated cognitive supply chain perspective that combines behavioral economics, linguistic urgency analysis, and logistics optimization within the context of voice-first commerce ecosystems. The research contributes theoretically by extending temporal bias and anticipatory possession concepts into supply chain studies and provides practical implications for retailers seeking to build adaptive, ethically governed, and AI-enabled fulfillment systems in the era of atomic commerce.*

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## INTRODUCTION

The whispered directive, "Alexa, order size 2 diapers," uttered during a nocturnal infant feeding, encapsulates the seductive convenience of voice commerce while

simultaneously obscuring its profound operational repercussions. This frictionless transaction represents a burgeoning paradox fundamentally altering retail logistics: although voice-activated shopping currently constitutes merely 12% of total e-commerce volume, it commands a disproportionate 31% of urgent replenishment orders essential items like infant formula, pet food, or printer ink procured amidst acute household shortages (Statista, 2024). This behavioral asymmetry generates significant reverberations across global supply networks, as voice-induced demand spikes exhibit marked divergence from forecasting models meticulously calibrated for deliberate, screen-based purchasing journeys. Encountering these compressed decision cycles and impulse-driven orders, traditional operational systems manifest staggering inefficiencies, quantified by the Capgemini Research Institute (2023) at \$18 billion in annual global inventory waste. This colossal financial hemorrhage originates from three interlinked systemic failures: fundamentally misaligned stock forecasting due to the inherent volatility of voice orders rendering historical data unreliable; a documented 23% increase in perishable spoilage observed among grocers when unexpected clusters of voice orders for items like organic milk overwhelm established rotation schedules; and a 42% surge in last-mile delivery costs as retailers scramble to meet the implicit "same-day" expectation conveyed through vocal urgency, particularly during predictable ordering peaks. This inherent tension wherein cognitive ease for consumers breeds logistical chaos for supply chain professionals demands rigorous scholarly interrogation beyond the prevailing user-experience-centric literature. Addressing these fundamental operational recalibrations necessitates integrating insights from emerging research domains focused on algorithmic assurance, antifragile logistics design, and AI-mediated supply resilience (Dzreke & Dzreke, 2025e; Dzreke et al., 2025h).

### **Gap Analysis: Bridging Behavioral Shifts and Operational Realities**

A significant academic research was dealt with voice assistant usability and the quality of underlying natural-language processing systems (Liao et al., 2021; Porcheron et al., 2018). Nonetheless, there is a critical theoretical gap of precisely where the field of behavioural economics meets with the field of supply chain dynamics. Current studies are largely confined to human computer interaction orthodoxies, which ignore the spill-over effects of the distinctive psychological architecture of voice commerce radically shortened decision-making pathways and heuristic-based command systems, through downstream fulfilment networks, producing operational effects that can be measured. This omission is especially important considering empirically provable discrepancies between voice and conventional e-commerce transactions as strictly determined in Table 1.

Three urgent divergences demand urgent operational recalibration action plans: first, the startling 47.6% greater impulse purchase rate indicates significantly reduced deliberation prior to purchase, which fundamentally challenges the predictive efficacy of traditional demand models which depend on considered consumer behaviour; second, the alarming 272.7% increase in post-purchase search means that the buyer is uncertain about the specifications or appropriateness, predestination portending expensive reverse-logistics issues as customers admit to seeking clarification late in the day; third, the strong temporal concentration of orders at predictable

Such measurable behavioural transformations are still poorly explained by the current theoretical framework, which accounts for the urgency of new conceptual formulations that can address the gap between the cognitive psychology that underlies voice relationships and the constraints in space and time that global logistics networks have to face. This theoretical vacuum directly correlates with the precision-fragility paradox becoming more apparent in AI-centered retail settings when the growing technological precision increases the customer lifetime value

metrics but also increases operational fragility due to unmodeled demand volatility (Dzreke, 2025b).

Table 1. Comparative Order Characteristics: Voice vs. Traditional E-Commerce Channels

Metric	Voice Commerce	Traditional E-Commerce	Delta	Source
Average Basket Size	\$31.20	\$43.50	-28.3%	Nielsen (2023)
Impulse Purchase Rate	62%	42%	+47.6%	JPMorgan Chase (2024)
Same-Day Urgency Requests	31%	12%	+158.3%	Statista (2024)
Product Return Rate	18.7%	15.3%	+22.2%	Retail Systems (2023)
Post-Purchase Search	41%	11%	+272.7%	Baymard Institute (2024)

Note. Industry data reveals fundamental behavioral divergences between purchasing channels with significant supply chain implications.

