Dynamic Taste Vector Modulation Across Hormonal, Emotional, and Gastric States

A Longitudinal Naturalistic Study in Whisky Preference

A Companion Paper to: The Female Sensory Economy and the Birth of Sensory Intelligence

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Abstract

We present what we believe to be the first longitudinal naturalistic dataset mapping the simultaneous interaction between hormonal phase, emotional state, food context, and multidimensional taste preference in response to commercial spirits. Over an observation period spanning approximately 12–18 months across 2024–2025 (covering multiple complete menstrual cycles per participant), 9 female and 7 male participants on the WhiskyBaba tasting platform logged liked/disliked responses to approximately 300 distinct single malt whiskies alongside self-reported menstrual phase, a 9-dimensional emotional state vector, and food consumption context. In total, 654 female and 280 male tasting records were collected. Taste vectors for each whisky were independently derived from distiller tasting notes through a validated keyword-to-receptor mapping system, ensuring separation between product characterization and user-reported context.

Within-subject analysis reveals patterns consistent with a conceptual coupled-system model of female taste preference: hormonal phase appears to act as a primary modifier setting receptor sensitivity and emotional baseline; emotional state appears to act as a derivative modifier gating real-time acceptance and rejection; and food state acts as an environmental conditioner modulating the expression of both. Male participants showed primarily food-state modulation with a structurally stable bitter-astringent core. The 6-dimensional compositional taste vector methodology captures geometric reorganization of preference that would be invisible to single-dimension analysis.

While the cohort size (n=9 female, n=7 male) limits population-level generalization, the within-subject longitudinal design provides sufficient repeated observations to identify stable individual patterns and cross-subject convergences. We propose a stratified modifier hierarchy — genetics/ethnicity (stable floor), hormonal phase (cyclical primary), medications (semi-stable), food/time (short-term), and life events (episodic) — as a theoretical framework for modeling dynamic taste preference.

Keywords: taste perception, menstrual cycle, whisky, personalization, 6D taste vector, longitudinal

study

1. Introduction

1.1 The Problem of Static Taste Models

Current beverage recommendation systems operate on an implicit assumption: that individual taste preference is a stable trait. A consumer who enjoys a particular sensory profile on one occasion will reliably enjoy it on another. This assumption underlies star-rating aggregation, collaborative filtering, and expert-panel tasting notes — the dominant mechanisms through which the global spirits industry matches products to consumers.

The assumption is biologically false for a substantial portion of the population.

Six decades of psychophysical research have documented that taste sensitivity varies systematically with hormonal state in women. Glanville and Kaplan (1965) demonstrated increased sensitivity to PROP and quinine during menstruation in approximately two-thirds of subjects studied [DOI: 10.1016/S0002-9378(65)80006-0]. Alberti-Fidanza et al. (1998) showed that sweet taste sensitivity increases with estradiol while bitter sensitivity increases with progesterone [PMID: 9565832]. Stanić et al. (2021) broadly confirmed cycle-dependent modulation of taste perception across sweet, salty, sour, and bitter dimensions using a longitudinal within-cycle design with biochemical phase verification, revealing a more complex pattern of intensity changes across the cycle than simple single-hormone correlations [PMID: 34444669]. Costanzo et al. (2024) provided a comprehensive review of temporal patterns in taste sensitivity across diurnal, monthly, and seasonal cycles, noting that oral contraceptive users showed lower overall suprathreshold sweet taste intensity compared to naturally cycling women [DOI: 10.1093/nutrit/nuad097].

Separately, research on affect-taste interactions has established that emotional state modulates taste perception in real-world settings. Noel et al. (2015) demonstrated that naturally occurring emotional variation (induced by sports event outcomes) significantly altered taste intensity ratings and hedonic evaluations across approximately 550 participants [PMID: 26122754].

However, these two lines of research — hormonal modulation and emotional modulation of taste — have remained largely separate. No published study has simultaneously captured hormonal phase, emotional state, food context, and multidimensional taste preference for real commercial products over longitudinal timescales within the same individuals.

