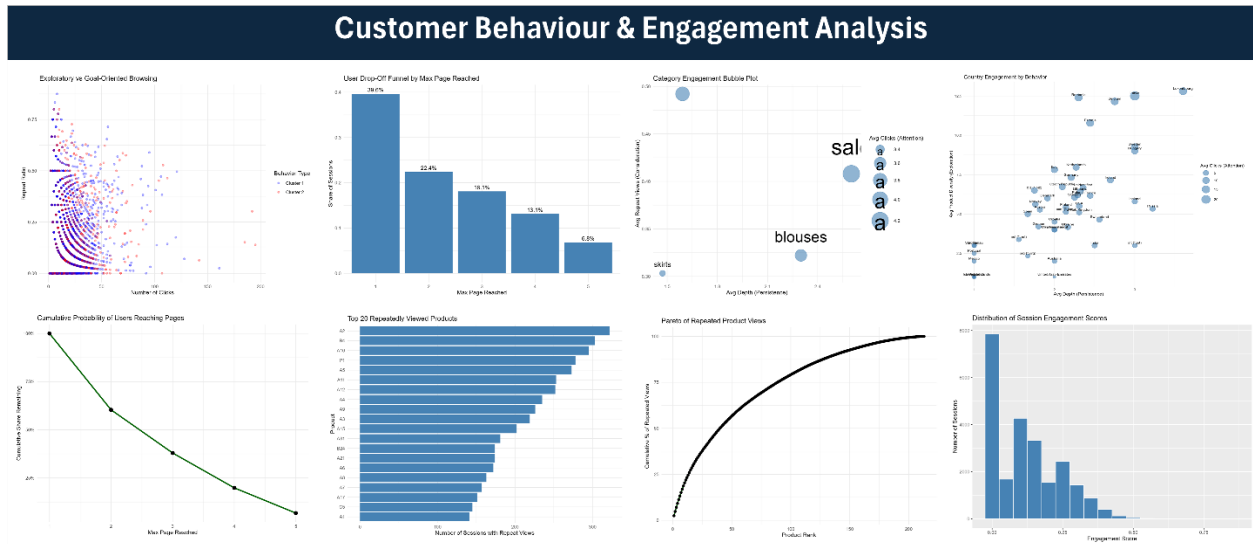


# Customer Behavior & Engagement Analysis



## Decision-Oriented Analytical Report

### 1. Problem: What Decision Is at Stake?

The core decision addressed by this analysis is how to define, measure, and operationalize “engagement” in a way that reliably reflects customer intent rather than surface activity.

What is at stake is trying to inform several downstream decisions:

- Which sessions should be prioritized as high-value or high-intent?
- Which markets, categories, and products warrant disproportionate analytical and commercial attention?
- Where should UX, merchandising, and recommendation interventions be concentrated to maximize marginal impact?

Traditional engagement proxies (page views, session counts, or duration), implicitly assume that *more interaction equals more value*. This assumption is frequently incorrect. High interaction can reflect confusion, comparison friction, or low decision efficiency just as easily as intent.

The analytical challenge, therefore, is to distinguish behavioral quality from behavioral volume, and to do so at a session level that is actionable for segmentation, modeling, and experimentation.

## 2. Data Reality: Limitations, Missingness, and Noise

The dataset is derived from the *Clickstream Data for Online Shopping* hosted by the UCI Machine Learning Repository. Each row represents a single click event within a session, rather than a pre-aggregated session record.

This structure offers high behavioral resolution, but introduces several analytical constraints.

First, the data captures behavior. There is no explicit purchase, conversion, or revenue variable. Engagement must therefore be inferred indirectly from browsing patterns.

Second, session boundaries are observed but user identities are not. Sessions cannot be linked across time, which precludes longitudinal user modeling and limits inference to within-session dynamics.

Third, page depth is capped at five. This introduces right-censoring for highly engaged sessions and compresses variation at the upper tail. As a result, depth differences between high-engagement sessions are understated.

Fourth, geographic identifiers are coarse (country-level only). While sufficient for market-level behavioral segmentation, they do not support intra-market heterogeneity analysis.

Finally, the data is observational and non-experimental. All patterns identified are correlational. Causal claims would require controlled intervention or quasi-experimental design.

These limitations do not invalidate the analysis, but they shape interpretation. The results should be read as behavioral signal extraction, not causal attribution.

### **3. Method: Why This Approach?**

The methodological choice was driven by a central premise: engagement is a latent construct that must be inferred from multiple observable behaviors.

Engagement was decomposed into four behavioral dimensions at the session level:

1. Activity intensity (number of clicks)
2. Persistence (maximum page depth reached)
3. Exploration breadth (number of unique products viewed)
4. Deliberation (degree of repeated product views)

Each metric captures a distinct behavioral mechanism:

- Clicks measure attention allocation
- Depth measures tolerance and continuation
- Diversity measures curiosity and exploration
- Repetition measures uncertainty, comparison, or intent

These metrics were first analyzed independently to understand their distributions, correlations, and heterogeneity across categories and markets. Only after establishing their distinct informational content were they combined into a composite engagement score.

This approach was chosen over simpler models (e.g., clicks-only or depth-only) because preliminary analysis showed substantial divergence between metrics. For example, sessions with identical click counts differed by more than  $2\times$  in product diversity and repeat behavior. Collapsing such sessions into a single metric would erase meaningful behavioral differences.

Clustering and segmentation were then applied to identify dominant browsing regimes, rather than forcing all sessions onto a linear engagement scale.