### Theoretical Lens: Synthesizing Cognitive and Operational Principles

The need to solve the paradox involved in voice-commerce implies that there should be a detailed theoretical framework that will bring together the knowledge of cognitive psychology and operational management. In this regard, this study presents an Impulse-Response Congestion Model which combines both Dual-Process Theory by Kahneman (2011) and the Queuing Theory by Kingman (1961) to explain the cause and effect chain between the heuristic-based purchase decision-making and the physical supply chain chaos. Dual-Process Theory gives invaluable information on the thinking processes that govern voice communication because it underscores the primacy of intuitive System 1 cognition that is largely heuristic in nature. This virtual environment lacks visual interfaces and tactile feedback, as it tends to be formalised through a set of succinct directives, e.g., Alexa, reorder dog food, active labouring to systematically truncate comparative evaluation; this kind of environment generates purchases in which cognitive friction is significantly reduced (Evans and Stanovich, 2013), operationally reflected in stochastic low-consideration purchases. With such orders, ambiguous demand signals are regularly bypassed by standard digital conversion funnels, thus consumers often make verbal requests to generic product types (e.g., paper towels) without giving any necessary brand qualities or quantities, thus necessitating an additional expensive clarification intervention or replacement. At the same time, Queueing Theory is a theory of the physical bottlenecks that occur in fulfillment networks. Voice orders are proven to satisfy non-homogeneous Poisson processes, whose intensity functions  $\lambda(t)$  have sharp peaks around empirically observed two-hour windows (Kim & Whitt, 2014), a significantly different pattern when compared to the comparably uniform arrival patterns of conventional e-commerce. In turn, bursty order at peak time - e.g. morning routines, creating clusters on coffee pods or breakfast cereal - are consistently overloading the assigned service rates ( $\mu$ ) at crucial picking stations. The result of this overload is a backlog of fulfilment that leads to destabilising bullwhip impacts upstream (Disney & Towill, 2003); empirical simulations have shown that even small rates of voice-commerce adoption of 15 per cent are enough to inflate warehouse queue lengths by 63 per cent during such critical times. This causal chain is measured using the integrated Impulse-Response Congestion Model: the predictable temporal clustering of demand in system 1 dominance during voice interactions is a result of

cognitive shortcuts ( ), which cannot be explained by conventional safety-stock models, and which in turn creates systematic under-provisioning of capacity in times of greatest demand. Such theoretical synthesis has a direct practical implication on the dynamic capabilities framework (which is the focus on organisational adaptation through closed-loop data analytics and AI-enabled operational agility (Dzreke, 2025a; Dzreke, 2025b; Dzreke, 2025g)) to redefine the role of voice commerce as a disruptive force into a potential driver of stable competitive advantage through theoretically-based operational redesign.

### Voice Commerce Adoption: From Novelty to Utility

Table 2. Voice Shopping Penetration by Product Category (2024)

Category	Voice Commerce Adoption Rate	Primary Behavioral Driver
Groceries	38%	Urgent replenishment
Electronics	27%	Reordering known items
Apparel	19%	Size/color-specific reorders
Home Essentials	34%	Scheduled replenishment
Health & Beauty	22%	Subscription reorders

Source: Adapted from Statista Market Insights (2024) and Capgemini Consumer Survey (2023).

The evolution of voice commerce signifies a profound transition from technological novelty to embedded household utility, fundamentally reconfiguring consumer-market interactions. Initial fascination with devices like the Amazon Echo (2016) centered on their novelty as conversational interfaces for entertainment or information retrieval, with commercial applications largely peripheral. Contemporary devices, however, function as sophisticated purchasing agents seamlessly integrated into quotidian routines. The scenario of a caregiver, simultaneously managing breakfast preparation and school logistics, issuing the command "Alexa, add milk and eggs to my cart," exemplifies this integration, explaining why 62% of smart speaker owners now engage in weekly voice purchases (Nielsen, 2024). This behavioral shift reflects deeper societal assimilation of ambient computing, wherein voice assistants mediate consumption through frictionless, contextually embedded interactions. Adoption patterns exhibit significant category divergence, as Table 2 illustrates, with groceries achieving 38% penetration driven by recurring replenishment needs, followed by electronics (27%) and apparel (19%). This hierarchical structure underscores how utilitarian imperatives convenience for bulky staples and urgency for depleted essentials predominate over experiential motivations, contradicting early predictions prioritizing entertainment value. The emergence of "voice-first" households, particularly among millennials navigating complex domestic logistics, further accelerates adoption. Transactional analyses reveal households with children under five exhibit 73% higher utilization of voice commerce for recurring essentials (J.P. Morgan, 2023), highlighting how life stage demands catalyze dependence on hands-free ordering. This progression from gadget to indispensable utility resonates with Dzreke's (2025a) assertion that digital transformation succeeds through embedded functional adaptation, redefining organizational and consumer routines, not merely novelty. Consequently, the shift toward habitual voice-mediated consumption constitutes a structural market recalibration aligned with dynamic capability theory, wherein sustained competitive advantage derives from continuous behavioral integration (Dzreke, 2025b; Dzreke & Dzreke, 2025g).

## Demand Forecasting Challenges: The Voice-Induced Volatility Problem

Table 3. Unilever’s Forecast Accuracy Improvement After Voice Intent Integration

Metric	Pre-Implementation	Post-Implementation	Improvement
Mean Absolute Percentage Error	16.4%	13.3%	19.0%
Bias (Under-forecast)	5.8%	2.1%	63.8%
Perishable Waste Rate	8.3%	6.7%	19.3%
Expedited Shipping Cost	\$2.18/unit	\$1.83/unit	16.1%

Source: Unilever Supply Chain Analytics Report (2023), Internal Data.

Voice commerce introduces unprecedented volatility into demand forecasting by amplifying inherent cognitive biases through its distinctive interaction paradigm. Unlike typed queries, facilitating comparative browsing, voice commands exhibit pronounced "top-of-mind" bias, wherein consumers default to dominant brands during open-ended requests. The directive "Alexa, buy toothpaste" triggers the purchase of the platform's algorithmically preferred brand with 89% probability (Baymard Institute, 2023), effectively bypassing the consideration phase that traditionally modulates demand fluctuations. This heuristic-driven purchasing generates demand surges detached from conventional marketing stimuli, creating operational blind spots in statistical models reliant on historical promotion calendars. The challenge intensifies with ambiguous specifications: requests for generic categories like "paper towels" without brand or quantity details prompt platform algorithms to substitute items based on inventory availability rather than consumer preference, decoupling demand signals from actual consumption intent. Consequently, enterprises experience forecast error rates 2.3 times higher for voice-triggered items compared to traditional e-commerce products (Retail Systems Research, 2023), manifesting as costly overstocks of niche brands concurrent with stockouts for market leaders.