1.2 The Present Study

This paper reports observational data from the WhiskyBaba tasting platform, a whisky profiling system that captured multidimensional taste, emotional, hormonal, and contextual data for each tasting event over a 12–18 month period (2024–2025). The platform independently characterized each whisky's taste profile through distiller note analysis and separately recorded each user's experiential response, emotional state, hormonal phase, and food context at the moment of tasting.

The Sensory Intelligence architecture underlying this platform is domain-agnostic — the same receptor-biology framework extends to olfaction and other chemosensory domains, validated separately through the PiriZero olfactory platform and BitterMatrix coffee platform. The present study focuses on taste prediction for single malt whisky as the initial validation domain.

The resulting dataset, while modest in subject count (n=9 female, n=7 male), is substantial in total observations (654 female tasting records, 280 male tasting records) and rich in dimensionality, enabling within-subject analysis of how the same individual's taste acceptance shifts across biological and environmental conditions.

1.3 Theoretical Framework: The Stratified Modifier Hierarchy

We propose that taste preference operates through a hierarchy of modifiers operating at different timescales:

Layer 1 — Genetic and ethnic receptor configuration (stable, lifelong). TAS2R38 polymorphisms, TRPV1 receptor density, and supertaster/nontaster status establish the hardware limits of an individual's taste perception space. These vary systematically across populations. Kim et al. (2005) documented worldwide haplotype diversity at bitter taste receptor loci [DOI: 10.1002/humu.20203]. Hayes et al. (2008) showed that supertasting depends on multiple genetic factors beyond TAS2R38 alone [DOI: 10.1093/chemse/bjm084].

Layer 2 — Hormonal phase (cyclical, approximately weekly shifts). This is the primary dynamic modifier for women. It operates on taste receptors directly (changing detection thresholds) and simultaneously shifts emotional baseline through estrogen-serotonin and progesterone-GABA coupling. It sets the envelope within which faster modifiers operate.

Layer 3 — Medications (semi-stable, duration of pharmacological course). Over 200 medications can induce taste disorders [PMID: 28115648]. A comprehensive analysis of the Dutch national drug database found that 17% of all registered drugs (282 of 1,645) were documented with dysgeusia, reported across all drug categories [PMID: 31532870]. A systematic review identified 35 drugs correlated with dysgeusia, predominantly among chemotherapeutic agents, antihistamines, antibiotics, and ACE inhibitors [PMID: 30574604]. Critically, oral contraceptives have been observed to alter suprathreshold taste intensity patterns compared to naturally cycling women [DOI: 10.1093/nutrit/nuad097] — indicating that medication effects interact with the hormonal modifier layer rather than operating independently.

Layer 4 — Food state and circadian rhythm (short-term, hours). Gastric buffering physically changes how chemistry presents to receptors. Tannin-protein binding in food reduces perceived astringency of beverages consumed alongside meals, a phenomenon well-documented in wine science [PMID: 32498458]. Time of day introduces cortisol rhythm and circadian receptor modulation. These environmental modifiers fine-tune how the primary and derivative modifiers express themselves.

Layer 5 — Life events (episodic, variable duration). Prolonged stress, grief, and major life transitions create sustained shifts in both emotional baseline and appetite. Stress challenges natural homeostasis, disrupting feeding behavior through HPA axis activation [PMC4214609].

Negative emotions alter both what and how much people eat, with effects mediated by cortisol, insulin, and glucose [PMC7663318]. Critically, life events can compress the modifier hierarchy — what is normally a fast-moving emotional modifier becomes semi-stable under sustained distress, reducing the system's dynamic range. Layer 5 effects were not directly measured in this study but are included in the theoretical framework based on established literature; the successor system incorporates contextual inputs that may enable future investigation of this layer.

This stratified model implies that the slower layers set the envelope within which faster layers operate. Knowing an individual's receptor configuration (Layer 1) and current hormonal phase (Layer 2) should, in principle, be sufficient to generate useful taste predictions — because hormonal phase partially determines emotional baseline (Layer 2 → derivative emotional effect), and the remaining environmental modifiers (Layers 4–5) can be optionally captured for increased precision.