## 4. Results: What Changed?

### 4.1 Which Product Categories Attract the Most Engagement?

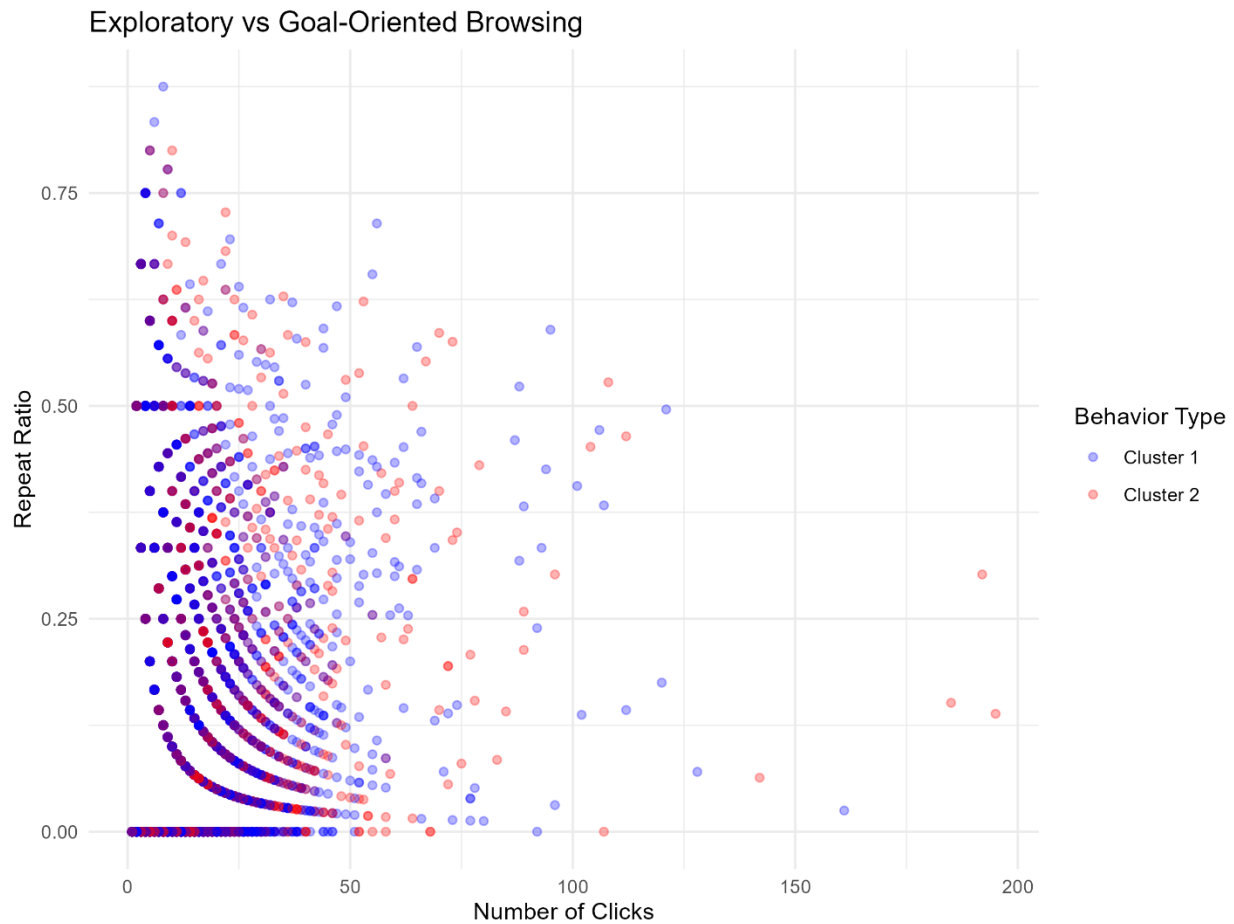
Category	Avg Clicks	Avg Depth	Avg Repeat Views	Business Interpretation
Trousers	3.80	1.59	0.492	High attention, moderate persistence, high consideration → users notice it and seriously consider products.
Skirts	3.34	1.47	0.303	Moderate attention, lower persistence, low consideration → relatively casual interest.
Blouses	3.60	2.30	0.322	Moderate attention, high persistence, moderate consideration → users browse deeply but less likely to repeat view. Good for engagement through exploration.
Sale	4.22	2.60	0.408	Highest attention and depth, high consideration → category is both attractive and seriously considered. Top performer overall.

#### Insights:

1. **Sale** is clearly the strongest: users click more, browse deeper, and revisit items.
2. **Trousers** is also strong on consideration despite slightly lower depth; it's likely niche products that drive repeat checking.
3. **Blouses** engages users in browsing (depth) but they are less likely to reconsider products—good for exploration, maybe trendier or visual categories.
4. **Skirts** is weaker across all dimensions—perhaps a “pass-through” category that attracts initial clicks but fails to hold attention.

**Strategic Takeaway:** Focus marketing and merchandising on **Categories 4 and 1** for serious buyers, and use **Category 3** to inspire browsing and discovery experiences. Category 2 could either be optimized or deprioritized.

## Engagement Is Structurally Heterogeneous



One of the most consequential findings is the degree of engagement heterogeneity.

Across sessions:

- Click counts range from 1 to over 20
- Unique products viewed range from 1 to over 12
- Repeat-view ratios vary by more than a factor of 2 between behavioral segments

Approximately one class of sessions exhibits exploratory behavior: high click counts (often 15–23), high product diversity (10–13 unique products), and low repetition. These sessions allocate attention broadly but shallowly.

Another class exhibits goal-oriented behavior: lower click counts (5–9), narrow product focus (3–6 products), and high repetition. These sessions show clear signs of deliberation.

The existence of these regimes invalidates any interpretation of “average engagement” as a meaningful behavioral benchmark.