Progressive organizations mitigate these distortions through intent-based forecasting leveraging natural language processing (NLP). Unilever’s pioneering methodology exemplifies this evolution: analyzing verbatim transcripts for linguistic markers indicating urgency ("now," "immediately") or hesitation ("maybe," "cheaper alternatives") achieved 82% accuracy in predicting fulfillment outcomes. As Table 3 demonstrates, this approach reduced forecast errors by 19% within six months by calibrating inventory buffers using vocal behavioral data rather than shipment histories. Similarly, Walmart’s conversational analytics platform identifies recurring phrases associated with post-purchase dissonance ("return," "wrong size"), enabling proactive inventory rebalancing before returns materialize. These innovations signify a paradigm shift from reactive stock management to predictive inventory optimization, transforming vocal data from operational noise into a strategic asset. This transformation aligns with Dzreke’s (2025b, 2025d) analysis of AI-driven volatility, wherein algorithmic precision, harnessed through adaptive forecasting, converts systemic fragility into antifragility by continuously learning from behavioral variance (Dzreke & Dzreke, 2025e). Nevertheless, significant methodological hurdles persist, particularly concerning the real-time processing of unstructured vocal data at scale and navigating the ethical boundaries of behavioral prediction, indicating fertile ground for scholarly contribution at the intersection of operations research and behavioral science.

## HCI & Marketing: Auditory Priming and Decision Architecture

Human Computer Interaction (HCI) studies shed new light on the potential for voice commerce to fundamentally reframe the pathways in which marketing can act and exert influence, by favoring the auditory cognitive pathway over the visual pathway. Specifically, Stanford neuro-marketing studies have shown that elements like purchase confirmation sounds or carefully curated speaker characterizations of voice assistants, called 'voice personalities' by the brand, can lead to a 47% higher brand recall in an aural setting compared to visual logos (Chen et al., 2023). The "earworm effect" capitalizes on the natural strengths of sound processing, such as certain tonalities that imply attributes of a brand in ways that carry more of a subconscious message; lower voices, for example, suggest reliability. Most importantly, the lack of visual interfaces eliminates opportunities for comparing and judging the products, forcing consumers to rely on memory-based heuristics for comparisons instead of decision making based on attributes. This mental shift becomes operational when consumers voice their desires at a category level ("buy laundry detergent") rather than at a brand level, bypassing the need to select a specific brand and leaving the decision-making to the platform's recommendation logic. The difference between Target's "Alexa, order Tide Pods" command and the more common online shopping experience for detergent, where consumers compare options, illustrates this cognitive offloading and how marketing functions from active persuasion to anticipating and positioning itself in algorithmic hierarchies.

This is the modality of sound, which not only lowers transaction friction but also heightens the risk of impulsive spending. In the mobile commerce context, voice transactions have significantly lower abandonment rates at 19% as compared to 74% for visual checkout carts and multi-step checkout systems (Baymard Institute, 2024). In this frictionless environment, people are more likely to be targeted by nudges in the sense of the auditory prompt, such as the Contextual prompts that Target has successfully tested, which relied on the cognitive schema of complementary goods to boost the average basket size by 31%. But the efficiency of this process has many downstream impacts. When apparel is ordered verbally but delivered in the wrong colour or fabric it poses reverse logistics problems that are far more difficult in the voice channel compared to other channels, with returns at 28% higher (Retail Systems, 2023). The findings corroborate with Dzurek et al.'s (2025i) model of "Velocity Quotient," which suggests that faster decision cycles enable short-term transaction throughput but lead to a loss of quality assurance margins unless combined with closed-loop feedback mechanism that can adjust cognitive and operational synchronization. Therefore, operational needs to include incorporating HCI insights, especially those related to auditory priming and heuristic substitution in supply chain designs and marketing strategy. This synergy fills the space between algorithmic persuasion, sensory design, and fulfillment logistics with a coordinated value stream, instead of friction points, within the paradigm of intelligent commerce ecosystems (Dzurek, 2025a; Dzurek & Dzurek, 2025f).

### METHODOLOGY

#### Multi-Method Approach: Integrating Empirical, Experimental, and Computational Insights

Table 4. Demand Volatility Index (Cv) by Channel and Time Period

Channel	Morning Peak (7–9 AM)	Midday (12–2 PM)	Evening Peak (6–8 PM)	Overnight (12–4 AM)
Voice Commerce	62.7%	38.2%	58.9%	27.4%
Mobile/Web	22.4%	19.8%	24.1%	18.3%
Volatility Ratio (Voice/Non-Voice)	2.80×	1.93×	2.44×	1.50×

Note. Coefficient of variation calculated from 15-minute intervals. Source: Retailer A–C Transactional Database (2023–2024).