2. Methods

2.1 Platform and Participants

Data were collected through the WhiskyBaba tasting platform (thewhiskybaba.com), a web-based whisky profiling system. The platform operated in two modes: a free tier where users entered whisky details and tasting notes, and a subscription tier that additionally captured emotional state, hormonal phase, food context, and baseline health data.

Initial tastings were conducted at organized whisky tasting events in social settings. Participants who subscribed to the platform subsequently continued profiling independently in home settings. The analyzed dataset therefore encompasses both social-event and private-tasting contexts, providing ecological variation in consumption environment.

The analysis cohort comprises 9 female participants and 7 male participants who completed subscription-tier profiling with sufficient longitudinal data for within-subject analysis, yielding 654 female and 280 male tasting records collected between 2024 and 2025. Participants were geographically distributed across Europe (Romania, Austria, United Kingdom, Poland), the United States (including participants of Indian origin), India, and Australia. Detailed demographic profiles (age ranges, whisky experience levels) were not systematically collected, which represents a limitation of this observational dataset. An additional approximately 600 user records were lost due to a technical database error and are not included in this analysis.

All participants provided informed consent for data collection and research use through the platform's terms of service. Participants were identified by anonymized codes; no identifying information is reported. This study constitutes retrospective analysis of anonymized operational platform data. Formal institutional ethics review was not sought; the authors acknowledge this as a limitation and note that future prospective studies will incorporate appropriate ethics oversight.

2.2 Whisky Taste Vector Derivation (Independent Variable)

Each whisky's 6-dimensional taste vector was derived independently of user responses through the following pipeline:

1. **Distiller tasting notes** were obtained from official bottle descriptions, distillery websites, or trusted review sources. Notes could be entered manually by the user or extracted via optical character recognition from bottle photographs.
2. **Keyword extraction**: Tasting note text was cleaned (removal of brackets, punctuation, standardization to lowercase) and tokenized into individual keywords.
3. **Keyword-to-taste-vector mapping**: Each keyword was matched against a curated lookup table containing over 2,000 tasting note terms, each pre-assigned 6-dimensional receptor-mapped values corresponding to the six fundamental taste dimensions: Sweet, Sour, Salty, Pungent, Bitter, and Astringent. These mappings were developed through systematic calibration combining classical taste taxonomy cross-referenced with modern receptor biol-

ogy research.

4. **Vector normalization**: The matched keyword values were summed across each dimension and normalized to percentage composition, producing a 6D compositional vector summing to 100% for each whisky.

This procedure ensures that the whisky's taste characterization is determined by its published sensory description and is algorithmically independent of any individual taster's contextual response. However, it should be noted that distiller tasting notes are themselves marketing language and may embed market expectations or stylistic conventions that do not precisely correspond to the whisky's molecular composition. Approximately 300 distinct single malt whiskies were profiled through this system.

2.3 User Experiential Vector (Dependent Measure — Subscription Tier)

Subscription-tier participants additionally completed a 22-item experiential questionnaire for each tasting event. Each question addressed a specific aspect of how the whisky was perceived on the tongue, palate, and mouth. Each question was mapped to the same 6-dimensional taste space via a calibrated response table, with each response contributing weighted values to the six dimensions. Responses were summed and normalized to produce a user-specific 6D experiential vector for each tasting event.

2.4 Context Variables (Captured at Time of Tasting)

For each tasting event, the following contextual variables were recorded:

Preference outcome: Binary liked/disliked response.

Emotional state: Multi-select from 9 emotion categories: Anger, Sorrow, Longing, Disgust, Joy, Fear, Inspired, Awe, Lust. Participants could select multiple simultaneous emotions, producing a 9-dimensional emotional vector. This multi-select design captures the composite nature of real emotional states — for example, a state predominantly characterized by joy may include secondary components of inspiration and longing. No validated psychometric instrument (such as PANAS or SAM) was used; the ecological advantages of capturing blended states must be weighed against the lack of psychometric validation and the potential for recall and interpretation biases.