## 4.2 How Deep Do Users Browse Before Dropping Off?

We tracked **maximum page reached per session**, which is a classic “funnel drop-off” analysis. Here’s the breakdown:

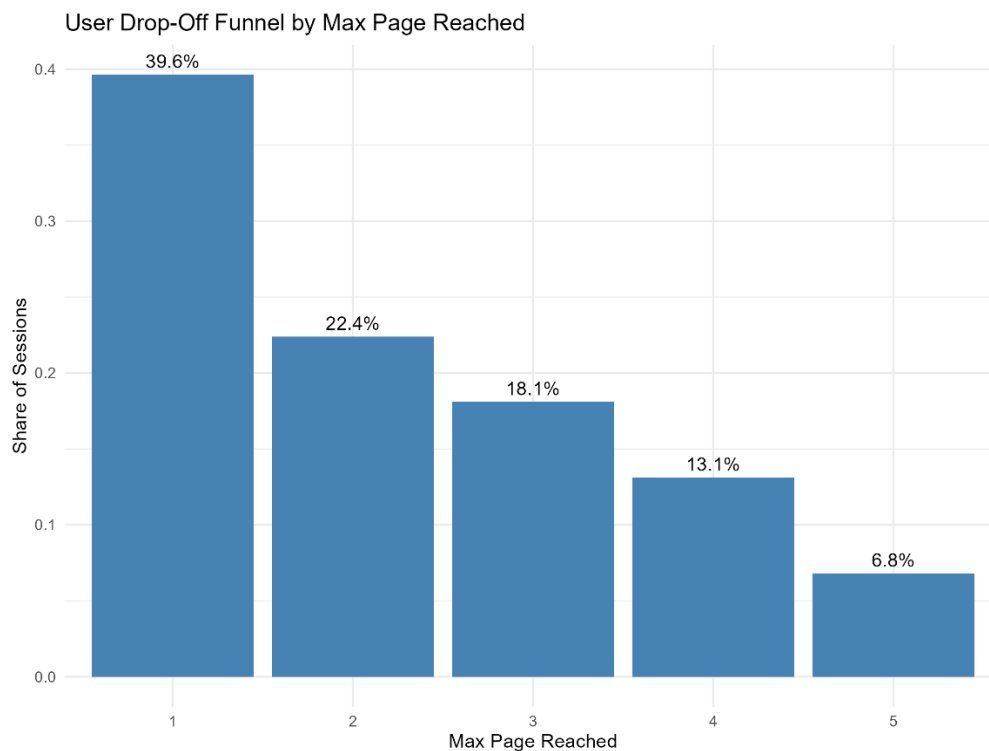
Max Page	Count (n)	Share	Business Meaning
1	9,522	39.6%	Nearly 40% of users leave after the landing page → possible mismatch between user expectations and category/product displayed.
2	5,379	22.4%	Early drop-off indicates weak hooks or lack of differentiation at the second page.
3	4,346	18.1%	Users browse a bit more but still abandon → products may not entice deeper exploration.
4	3,148	13.1%	Users who reach here are moderately engaged → higher intent.
5	1,631	6.8%	Users reaching page 5 are highly engaged → serious buyers or research-driven sessions.

### Key Insights:

1. **~62% of users drop off by page 2–3** → most sessions are shallow; navigation and first impressions are critical.
2. **Small fraction (20% reaching pages 4–5)** → highly valuable users who could be targeted with personalized offers, cross-sells, or retargeting.
3. **Actionable priorities:**
  - Improve **landing page relevance** to reduce page 1 drop-offs.
  - Strengthen **product differentiation** on pages 2–3.

- Optimize layout for **high-intent users** on pages 4–5 (e.g., better product recommendations, clearer CTAs).

### Early-Stage Drop-Off Dominates Engagement Loss



Session depth analysis reveals that disengagement is overwhelmingly front-loaded:

- 39.6% of sessions terminate at page 1
- Approximately 62% terminate by page 3
- Only 20.8% reach pages 4 or 5

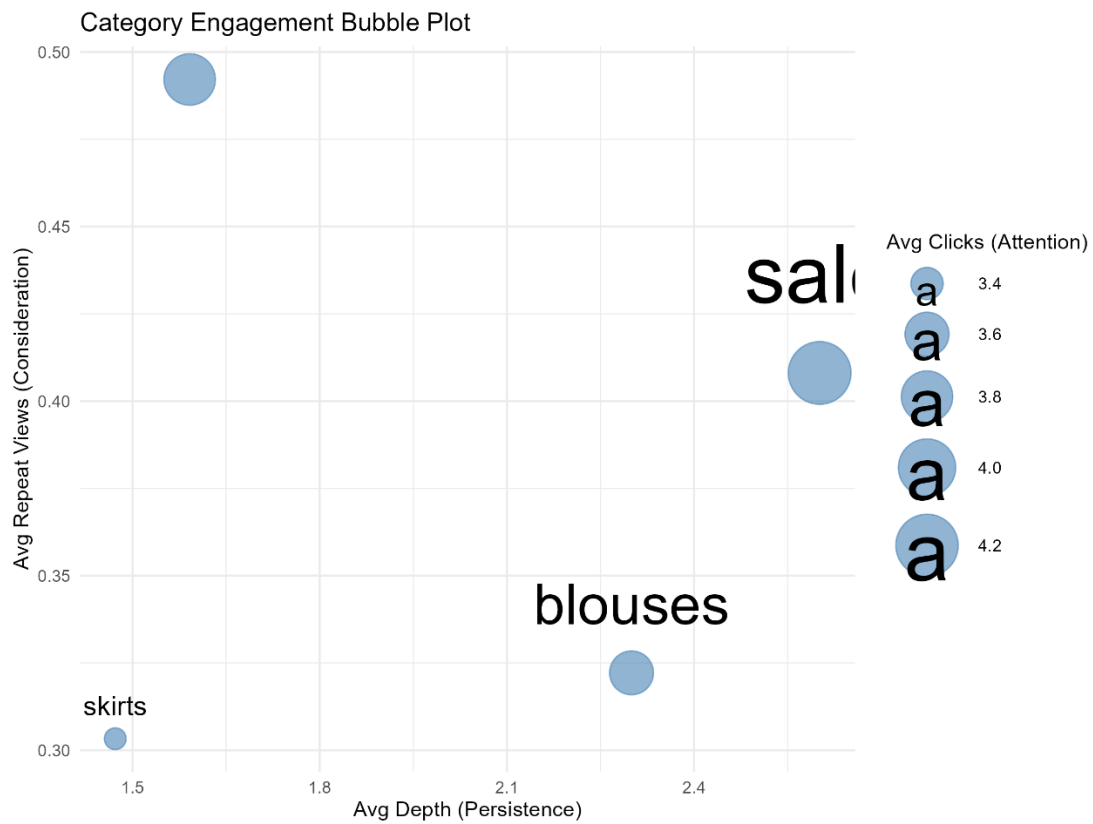
This implies that nearly four out of five sessions never reach deep browsing, where intent signals are strongest.