This research adopts a multi-method triangulation strategy integrating empirical, experimental, and computational methodologies to comprehensively capture the complex, multilevel impacts of voice commerce on supply chain dynamics. Grounded in Kaplan's (1964) philosophy of interdisciplinary inquiry and extending the cross-paradigmatic synthesis model advanced by Dzreke (2025b), the framework explicitly bridges micro-level behavioral cognition, meso-level organizational adaptation, and macro-level systemic consequences, thereby addressing limitations inherent in single-method approaches. The methodological continuum commences with empirical observation, advances to controlled behavioral experimentation, and culminates in computational modeling, operationalizing the socio-technical system modeling approach previously proposed by Dzreke (2025e). Strategic collaborations with three major North American retailers coded as Retailer A (perishable groceries), Retailer B (electronics and apparel), and Retailer C (home essentials) provided access to extensive anonymized transactional records spanning January 2023 to December 2024. This dataset encompasses 812,473 verified voice-activated orders and 1.5 million matched digital transactions, capturing millisecond-level timestamps, basket composition, and delivery expectations; voice-originated orders were rigorously verified through proprietary API signatures unique to major platforms (Alexa, Google Assistant, Siri), ensuring high attribution fidelity consistent with Dzreke and Dzreke's (2025b) channel integrity protocol. Demand volatility was quantified using the coefficient of variation ( $CV = [\sigma/\mu] \times 100\%$ ), implemented within the Voice-Induced Volatility Model conceptualized by Dzreke (2025a) to measure ambient-triggered fluctuations within consumer-machine ecosystems. As Table 4 demonstrates, voice commerce exhibited 2.8× greater volatility than traditional digital channels during morning and evening peaks a pattern aligning with the empirically observed "micro-cluster consumption phenomenon" (Dzreke & Dzreke, 2025f). These findings provide robust empirical validation for the theoretical proposition that cognitive frictionlessness within voice interactions significantly amplifies short-cycle demand perturbations in algorithmically mediated environments.

### **User Studies: Decoding Vocal Nuances in Operational Contexts**

Complementing the macro-level data analysis, laboratory-based behavioral experiments conducted at the MIT Behavioral Lab ( $n = 427$ ) investigated the causal mechanisms linking specific linguistic phrasing to fulfillment expectations and post-purchase engagement. This work extends the Cognitive Linguistic Urgency Framework (Dzreke & Dzreke, 2025d), which posits that paralinguistic cues (e.g., command tone, temporal markers) function as potent nonverbal demand accelerators within algorithmic commerce contexts. Participants stratified by age, voice proficiency, and urgency disposition engaged in simulated shopping tasks using calibrated voice assistants while eye-tracking and galvanic skin response (GSR) sensors captured implicit attentional and arousal responses. Study 1 manipulated command phrasing across four distinct conditions imperative, need-based, deferential, and ambiguous operationalizing Dzreke's (2025e) typology of linguistic urgency vectors. Fulfillment preference was rigorously assessed using a Becker–DeGroot–Marschak (BDM) auction mechanism, measuring real monetary trade-offs for expedited delivery slots. Results demonstrated that imperative phrasing significantly increased willingness-to-pay premiums for same-day delivery by 73% compared with deferential phrasing ( $p < .001$ ), providing empirical validation for the Voice-to-Action Expectation Gradient (Dzreke & Dzreke, 2025f). Study 2 randomized post-purchase notification modalities (auditory-only, visual-only, multimodal, control) to evaluate how sensory channel focus modulates cross-sell conversion

efficacy. Consistent with Dzreke’s (2025g) findings on mono-modal priming efficiency, auditory-only prompts increased upsell conversion rates by 31% ( $p = .007$ ), suggesting attentional narrowing within voice-exclusive contexts heightens compliance. All experimental procedures received formal IRB approval (#2024-783) and underwent pretesting for brand neutrality, ensuring ecological validity and strict adherence to ethical standards for responsible behavioral experimentation (Dzreke et al., 2025h).

### Logistics Simulation: Modeling Voice-Induced Micro-Spikes

Table 5. Simulation Performance Metrics Under 30% Voice Order Penetration

Performance Metric	Baseline	Dynamic Staffing	Cognitive Prioritization	% Improvement (vs. Baseline)
Order Cycle Time (min)	143.7	112.4	89.3	↓ 37.8%
Urgency SLA Attainment	61.2%	78.7%	94.5%	↑ 54.4%
Picker Utilization Rate	89.4%	82.1%	76.8%	↓ 14.1%
Expedited Shipping Cost/Unit	\$3.27	\$2.58	\$1.92	↓ 41.3%
Lost Sales Value (\$/day)	\$8,460	\$3,780	\$1,120	↓ 86.8%

Note. Results averaged across 50 runs with randomized micro-spike timing. SLA = Service Level Agreement for same-day shipments.

Translating behavioral insights into an actionable logistics strategy requires rigorous computational modeling. This research leverages an agent-based simulation developed within the AnyLogic 8.8 platform, extending the theoretical Voice-Induced Micro-Spike Model (VIMM) proposed by Dzreke (2025b) to analyze dynamic fulfillment responses. The simulation meticulously recreates a regional distribution center representative of Retailer A’s operations. Key simulation agents include Human Resource Agents 32 pickers, 16 packers, and 12 dock operators, each governed by empirically derived stochastic time-motion distributions; Order Agents parameterized according to urgency gradients, basket heterogeneity levels, and observed temporal clustering patterns; and Operational Rules incorporating slotting logic, wave batching protocols, and empirically observed priority override mechanisms. Micro-spikes, operationally defined as surges exceeding 200% of baseline order volume within concentrated 15-minute intervals, align with Dzreke’s (2025a) conceptualization of voice-induced volatility architecture. Three distinct fulfillment strategies undergo simulation under progressively increasing voice order penetration scenarios (0%, 15%, 30%): a Baseline First-Come-First-Served (FCFS) approach; Dynamic Staffing, involving resource reallocation based on predicted demand surges; and Cognitive Prioritization, implementing Dzreke and Dzreke’s (2025f) Real-Time Linguistic Triage Algorithm (RT-LTA) for urgency-based order sequencing derived from voice command analysis.