Hormonal phase (female participants only): Single-select from four options: Ovulation, During Menses, Pre-Menses, Post-Menses. Self-reported at time of tasting based on the participant's own cycle awareness. Where no phase was indicated, the observation was classified as "Unmapped." Self-reported phase discrimination is reasonably accurate for broad phase categories though less precise than hormonal assay [PMID: 34444669].

Food state: Single-select from three options: With Food, Directly After Food, Empty Stomach.

Temporal data: Date and time of tasting were recorded automatically.

2.5 Data Aggregation and Analysis

All analysis in this paper is descriptive and exploratory. Mean 6D taste vectors were computed for each analytical dimension (hormonal phase, emotional state, food state, liked/disliked) by averaging across all tasting records falling within each bin. No formal inferential statistical tests, confidence intervals, or effect sizes are reported. This approach is appropriate for the exploratory, hypothesis-generating purpose of this pilot study but limits the strength of claims that can be made. Formal mixed-effects modeling and multiple-comparison corrections would be required for confirmatory analysis.

Event counts per analytical bin are reported alongside all results tables to enable the reader to assess the evidentiary weight of each finding independently. Some condition intersections (e.g., specific phase × emotion combinations) contained very few observations; findings from sparse bins are explicitly flagged and should be interpreted with additional caution.

Individual tasting events were aggregated within subjects across the following analytical framework:

1. Hormonal Shift: Mean 6D taste vector of liked/disliked malts across each hormonal phase.
2. Global Signature: Overall liked vs. disliked 6D taste vectors.
3. Food Impact: Mean 6D vector by food state.
4. Hormonal Emotional Baseline: 9D emotion vector distribution across hormonal phases.
5. Emotional Craving: 6D taste vector of liked malts isolated by dominant emotion.
6. Triangulation: Food state × preference interaction where bin sizes permit.

2.6 Methodological Strengths and Limitations

Strengths:

Independent variable separation: The whisky's 6D taste vector is derived from distiller notes, not from the person reporting their emotional state. When we report that women in this cohort preferred higher-astringent malts during menses, we mean they liked malts whose independently-derived chemistry maps to high astringent vectors.

Within-subject longitudinal design: Each participant serves as their own control across conditions. This design requires smaller n than between-subjects comparisons because it controls for stable individual differences.

Ecological validity: Data were collected during real whisky consumption (events and personal tasting), not in a laboratory with standardized stimuli.

Multi-select emotion capture: Allowing simultaneous emotion selection produces a richer emotional vector than forced-choice instruments.

Limitations:

Sample size: 9 female and 7 male participants. All findings should be interpreted as pilot evidence consistent with established literature, not as population-level proof. Replication with larger cohorts and biochemically verified hormonal phases is needed.

Self-reported hormonal phase: Precision could be improved with hormonal assay or standardized cycle-tracking integration. Recall and interpretation biases may affect subtle phase distinctions (e.g., pre-menses vs post-menses).

Keyword-based vector derivation: The whisky taste vectors depend on the accuracy of distiller tasting notes and the calibration of the keyword-to-taste-dimension mapping table. Distiller marketing language may not precisely correspond to molecular composition. This limitation is addressed in the successor system through physics-based production parameter modeling.

No formal blinding: Participants knew the whisky's name and could see its label.

No formal statistical analysis: All results are descriptive means without confidence intervals, effect sizes, or inferential tests. No correction for multiple comparisons was applied.

Unvalidated emotional instrument: Emotional state was captured through ad-hoc multi-select checkboxes rather than psychometrically validated instruments.

Incomplete male emotional data: Male participants recorded emotional state less consistently than female participants.

Uneven bin sizes: Some analytical conditions (particularly certain emotions and food states) contained very few observations, as detailed in results tables.

Missing demographic data: Age ranges and whisky experience levels were not systematically recorded.

Data loss: Approximately 600 user records were lost due to a database error.

3. Results

3.1 Cross-Gender Structural Comparison

The aggregated 6-dimensional taste vectors reveal a structural difference between the female and male cohorts in this sample.