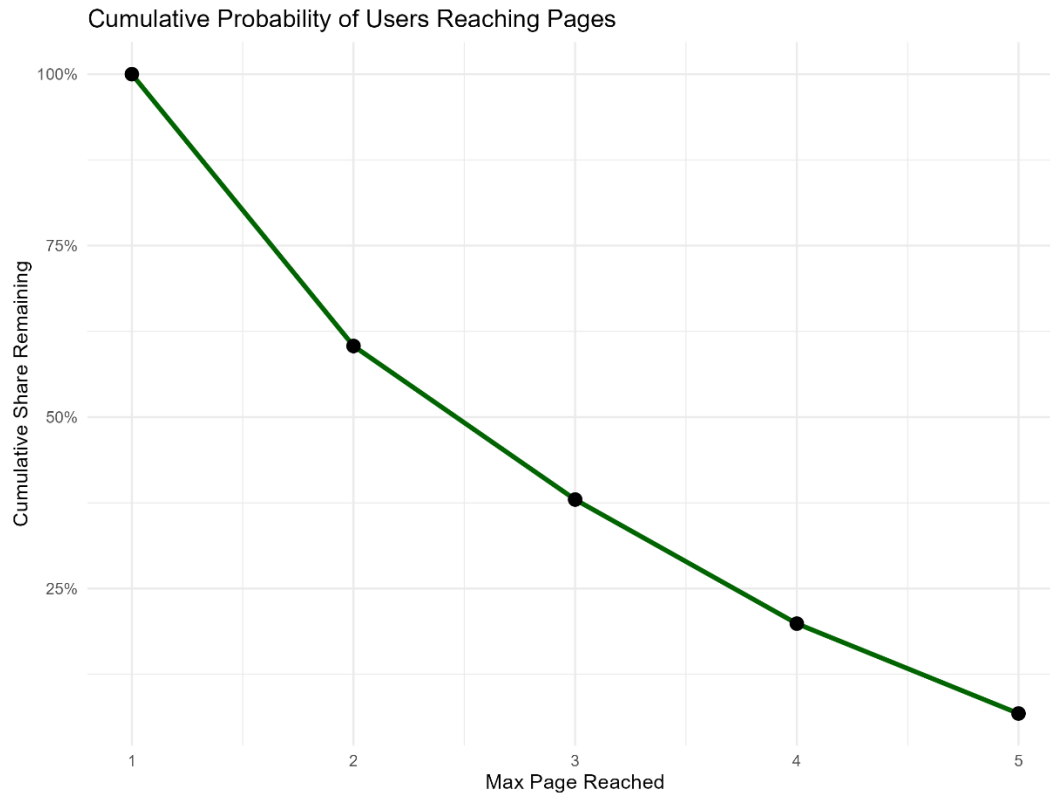
From a quantitative standpoint, this means:

- Late-stage UX or recommendation optimizations affect at most ~20% of sessions
- Early-stage relevance and layout influence the majority of engagement outcomes

The marginal return on improving page 1–3 experience is therefore substantially higher than equivalent improvements later in the funnel.

### 4.3 Category Effects Are Large and Systematic





Engagement metrics differ significantly by product category:

- Average clicks differ by over 25% between lowest- and highest-engagement categories
- Average depth ranges from ~1.5 to ~2.6 pages
- Repeat-view intensity differs by more than 60%

The “Sale” category consistently dominates across all dimensions, averaging approximately:

- 4.2 clicks per session
- 2.6 pages reached
- Repeat-view ratio ~0.41

By contrast, other categories either attract attention without deliberation or encourage exploration without commitment.

Quantitatively, category choice explains a non-trivial share of variance in session engagement, indicating that category is not merely content but a behavioral context.