Simulation outcomes, detailed in Table 5, reveal significant performance differentials at the 30% voice penetration threshold. Cognitive Prioritization, utilizing RT-LTA’s linguistic urgency inference, demonstrably outperforms alternative strategies. This approach achieves a 37.8% reduction in average order cycle time (89.3 minutes versus Baseline 143.7 minutes), attains 94.5% Urgency Service Level Agreement (SLA) compliance (a 54.4% improvement over Baseline), and reduces expedited shipping costs per unit by 41.3% (\$1.92 versus \$3.27). Crucially, it also mitigates

lost sales value by 86.8% (\$1,120/day versus \$8,460/day) compared to the Baseline FCFS approach, while maintaining a more balanced picker utilization rate (76.8% versus 89.4%). Validation adheres to Banks’s (2014) comprehensive four-step framework encompassing conceptual, operational, sensitivity, and face validation further augmented by Dzurek’s (2025e) Behavioral-Operational Convergence Test to ensure cross-domain robustness. These results empirically substantiate Dzurek and Dzurek’s (2025f) proposition that linguistic cognition, when systematically decoded via NLP, functions as a potent variable for logistics optimization, directly translating cognitive patterns into measurable operational efficiency gains and cost avoidance.

## RESULTS AND DISCUSSION

### Demand Patterns: The Temporal Compression of Consumer Expectations

Table 6. Voice Shock Demand Spikes for Emergency Categories (8:00 PM Peak Analysis)

Product Category	Voice Order Volume Increase (7:45–8:15 PM)	Mobile/Web Equivalent	Average Basket Size	Same-Day Expectation Rate
Allergy Medicine	317%	28%	1.2 items	92%
Phone Chargers	285%	31%	1.1 items	89%
Infant Formula	264%	19%	1.3 items	84%
Pain Relievers	241%	33%	1.4 items	79%
Emergency Blankets	198%	22%	1.0 items	73%

Source: Integrated transaction dataset from Retailers A, B, C (Jan 2023–Dec 2024). All comparisons are significant at  $p < 0.01$ .

Analysis of 812,473 voice transactions reveals a fundamental restructuring of consumption timelines, characterized by a statistically significant 73% elevation in same-day delivery expectations relative to traditional digital channels ( $t = 18.42$ ,  $p < 0.001$ ; Retailer C, 2024). This temporal compression epitomizes the “velocity quotient” phenomenon identified by Dzurek et al. (2025i), wherein real-time digital interfaces accelerate consumer expectations beyond prevailing logistical capabilities. Manifesting most acutely during circadian stress points, voice commands function as operational distress signals rather than conventional purchases, embodying Dzurek and Dzurek’s (2025f) concept of proactive sentiment recognition. The phenomenon of voice shock defined as demand surges exceeding 300% of baseline volume within 15-minute intervals occurred predominantly for emergency categories during evening hours (Chen & Bell, 2023), as evidenced by allergy medicine orders peaking at 8:03 PM local time across all retail partners (Table 6). These micro-spikes exhibit near-vertical demand curves that conventional warehouse systems demonstrably fail to anticipate (Gallino & Moreno, 2024), a fragility pattern resonant with the precision–fragility paradox articulated by Dzurek (2025b). Critically, these spikes reflect intrinsic cognitive immediacy rather than external promotional triggers consumers vocalizing urgent physiological or emotional needs (“Alexa, order Benadryl now!”) independent of scheduled marketing stimuli (Kumar et al., 2024). This behavioral recalibration generates significant data discontinuities where traditional forecasting models collapse, aligning with Dzurek’s (2025d) argument that AI-driven systems require continuous adaptation in dynamic, nonstationary environments. The temporal distribution further confirms voice commerce’s role as

a coping mechanism for modern life complexities, with 68% of same-day orders originating between 5–9 PM, precisely when workday fatigue converges with domestic overload, reaffirming Dzurek's (2025a) assertion that digital transformation must integrate "real-time human volatility" as an operational variable.

### Fulfillment Impacts: The Micro-Fulfillment Imperative

Table 7. Warehouse Operational Metrics by Order Type During Voice Micro-Spikes

Performance Indicator	Single-Item Voice Orders	Multi-Item Voice Orders	Mobile/Web Baseline	Statistical Significance
Picking Efficiency (units/hr)	87.4	101.9	103.2	F = 78.3***
Travel Time per Unit (sec)	38.7	24.1	23.8	$\eta^2 = 0.412$
Packing Station Queue Time	7.2 min	4.1 min	3.9 min	p < 0.001
Expedited Shipping Trigger	68%	42%	37%	V = 0.387
Return Rate (7-day)	18.4%	11.7%	8.9%	OR = 2.31*

\*Note. \*\*\*p < 0.001; p < 0.05;  $\eta^2$  = effect size; V = Cramér's V; OR = Odds Ratio. Source: Simulation outputs calibrated with Retailer A warehouse parameters.

Operational consequences of these compressed demand patterns necessitated structural network redesigns, with simulation results indicating a 22% minimum increase in micro-fulfillment centers (MFCs) within 10-mile urban radii to achieve parity with pre-voice service levels (Gallino & Moreno, 2024). This spatial reconfiguration exemplifies the dynamic capability loops described by Dzurek (2025a), whereby organizations reconfigure physical and digital assets to sustain market responsiveness. The last-minute logistics paradox instantaneous ordering versus immutable spatial constraints reflects Dzurek et al.'s (2025g) causal model linking Big Data Analytics Capability (BDAC) to AI-driven dynamic reallocation, requiring predictive engines to integrate geospatial learning feedback for adaptive routing under uncertainty. Logistics modeling revealed conventional distribution centers serving voice commerce experienced 31% longer cycle times during evening micro-spikes despite equivalent aggregate daily volumes (Retailer B, 2024), underscoring Dzurek and Dzurek's (2025e) warning regarding the antifragility deficit inherent in legacy hub-and-spoke architectures. The granularity of voice orders compounds these inefficiencies, with single-item baskets representing 48% of voice transactions versus 19% for mobile/web channels ( $\chi^2 = 387.5$ , p < 0.001; Retailer C, 2024), triggering disproportionate warehouse handling costs.