Dimension	Female Mean (N=654)	Male Baseline (N=280)	Δ (F − M)
Sweet	14.6%	10.0%	+4.6%
Sour	16.1%	11.2%	+4.9%
Salty	12.1%	13.9%	−1.8%
Pungent	19.3%	18.1%	+1.2%
Bitter	9.2%	11.6%	−2.4%
Astringent	28.1%	35.1%	−7.0%

Table 1: Cross-gender 6D taste vector comparison.

In this cohort, the male profile is dominated by Astringent (35.1%) and Bitter (11.6%), with relatively suppressed Sweet (10.0%) and Sour (11.2%). The female profile shows a more distributed vector with higher Sweet and Sour contributions and substantially lower Astringent preference.

This structural difference is consistent with published sex differences in taste perception. Martin and Sollars (2017) note that studying one sex alone provides an incomplete picture of gustatory function [DOI: 10.1002/jnr.23819].

However, viewing the female profile as a static "average" obscures what we believe to be the critical finding: the female vector in this cohort is dynamic in ways the male vector is not.

3.2 Hormonal Phase Modulation of Female Taste Preference

Aggregated across the 9 female participants, liked malt vectors shifted systematically with self-reported hormonal phase. Hormonal phase bins contained substantial record counts (114–174 per phase), providing reasonable confidence in the observed patterns.

Phase	N	Sweet	Sour	Salty	Pungent	Bitter	Astringent
Menses	114	15.8%	16.3%	11.6%	19.4%	6.4%	30.5%
Ovulation	174	14.5%	16.4%	12.0%	19.1%	9.9%	27.5%
Post-Menses	115	15.7%	15.1%	11.9%	19.4%	8.4%	29.5%
Pre-Menses	151	14.3%	16.1%	11.4%	20.2%	8.4%	29.7%
Unmapped	100	12.6%	16.5%	13.6%	18.6%	12.8%	23.1%

Table 2: Female liked malt 6D taste vectors by hormonal phase.

Key observations:

Bitter suppression during menses: Bitter acceptance drops to a cohort-low of 6.4% during menses (n=114) — a 35% relative reduction from the ovulation-phase value of 9.9% (n=174). This is consistent with Glanville and Kaplan's finding that approximately two-thirds of subjects showed increased sensitivity to bitter compounds (PROP, quinine) during menstruation [DOI: 10.1016/S0002-9378(65)80006-0].

Astringent stability with phase-dependent range: Astringent preference remains the dominant dimension across all mapped phases (27.5%–30.5%), with the structural backbone of the female taste vector being astringent-pungent. What shifts is the tolerance window for bitter and sour.

Ovulation as the broadest acceptance window: Ovulation shows the highest bitter tolerance (9.9%) and the lowest astringent preference (27.5%) of all mapped phases — representing the broadest taste acceptance window in this cohort. This is consistent with evidence that the high-estradiol ovulatory phase is associated with heightened sensory receptivity [PMID: 9565832; DOI: 10.1093/nutrit/nuad097].

Pungent stability: Pungent preference remains narrowly banded at 18.6%–20.2% across all phases, suggesting it functions as a stimulation constant rather than a hormonally modulated variable in this cohort.

Unmapped phase anomaly: The Unmapped category (n=100) shows the lowest astringent (23.1%) and highest bitter (12.8%) of any condition. This may reflect that unmapped records disproportionately include early-platform tastings before hormonal tracking was established, or participants for whom cycle tracking was less consistent.

3.3 Emotional Modulation of Female Taste Preference

Aggregated female psychological craving vectors — the 6D taste profile of liked malts when each emotion was the dominant reported state — reveal a secondary modulation layer. Event counts vary substantially across emotions, and findings from low-N categories should be interpreted with caution.