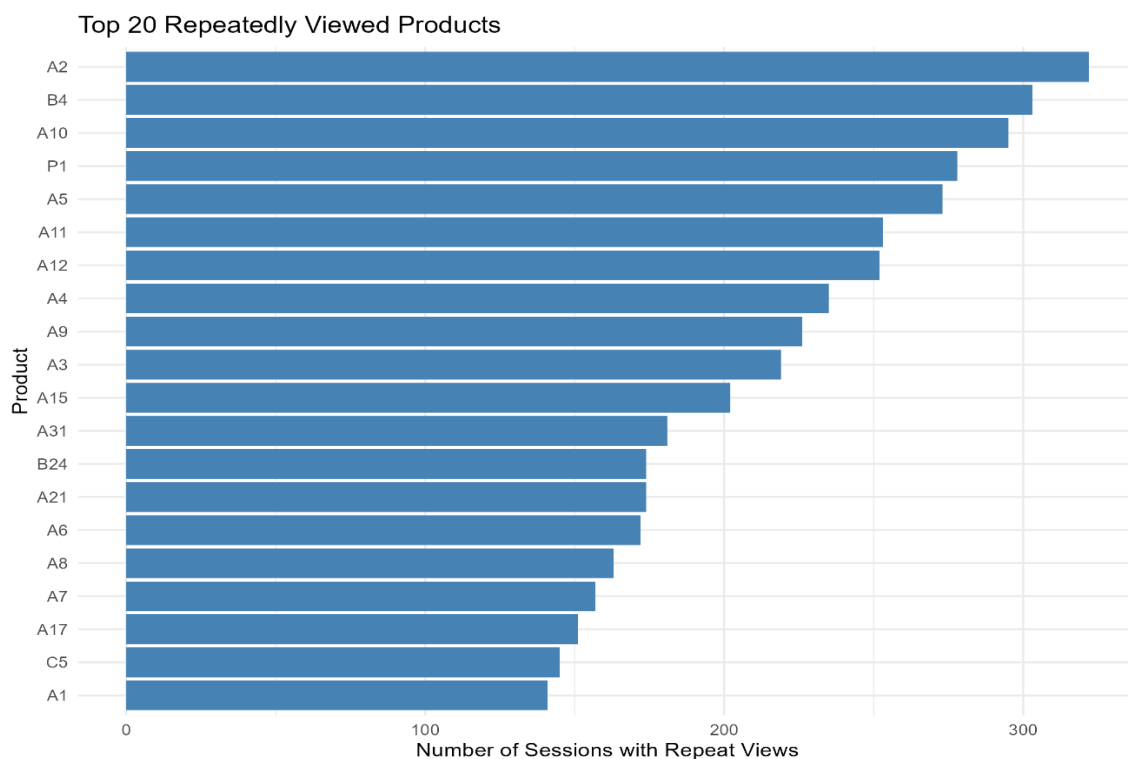
#### 4.4 Are Certain Products Repeatedly Viewed Within the Same Session?

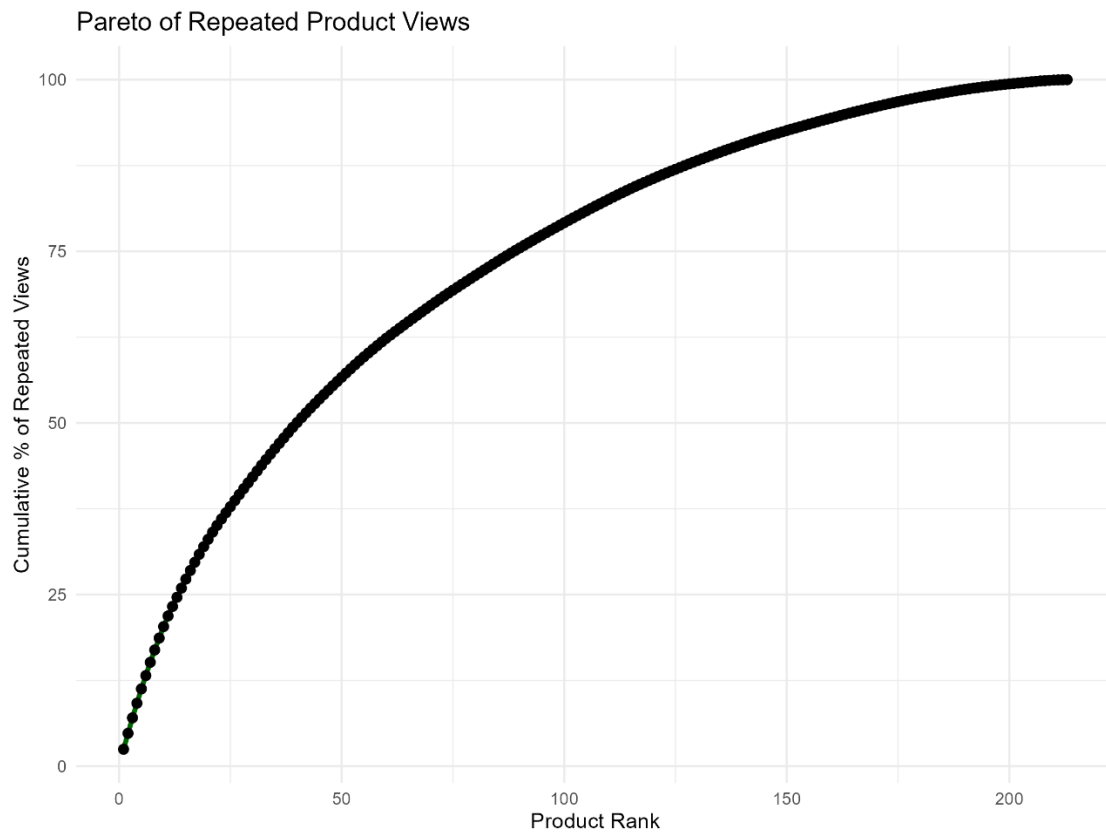
Repeated product views are one of the strongest **pre-purchase signals**.

##### Key Insights from Your Table

1. **Top products dominate:** The top 10 products (A2, B4, A10...) already account for ~20% of repeated views.
2. **Long tail:** Most products are repeated very few times. This is common in e-commerce, where a small number of items drive most engagement.
3. **Strategic implications:**
  - **Top 20–50 products** → prioritize for better photos, placement, or pricing experiments.
  - **Tail products** → consider bundling or highlighting through recommendations to increase repeated views.