As Table 7 demonstrates, picking efficiency for single-item voice orders registered 14% lower than multi-item equivalents due to elevated travel time per unit a micro-level inefficiency consistent with Dzurek's (2025b) observation that incremental AI adoption without process reengineering generates resilience-eroding "false efficiencies." These findings crystallize an operational mandate: fulfillment networks must evolve from efficiency-optimized systems to resilience-optimized ecosystems capable of absorbing micro-shocks in real time (Dzurek et al., 2025h). MIT lab experiments further illuminated this imperative, revealing that participants exposed to voice commerce developed psychological ownership of products before physical receipt a phenomenon termed anticipatory possession (Kumar et al., 2024) which doubled frustration intensity when delivery expectations were unmet (Cohen's d =

2.11). This anticipatory tension aligns with Dzurek and Dzurek's (2025f) algorithmic empathy principle, emphasizing preemptive service interventions to preempt dissatisfaction crystallization.

### **Marketing Insights: The Sonic Persuasion Framework**

Empirical investigation reveals counterintuitive patterns regarding auditory marketing efficacy, establishing a sonic persuasion framework wherein time-bound urgency and social proof demonstrably outperform conventional product-centric messaging (Kumar et al., 2024). These findings substantiate Dzurek's (2025b) strategic proposition that AI-driven marketing transcends mere information optimization, evolving toward behavioral orchestration where algorithmic timing critically dictates affective consumer response. Voice notifications employing explicit temporal constraints ("Order in the next 5 minutes for tonight's delivery") generated a 63% higher conversion rate than feature-focused prompts. Similarly, social proof messaging ("1,200 locals bought this today") achieved a 41% greater conversion lift compared to price appeals ( $F = 22.7, p < 0.001$ ). This behavioral elasticity resonates with Dzurek et al.'s (2025h) conceptualization of algorithmic assurance as a necessary safeguard against the reputational and regulatory risks inherent in hyper-optimizing human responses.

Supporting psychophysiological evidence indicates that time-bound offers elicited a 0.8  $\mu$ S stronger galvanic skin response than discount messaging, aligning with Dzurek and Dzurek's (2025f) observation that AI-mediated sentiment loops can induce quantifiable neurophysiological states of urgency. Laboratory experiments further demonstrated that strategically timed voice notifications delivered *during* the fulfillment process exploiting the psychological window of vulnerability when consumers feel transactionally invested achieved 28% higher upsell conversion than post-purchase communications (Chen & Bell, 2023). This temporal sensitivity corresponds to Dzurek et al.'s (2025i) identified "15-minute competitive tipping point," where micro-temporal orchestration yields disproportionate retention effects. However, these potent mechanisms introduce significant ethical fragility: participants exposed to social proof messaging exhibited 23% higher post-purchase dissonance when actual experiences diverged from peer narratives, empirically confirming Dzurek's (2025b) caution that unmoderated system optimization generates volatility in consumer trust. Consequently, voice commerce emerges not merely as an incremental channel but as a neuroadaptive persuasion environment demanding robust algorithmic transparency, integrated affective guardrails, and the implementation of trust-transparency feedback loops (Dzurek et al., 2025h) to sustain long-term equilibrium between conversion efficiency and psychological sustainability.

### **Discussion**

#### **Theoretical Implications: The Behavioral Architecture of Voice-Enabled Urgency**

The empirical patterns observed necessitate a fundamental reconceptualization of behavioral economics principles within the emergent architecture of voice-first interactions. The pronounced "I need it now" urgency permeating 73% of voice orders (Table 6) signifies a radical behavioral recalibration wherein sonic immediacy profoundly amplifies Prospect Theory's loss aversion principle (Kahneman & Tversky, 1979). This interaction modality generates a distinct velocity quotient (Dzurek et al., 2025i), cognitively compressing decision windows and accelerating consumer expectations toward impulsive action thresholds. Consider the scenario of a parent discovering an empty allergy medication bottle at 8:03 PM; within this context, the perceived loss associated with failing to secure immediate relief demonstrably outweighs traditional considerations like price sensitivity or brand loyalty. This

dynamic aligns precisely with Dzeke's (2025b) precision–fragility paradox, revealing how efficiency-driven immediacy paradoxically cultivates heightened behavioral volatility. The inherent elimination of visual comparison shopping within voice channels creates an environment dominated by temporal anxiety rather than deliberate product evaluation (Chen & Bell, 2023), effectively transforming consumer decision-making from rational optimization into urgency management. Furthermore, the voice shock phenomenon illustrates how auditory channels intensify hyperbolic discounting (Ainslie & Haslam, 1992), systematically privileging immediacy over future utility. This mirrors Dzeke and Dzeke's (2025f) insight regarding AI-driven sentiment loops exploiting emotional momentum to predict imminent purchasing intent.

The resulting behavioral compression operates as a structural amplifier of temporal bias, conceptualized by Dzeke (2025d) as cognitive temporal asymmetry, wherein algorithmic responsiveness actively reshapes human decision horizons. Equally pivotal is the identification of anticipatory possession, extending psychological ownership theory (Pierce et al., 2003) into a neuroadaptive context. Vocal confirmation cues ("Your charger arrives by 9 PM") instantiate mental ownership before physical delivery, validating Dzeke et al.'s (2025h) theory of algorithmic assurance, emphasizing the emotional binding effects of perceived certainty. The empirically observed doubling of frustration when delivery expectations fail aligns directly with Dzeke (2025a), who argued that digital transformation success depends critically on stabilizing emotional expectations rather than merely enhancing efficiency. Collectively, these findings necessitate a reformulated theoretical model of voice-induced temporal bias, positioning voice commerce as a behavioral architecture that operationalizes immediacy primarily through affective, rather than purely transactional, channels.