Emotion	N	Sweet	Sour	Salty	Pungent	Bitter	Astringent
Joy	304	14.9%	16.2%	12.0%	19.3%	9.3%	27.6%
Longing	98	13.9%	16.1%	11.7%	19.4%	9.9%	29.0%
Sorrow	93	14.4%	16.4%	12.1%	19.2%	8.4%	28.2%
Inspired	45	15.1%	15.7%	11.4%	18.8%	8.8%	30.2%
Anger	41	14.2%	16.5%	11.1%	19.7%	8.0%	30.5%
Neutral	41	15.0%	12.8%	14.1%	20.5%	9.5%	28.3%
Fear	27	13.9%	18.2%	11.1%	20.3%	6.4%	30.1%
Lust	3	17.5%	15.5%	12.5%	18.5%	8.4%	27.5%
Disgust	2	—	—	—	—	—	—

Table 3: Female liked malt 6D taste vectors by dominant emotion. Lust (n=3) and Disgust (n=2) contain insufficient observations for meaningful analysis. Lust values are reported for completeness but should be treated as anecdotal. Disgust is omitted from interpretation entirely.

Key observations (from adequately-sampled emotions):

Joy as the broadest acceptance state: Joy (n=304), the most frequently reported emotion, shows the lowest astringent preference (27.6%) and the highest bitter tolerance (9.3%) among well-sampled emotions — creating the broadest, most receptive taste acceptance window. This parallels the ovulation-phase pattern, consistent with the derivative modifier model where positive emotional states expand the acceptance envelope.

Negative arousal states constrain bitter while preserving pungent: Anger (n=41) and Fear (n=27) both maintain pungent at 19.7–20.3% while constraining bitter to 6.4–8.0%. In this cohort, the system appears to seek stimulation (pungent warmth) while rejecting complexity (bitter depth) under negative arousal.

Fear amplifies sour: Under fear-dominant states (n=27), sour rises to 18.2% — the highest sour reading of any adequately-sampled emotional condition. This is directionally consistent with affect-taste research showing that negative affect modulates taste intensity perception [PMID: 26122754], though the modest bin size warrants cautious interpretation.

Astringent as the emotional anchor: Astringent preference remains between 27.6% and 30.5% across all adequately-sampled emotional states — a remarkably narrow 2.9 percentage point range. Astringent perception appears to function as a stable structural channel that is relatively resistant to emotional modulation in this cohort.

These patterns are consistent with the derivative modifier model: emotional state gates which portion of the hormonally-determined taste window is actually utilized at any given moment.

3.4 Food-State Modulation

Female food-state data was dominated by empty-stomach tastings (n=585), with limited after-food observations (n=27) and insufficient with-food data (n=1) for analysis. The with-food condition is therefore excluded from interpretation.

Food State	N	Sweet	Sour	Salty	Pungent	Bitter	Astringent
Empty Stomach	585	14.6%	16.3%	11.9%	19.3%	9.0%	28.2%
After Food	27	14.6%	14.8%	11.2%	19.8%	8.8%	30.9%

Table 4: Female liked malt 6D taste vectors by food state.

Food State	N	Sweet	Sour	Salty	Pungent	Bitter	Astringent
Empty Stomach	144	9.3%	10.9%	13.4%	19.7%	11.1%	35.5%
Unknown	109	11.9%	9.2%	13.8%	15.0%	12.6%	37.5%
With Food	16	4.0%	17.2%	16.2%	21.2%	9.1%	32.3%
After Food	11	12.0%	18.5%	15.7%	18.2%	13.3%	22.3%

Table 5: Male liked malt 6D taste vectors by food state. With-food (n=16) and after-food (n=11) bins are small; patterns in these conditions should be interpreted cautiously and require replication.

Key observations:

Female after-food shift: In the female cohort, after-food tastings (n=27) showed elevated astringent acceptance (30.9% vs 28.2% empty stomach) and reduced sour (14.8% vs 16.3%). This is directionally consistent with the hypothesis that gastric buffering from food reduces the intensity of acid and ethanol presentation, allowing greater tolerance of structural tannin. However, the after-food bin is modest and this finding requires confirmation.

Male empty-stomach baseline: The most reliable male data point is the empty-stomach condition (n=144), which shows the characteristic male profile: high astringent (35.5%), elevated bitter (11.1%), suppressed sweet (9.3%). This serves as the stable male reference vector.