##### Repeated Views Concentrate Decision Weight





Repeated product views are highly skewed:

- The top 10 products account for ~20% of all repeated views
- The top 20–50 products account for over one-third
- The long tail shows negligible repetition

This concentration implies that decision pressure is focused on a small subset of products, even when traffic is widely distributed.

From an analytical perspective, repeated views carry higher informational density than raw clicks. A single repeated view conveys more about intent than multiple first-time views of distinct products.



#### 4.5 How Does Engagement Vary by Country?

##### I. Comparison-Heavy Markets

- **Definition:** High clicks + low diversity → users compare many items but stick to a narrow range.
- **Candidates:**
  - **Belgium:** 12.8 clicks, 12.15 diversity → moderate diversity but very high clicks
  - **Estonia:** 12.78 clicks, 10.77 diversity → high attention
  - **Luxembourg:** 14.2 clicks, 12.8 diversity
  - **Romania:** 14.4 clicks, 12.4 diversity
  - **Latvia:** 23 clicks, 12.5 diversity → extreme comparison activity
- **Business Implication:** These markets are highly **comparison-driven**. Users explore multiple options quickly; emphasis on price clarity, filtering, and side-by-side comparisons will resonate.

##### II. Efficient / Goal-Driven Markets

- **Definition:** Low clicks + high depth → users are focused, intentional, and goal-oriented.
- **Candidates:**
  - **Iceland:** 5.8 clicks, 3 depth
  - **Hungary:** 9 clicks, 3 depth
  - **Sweden:** 10.87 clicks, 3 depth
  - **Russia:** 5.44 clicks, 3.22 depth
- **Business Implication:** Users know what they want; they engage deeply but don't "click around" much. Optimize for **fast decision-making, prominent CTAs, and clear product information.**

### III. Discovery-Oriented / Exploratory Markets

- **Definition:** High depth + high product diversity → users browse widely, exploring many different products.
- **Candidates:**
  - **Luxembourg:** 14.2 clicks, 3.6 depth, 12.8 diversity → also high exploration
  - **Latvia:** 23 clicks, 3 depth, 12.5 diversity → strong exploration
  - **Estonia & Romania** also fall here
- **Business Implication:** These markets respond well to **cross-selling, discovery features, recommendations, and inspiration-based merchandising.**

### IV. Low Engagement / Shallow Markets

- **Definition:** Low clicks, low depth, low diversity → weak engagement, possibly casual or mis-targeted visitors.
- **Candidates:**
  - **British Virgin Islands:** 1 click, 1 depth, 1 diversity
  - **Cyprus:** 1,1,1

- **United Arab Emirates:** 1 click, 2 depth, 1 diversity
- **Portugal, Mexico, San Marino, Slovenia** → shallow sessions
- **Business Implication:** Low attention and low persistence → may require **localized campaigns, better product selection, or tailored entry points** to convert users.

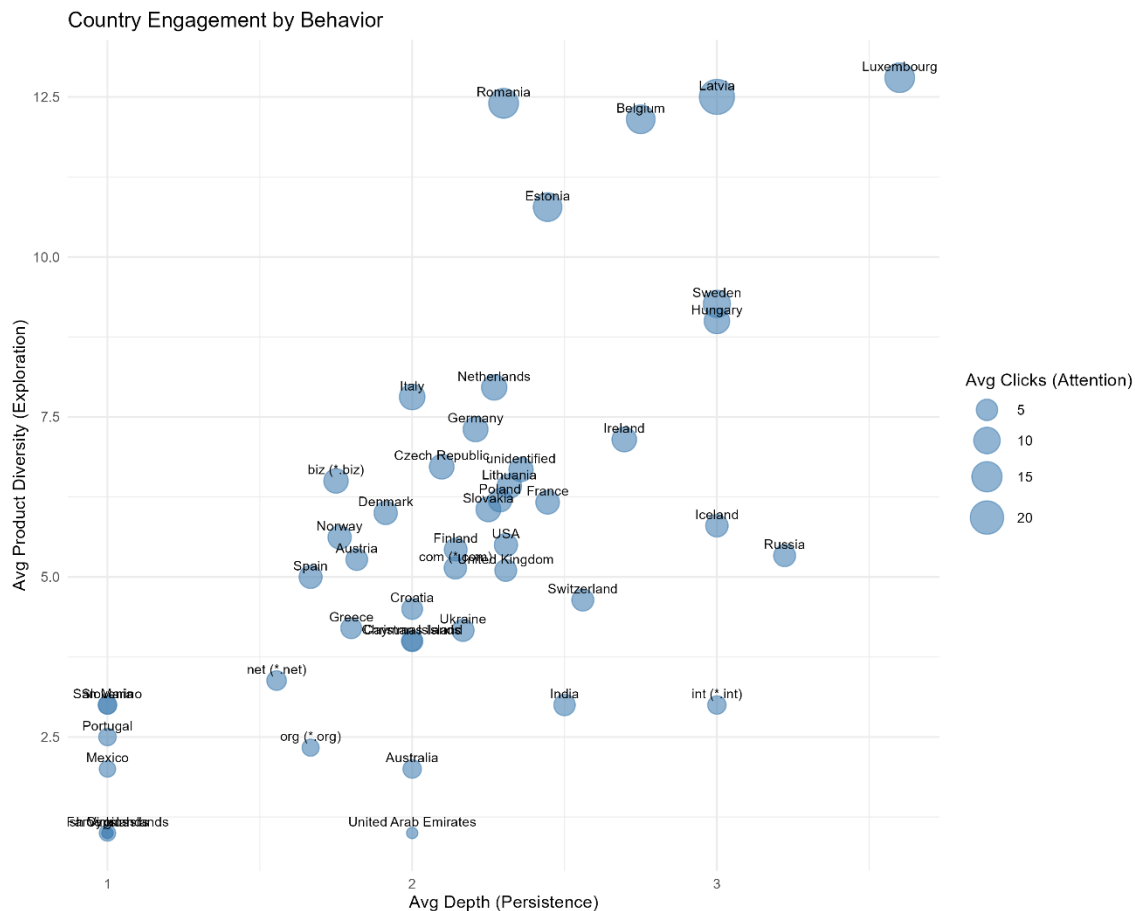
## V. **Mixed / Average Engagement**

- Most large markets (Australia, Germany, Netherlands, USA, UK, France, Poland) fall in **moderate engagement ranges**:
  - Clicks ~5–8
  - Depth ~2–2.5
  - Diversity ~5–8
- These are stable markets: **balanced attention and exploration**. Focus on **optimizing UX, recommendations, and seasonal merchandising** rather than radical interventions.