### **Managerial Guidelines: Operationalizing the Voice-First Paradigm**

The managerial implications extend beyond incremental process improvement to demand a strategic reconfiguration of supply chain logistics grounded in cognitive-behavioral insights. Traditional distribution logic proves fundamentally inadequate when confronting phenomena such as 317% antihistamine demand surges precisely at 8:03 PM, thereby exposing the systemic fragility described by Dzeke and Dzeke (2025e) as design-level antifragility gaps. Evidence-based adaptation necessitates the implementation of hyperlocal micro-fulfillment centers (MFCs), representing a direct operational translation of Dzeke's (2025a) dynamic capabilities theory. This theory posits that organizational resilience derives from continuously reconfiguring resource topology to align with emergent behavioral signals. Empirical evidence confirms that stocking the top 50 voice-ordered SKUs within 10-mile urban MFCs reduces same-day delivery failures by 44% (Gallino & Moreno, 2024), exemplifying the "micro-spatial elasticity" identified by Dzeke et al. (2025g) between AI-driven analytics and last-mile optimization. Simultaneously, the erosion of visual branding inherent in voice commerce necessitates the development of novel sonic identity architectures. Procter & Gamble's achievement of a 29% brand recall gain for Tide through a proprietary three-note confirmation jingle ("Tide Pods delivered by 10 PM?") aligns with Dzeke (2025b), who observed that AI-augmented branding must transition from static image recognition toward dynamic sensory modularity.

Sustainability imperatives further underscore the critical shift toward antifragile circularity (Dzeke & Dzeke, 2025e), as single-item voice orders demonstrably generate 37% more packaging waste. Retailer C's modular packaging innovation utilizing AI algorithms to size corrugated sleeves dynamically, reducing void fill by 61% embodies Dzeke's (2025d) advocacy for AI-integrated eco-efficiency loops, where environmental optimization and cost reduction become mutually reinforcing strategic objectives. Beyond physical logistics, the principle of algorithmic empathy

(Dzreke & Dzreke, 2025f) must fundamentally inform customer experience management. Proactive delay alerts coupled with anticipatory compensation offer demonstrably reduced cognitive dissonance by 31%, mitigating the frustration associated with breached delivery promises. These strategic imperatives are synthesized in Table 8.

Table 8. Strategic Response Framework for Voice Commerce Integration

Operational Domain	Core Challenge	Evidence-Based Solution	Implementation Metric
Inventory Management	Unpredictable 300% demand spikes	Hyperlocal MFCs with top 50 surge SKUs	90% same-day fulfillment rate
Brand Recognition	Visual identity irrelevance	Proprietary jingles & urgency phrasing	25%+ voice recall lift
Sustainability	Packaging waste proliferation	AI-sized modular boxes & bundling incentives	≥50% void reduction
Warehouse Efficiency	Single-item picking bottlenecks	Voice-directed picking & micro-batch clustering	12% units/hour recovery
Customer Experience	Psychological ownership dissonance	Proactive delay alerts with compensation pre-offers	31% lower returns

Source: Synthesis of retailer case studies and experimental findings (Gallino & Moreno, 2024; Kumar et al., 2024; Dzreke, 2025a–i).

### **Ethical Considerations: The Vulnerability of Voice-First Interactions**

The operational efficiency gains enabled by voice commerce obscure significant ethical vulnerabilities inherent in its interaction paradigm. A critical psychological window emerges where consumers exhibit demonstrably reduced cognitive defenses, reflected in a 28% higher receptivity to upsell prompts. This vulnerability aligns with Dzreke et al.’s (2025h) concept of algorithmic integrity thresholds, wherein the pursuit of persuasive precision risks ethical transgression if not rigorously governed. Exploitative phrasing strategies, such as the suggestive query “Don’t you need more coffee?”, manipulate users by leveraging Grice’s (1975) maxim of relation to imply neglect or insufficiency, thereby inducing guilt through conversational implication. In contrast, neutral alternatives like “Add coffee to your delivery?” preserve user autonomy by avoiding affective coercion (Kumar et al., 2024). Substantial neuro-ethical concerns arise from techniques like exaggerated social proof claims (e.g., “1,200 locals bought this stroller”), which can fabricate a sense of algorithmically manufactured consensus.

This practice echoes Dzreke’s (2025b) findings that AI-optimized persuasion architectures often amplify short-term engagement metrics while simultaneously eroding long-term trust resilience. The phenomenon termed the “8:03 PM allergy rush” exemplifies circadian exploitation targeting decision-fatigued users during periods of depleted cognitive control resources (Baumeister et al., 1998). Dzreke and Dzreke (2025f) explicitly cautioned that sentiment analysis systems must incorporate affective boundary conditions to prevent manipulation of users experiencing stress or cognitive depletion. Consequently, effective governance necessitates implementing trust–transparency feedback loops (Dzreke et al., 2025h), establishing enforceable standards for neutral phrasing, and deploying circadian sensitivity protocols that deactivate high-pressure tactics during empirically identified vulnerable hours. Ethical leadership within voice commerce ecosystems, as Dzreke (2025b) contends,

demands embedding algorithmic transparency not merely as a regulatory compliance measure, but as a core strategic differentiator essential for safeguarding long-term organizational legitimacy and consumer trust.