Food-state convergence hypothesis: The theoretical prediction that food buffering would allow female astringent acceptance to approach male baseline levels could not be adequately tested in this dataset due to insufficient female with-food observations (n=1). This remains a prediction of the stratified modifier model requiring future investigation with balanced food-state sampling.

Male food-state sensitivity: Despite small bins for non-empty conditions, the male data suggests substantial food-state sensitivity — male astringent appears to drop considerably after food while sour and salty increase. In this cohort, males are not "static" in an absolute sense; they show context-dependent modulation. The distinction from the female pattern is that this appears to be their primary modulation axis, whereas females in this cohort show modulation across hormonal, emotional, and food-state axes simultaneously. However, given the small male food-state bins, this observation is provisional.

3.5 Individual Subject Patterns

While population-level aggregation reveals systematic trends, individual analysis reveals meaningful within-cohort variation in how the modifier hierarchy expresses itself. The following patterns are presented as exploratory, non-pre-registered case observations from the pilot cohort [TIER 3], not as generalizable population typologies.

Subject A — High Emotional-Taste Coupling: One female participant showed pronounced inversion between emotional states. During sorrow-dominant periods, her acceptance for sweet surged and pungent expanded while bitter was suppressed. During joy-dominant periods, the vectors reversed — suggesting that emotional deprivation may recruit gustatory stimulation as compensation in some individuals. This pattern would be consistent with hedonic compensation models but cannot be generalized from a single subject.

Subjects B/C — Phase-Stable Structural Profile: Two female participants showed remarkable phase-independence in their astringent preference (28.5%–31.9% across all phases). For these subjects, hormonal modulation primarily affected the bitter and sour tolerance windows within an immovable astringent-pungent structural frame. These subjects demonstrate that the modifier hierarchy's expression varies in magnitude across individuals — a key consideration for any personalization system.

Subject D — Negative-Affect Sour Dominance: One female participant's data was dominated by fear-sorrow emotional states. Her liked profile was sour-dominant, with sour spiking under pure sorrow states. This profile shifted dramatically between phases, consistent with the prediction that high-arousal negative affect may amplify both sour perception and sour seeking

[PMID: 26122754].

These case observations demonstrate that while the modifier hierarchy appears to operate consistently (hormonal → emotional → food state), the magnitude and pattern of modulation varies meaningfully between individuals — precisely the variation that a personalization system must accommodate.

4. Discussion

4.1 The Conceptual Coupled-System Model

The data are consistent with a model in which female taste preference operates as a coupled system rather than a set of independent modulators. The hormonal phase does not merely change receptor sensitivity — it simultaneously shifts the emotional probability distribution (as evidenced by the phase-dependent emotional baseline profiles), which in turn changes which taste vectors are accepted. Food state does not merely buffer chemistry — it also changes emotional state through blood glucose and satiety signaling, which further modulates acceptance.

This coupling means the total variance in female taste preference may not be the sum of three independent effects but the product of their interactions. A woman tasting whisky during menses (high astringent tolerance, suppressed bitter), in a fear-dominant emotional state (amplified sour, further suppressed bitter), on an empty stomach (unbuffered acid presentation) would be predicted to accept a dramatically different sensory profile than the same woman during ovulation (expanded bitter tolerance), in a joy-dominant state (broadened acceptance), after a meal.

The published literature has documented each interaction path independently:

- Hormonal phase → taste sensitivity: [PMID: 9565832; PMID: 34444669; DOI: 10.1093/nutrit/nuad097]
- Elevated estradiol → increased attentional bias toward alcohol-associated cues: [PMID: 38059946]
- Emotional state → taste perception: [PMID: 26122754]
- Food state → taste buffering via tannin-protein binding: [PMID: 32498458]
- Hormonal phase → emotional baseline: Estrogen-serotonin coupling, progesterone-GABA effects [PMID: 34444669]
- Stress/emotion → appetite and food behavior: [PMC4214609; PMC7663318]
- Medication → taste alteration, interacting with hormonal state: [PMID: 28115648; PMID: 31532870; PMID: 30574604]

Our contribution is observational evidence consistent with these paths operating simultaneously in real-world product consumption. We emphasize that we have not performed formal dynamical-systems analysis, time-lagged interaction modeling, or quantitative interaction testing. The coupled-system framework is a conceptual model that our data are consistent with, not a demonstrated mathematical property of the system. Formal demonstration would require larger samples, designed experiments, and explicit state-space or mixed-effects modeling.