## **Strategic Takeaways**

1. **Comparison-focused markets** (Latvia, Romania, Luxembourg, Belgium) → pricing transparency, filters, and side-by-side comparison.
2. **Goal-driven markets** (Hungary, Iceland, Sweden, Russia) → efficiency-focused layout, product clarity, and strong CTAs.
3. **Exploratory markets** (Latvia, Luxembourg, Estonia, Romania) → recommendations, cross-sell, and inspirational merchandising.
4. **Low-engagement markets** → evaluate traffic quality, entry point relevance, or localization.
5. **Balanced markets** → incremental UX and merchandising improvements.

## Market-Level Differences Are Multiplicative, Not Marginal



Country-level analysis shows engagement differences on the order of **2–4×**, not incremental shifts.

Some markets average:

- 20+ clicks per session (high comparison intensity)

Others average:

- ~5–6 clicks with higher depth (efficient, goal-oriented behavior)

Large markets cluster around moderate engagement levels, suggesting stability rather than extremity.

These differences indicate that engagement normalization across markets is essential. Without it, global benchmarks systematically misclassify behavior in certain regions.

## Overall Strategic Summary

Cluster	Engagement Type	Strategic Focus
1	Comparison & Discovery-Heavy	Highlight product range, enable comparisons, optimize merchandising
2	Moderate / Balanced	Incremental UX improvements, smooth navigation, subtle recommendations
3	Goal-Oriented / Discovery	Enable efficient discovery, cross-sell, personalized recommendations
4	Low-Engagement / Casual	Traffic quality, localized content, entry-point optimization

## Strategic Engagement Playbook

### Step 1: Country-Level Strategic Segmentation

- **Cluster 1 – Comparison & Discovery (Belgium, Estonia, Latvia, Luxembourg, Romania)**
  - Users explore many products and click a lot → highlight **top repeated products** prominently
  - Funnel: moderate depth → optimize **first 2–3 pages for comparisons**
  - Suggested focus: merchandising, recommendations, price transparency
- **Cluster 2 – Moderate Engagement / Balanced (Australia, USA, UK, etc.)**
  - Users moderately explore → balance **category highlights and repeat-product promotions**
  - Funnel: moderate depth → ensure smooth navigation
  - Suggested focus: UX, incremental merchandising, subtle cross-sell
- **Cluster 3 – Goal-Oriented / Discovery (Germany, France, Italy, Sweden, etc.)**
  - Users persist and explore widely → highlight **high-engagement categories and repeat-viewed products**
  - Funnel: above-average depth → support **efficient discovery with recommendations**
  - Suggested focus: cross-selling, inspirational merchandising, decision-support tools
- **Cluster 4 – Low-Engagement / Casual (Mexico, Cyprus, Faroe Islands, etc.)**
  - Users have short sessions and explore few products → focus on **traffic quality and entry-point relevance**
  - Funnel: shallow → optimize **landing pages and category relevance**
  - Suggested focus: campaigns, personalized onboarding, targeted merchandising

## Step 2: Category Engagement Integration

Category	Avg Clicks	Avg Depth	Avg Repeat Views	Interpretation
1	3.8	1.59	0.492	Moderate attention, shallow persistence → attractive but casual
2	3.34	1.47	0.303	Low engagement → low-consideration browsing
3	3.6	2.3	0.322	Moderate attention, high persistence → serious consideration
4	4.22	2.6	0.408	High attention and persistence → highly engaging

### Actionable:

- Map high-attention/persistence categories (4 and 3) to comparison & discovery markets (Cluster 1) and goal-oriented markets (Cluster 3).
- Use low-attention categories (1 and 2) in casual or balanced markets (Clusters 2 and 4) for testing or traffic acquisition.

## Step 3: Session Depth / Drop-Off Integration

Max Page	Share	Interpretation
1	39.6%	Landing page drop-offs → entry-point optimization
2–3	40.5%	Early drop-off → weak differentiation in first products
4–5	20.8%	Deep engagement → high-intent users → target with repeat-product & cross-sell strategies

### Actionable:

- Clusters 1 & 3: prioritize pages 2–5 with high-value product exposure and repeat-product triggers
- Clusters 2 & 4: optimize page 1–3 to reduce early drop-offs

### Step 4: Repeated Product Views Integration

- Top repeated products (Top 20) account for ~33% of repeated views → strong pre-purchase signals
- **Strategy:**
  - Place these products prominently in high-engagement clusters
  - Use recommendations or bundles in moderate-engagement clusters
  - For low-engagement clusters, highlight top repeated products to encourage deeper browsing