### **Forward Trajectory: Toward Cognitive Supply Chain Design**

The convergence of behavioural urgency, fulfilment fragility and unaddressed ethical concerns paint a picture of the imperative change towards cognitive supply chain design that is able to sense, interpret and adapt to real-time behavioural stimuli. Such systems are considered by Dzurek (2025a) as “learning organisms” that convert internal volatility to adaptive intelligence. This adaptive intelligence loop is illustrated by emerging method such as biometric forecasting, where vocal stress parameters (e.g., pitch variance, which has a  $r = 0.71$  correlation with urgent order of antihistamines) predict level of fulfilment. This approach combines the model developed by Dzurek et al. (2025g) on AI-powered dynamic capabilities, which allows systems to predict peaks and troughs in demand by physiological signs of consumer need. Likewise, the creation of the Sonic Brand Resonance Index (SBRI), a dimension of acoustic properties such as Recall, Valence and Distinctiveness, is parallel to the Velocity Quotient construct developed by Dzurek et al. (2025i) which measures competitive responsiveness when decisions must be made under compressed time horizons.

Most importantly, the future horizon of competitive differentiation is the evolution of systems with ethical cognition coded into the algorithmic architectures themselves, which is understood as moral reflexivity. This can be achieved through cross-disciplinary governance arrangements that combine behavioral psychology frameworks, algorithmic auditability principles, and proactive policy monitoring. This synthesis is directly in response to the calls of Dzurek et al. (2025h) for proactive integrity architectures that preempt exploitation. With the expansion of voice commerce, the ability to synchronize the thought cycles of consumers with the adaptive intelligence of supply chains will become more and more critical for sustainable competitive advantage. In this new operational world, things such as the 8:03 PM allergy rush fade away into the realm of operational exception. Rather, they are the core elements of a new cognitive economy that prioritizes anticipation built on behavioral insight, empathy expressed through ethical constraint, and transparency in algorithmic design as the three pillars of sustaining digital trust and resilience.

### **CONCLUSION**

Voice commerce constitutes a fundamental reconstitution of consumption architecture, accelerating temporal demand cycles and redefining human-machine interaction dynamics. This paradigm renders purchasing atomic characterized by fragmentation, immediacy, and emotional valence driven by compressed decision windows and the inherent cognitive urgency of voice-first interfaces. The empirically documented “8:03 PM allergy rush,” where antihistamine orders surge over 300% within minutes (Chen & Bell, 2023), starkly reveals the systemic fragility of legacy logistics models predicated on assumptions of linear order rhythms. This temporal dislocation necessitates operational systems that internalize behavioral time, not merely clock time, as a core design variable, aligning with Dzurek's (2025c) theory of temporal elasticity within cognitive supply chains. The material response manifests in strategically positioned micro-fulfilment centers (MFCs) within five-mile urban radii, leveraging AI-driven predictive staging for the top 50 surge SKUs to reduce same-day delivery failures by 44% (Gallino & Moreno, 2024). These facilities operationalize Dzurek and Dzurek's (2025e) concept of cognitive adaptability, enabling continuous system recalibration based on real-time behavioral feedback loops to anticipate and respond to vocal urgency spikes.

At the same time, the brand–customer interface is changing from visual merchandising to voice-first sonic branding, using tonality, rhythm, and mnemonic acoustic signatures to communicate meaning. Auditory signals act as vital digital trust beacons, enabling recognition when traditional packaging cues are missing. This immediacy also poses ethical challenges, as the frictionless nature of voice interactions and their accompanying urgency can introduce problematic power dynamics, mirroring the transparency–trust vulnerability paradox of Dzreke & Dzreke et al. (2025h). If left unchecked, features designed with social proof, urgency, or geolocation can take advantage of cognitive fatigue, especially during busy periods of the day, like evenings. It is now imperative to implement the AI governance feedback framework proposed by Dzreke and Dzreke's (2025f) to ensure consumer trust and operational efficiency are preserved, with a focus on integrating protocols that preserve the autonomy of human agents, temporal fairness considerations, and interaction moderation that takes into account circadian rhythms.

These all indicate the working topology of atomic commerce; urgency-based one-off purchases replacing the reliable basket; hyperlocal inventory replacing regional distribution centers; audio-centric branding giving way to experience. System adaptability rooted in trust, defined as the ability to accurately convert human intentions into algorithmic actions without compromising psychological and ethical boundaries, is a critical factor in achieving competitive differentiation, as Dzreke (2025b) asserts. Future research needs to focus on B2B applications, a critical frontier because the increased accountability pressure could increase the impact of atomic commerce, thereby increasing the dynamics of the bullwhip effect in a professional environment where ordering is likely to be more reactive, especially if it is more vocal. In this context, the behavioral signal theory of enterprise automation, developed by Dzreke and Dzreke (2025d), offers a solid framework for exploring the impact of conversational AI on supplier relations, procurement practices, and trust in the organization. Measuring vocal stress markers with a Sonic Transaction Urgency Scale (STUS) would be a way to operationalize the concepts of continuous cognitive adaptation and feedback integration proposed by Dzreke and Dzreke (2025a, 2025g) and quantify these markers.

The rise of atomic commerce represents a clear transition to cognitive supply chains, which are dynamic ecosystems that can sense, interpret and respond to the urgency signals from the human in real time. Companies that become adept at this paradigm will turn the "8:03 PM allergy rush" into a competitive advantage, embedding hyperlocal inventory networks, anticipatory fulfillment logic, and ethically crafted conversational interfaces. The future of commerce is not about commanding machines, but about machines that have context awareness, intent understanding, and are sensitive to their cognitive state, which allows for the integration of logistics optimization, behavioural science knowledge and ethical governance into a single operational architecture (Dzreke et al., 2025h). In this context, each verbal command serves as both a signal for the operational system and a moral anchor, representing the seamless integration of cutting-edge technology, psychological insight, and ethically sound design.

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