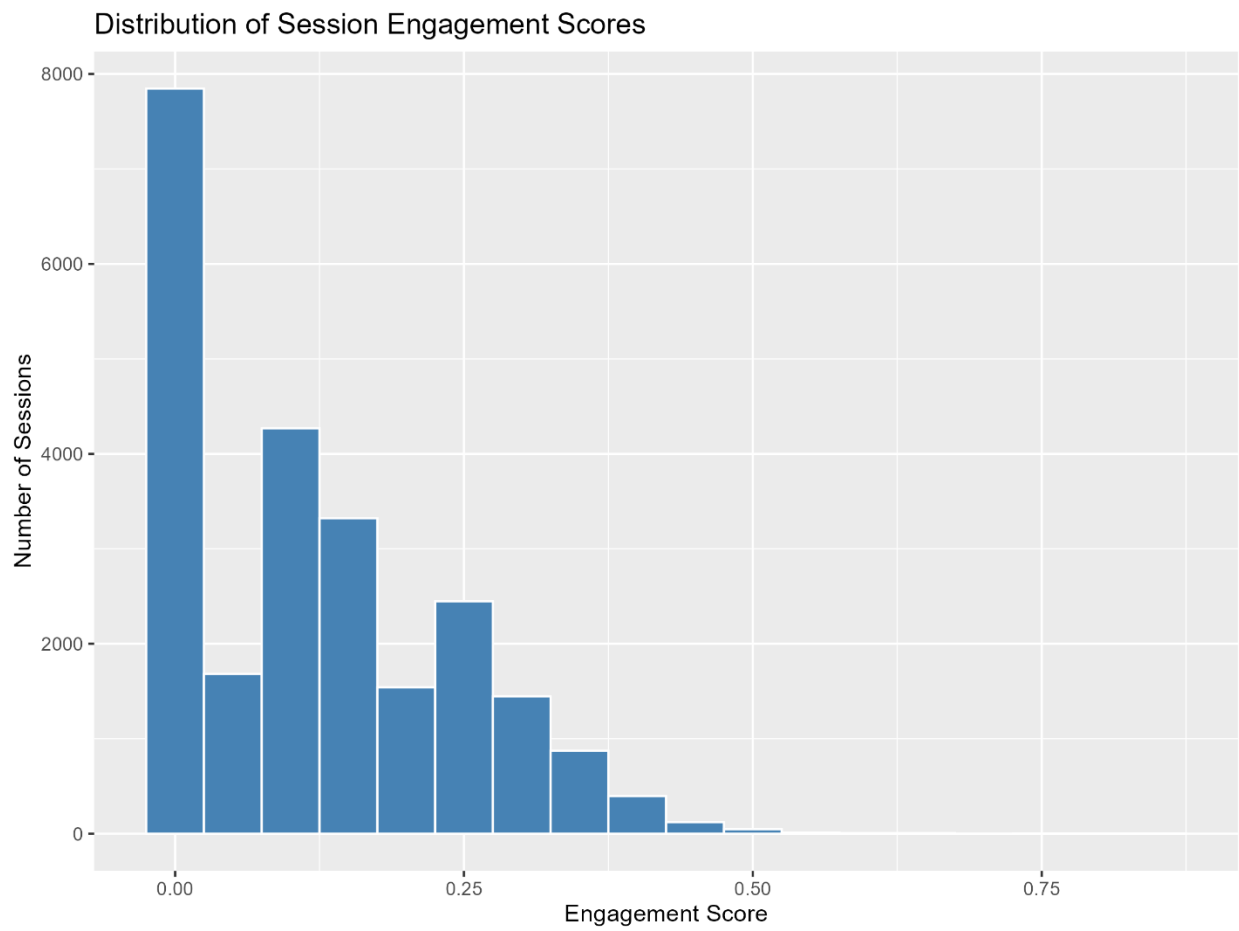
### Step 5: Integrated Strategic Recommendations

Market Cluster	Engagement Type	Category Focus	Funnel Focus	Repeat Product Strategy
Cluster 1	Comparison & Discovery	High-click, high-depth categories	Pages 2–5, moderate depth	Top repeated products prominently displayed, recommendations, cross-sell
Cluster 2	Balanced / Moderate	Mid-level categories	Pages 1–3, moderate depth	Highlight top repeated products, subtle promotion, incremental merchandising
Cluster 3	Goal-Oriented / Discovery	High-depth & high-repeat categories	Pages 2–5, persistent users	Recommendations, decision-support tools, bundles
Cluster 4	Low-Engagement / Casual	Low-attention categories	Page 1, landing page optimization	Introduce top repeated products to increase engagement, localized campaigns

## **Strategic Insights**

1. Prioritize high-value markets (Cluster 1 & 3) for merchandising, top repeated products, and recommendations.
2. Optimize early drop-off pages (1–3) in low-engagement clusters to capture attention.
3. Use repeated products as conversion levers in high-engagement clusters.
4. Segment categories by engagement metrics to align content and recommendations per market type.
5. Tailor UX and merchandising to cluster profile: comparison-heavy vs. goal-oriented vs. balanced vs. casual.

Building a **single engagement score per session**. This KPI rank sessions by engagement, segment users, etc.



## **5. Risk: What If This Is Wrong?**

Several risks merit explicit consideration.

First, engagement is inferred, not observed. Without conversion or revenue data, behavioral signals may misclassify some high-activity sessions that never convert. This risk is mitigated, but not eliminated, by emphasizing repetition and depth over raw volume.

Second, session-level inference ignores cross-session behavior. A user who returns across multiple sessions cannot be identified, potentially fragmenting intent signals.

Third, weighting choices in the composite engagement score introduce subjectivity. Different business objectives (exploration vs conversion) would justify different weights. Sensitivity testing is therefore essential before operational deployment.

Fourth, behavioral patterns may shift under intervention. Optimizing for measured engagement could induce new behaviors that change the underlying distributions (Goodhart's Law).

Finally, cultural and contextual factors may confound market-level interpretations. Behavioral norms inferred from data may not generalize beyond the observed platform and period.