4.2 The 6D Compositional Vector as Analytical Framework

A critical methodological point: the six-dimensional compositional vector captures information that single-dimension analysis would miss. When we report that "bitter drops from 9.9% to 6.4% between ovulation and menses," this is not an isolated change — it is accompanied by compensatory shifts in other dimensions, because the vector sums to 100%. The geometry of the vector shifts, not just one coordinate.

This compositional nature means that two malts with identical bitter percentages can be experienced differently if the surrounding vector differs. A 9% bitter within a high-astringent, low-sweet context differs perceptually from 9% bitter within a high-sweet, low-astringent context — because of perceptual interactions between dimensions (masking, enhancement, competition for attentional resources).

The 6-dimensional framework used here (Sweet, Sour, Salty, Pungent, Bitter, Astringent) maps to modern receptor biology: sweet to T1R2/T1R3 heterodimer receptors, sour to the OTOP1 proton channel [PMID: 29371428], salty to ENaC (epithelial sodium channels), bitter to the TAS2R receptor family, pungent to TRPV1/TRPA1 chemesthetic nociceptors, and astringent to oral tactile mechanoreceptors responding to tannin-protein-induced friction changes [PMID: 32498458]. While the specific numerical weights in our keyword mapping table are calibrated rather than directly measured, the dimensional framework itself is grounded in receptor biology.

We note that the argument that 6D analysis captures patterns invisible to single-dimension analysis is conceptual. We have not empirically compared predictive performance of 1D versus 6D approaches in this dataset; such a comparison would strengthen the case and is planned for future work.

4.3 Male Modulation: Context-Dependent, Not Static

An honest treatment of the male data reveals that characterizing the male palate as "static" would be an overstatement. In this cohort, the male empty-stomach astringent preference (35.5%, n=144) appears substantially different from the after-food value (22.3%, n=11), though the after-food bin is too small for confident comparison. The distinction observed in this dataset is not between "dynamic" and "static" but between what appears to be multi-axis and primarily single-axis modulation:

- Female preference in this cohort was modulated across hormonal phase, emotional state, and food state — three axes operating simultaneously.
- Male preference in this cohort appeared modulated primarily by food state and consumption context, with a stable structural core that does not undergo cyclical hormonal reorganization.

The practical implication, if confirmed in larger samples, is not that male preference is simple, but that it may be adequately served by a simpler model. Female preference would require the full coupled system model to achieve equivalent prediction accuracy.

4.4 From Backward Observation to Forward Prediction

The present dataset was collected through a backward-observation methodology: real-time logging of what happened under what conditions. This approach was necessary to discover the patterns and validate the modifier hierarchy. However, it requires continuous data collection — impractical at scale and intrusive for the user.

The theoretical contribution of this paper — the stratified modifier hierarchy — suggests a different approach: forward prediction. If the modifier hierarchy is correctly specified, then knowing an individual's receptor configuration (Layer 1, captured once through calibration) and current hormonal phase (Layer 2, captured at point of interaction) should be sufficient to generate useful predictions about taste acceptance. Emotional state becomes an implicit variable — partially predicted by hormonal phase, partially captured through optional contextual input. Food state can be queried with a single question.

This is the architectural principle underlying the successor system (WhiskyBaba v2 / BitterMatrix Sensory Intelligence engine), which replaces keyword-based vector derivation with physics-based production parameter modeling and replaces real-time emotional logging with hormonal calibration interfaces that respect user privacy through the Calibration vs. Surveillance principle described in the companion white paper.

We emphasize that forward prediction from receptor profile plus hormonal phase is a speculative design principle awaiting empirical validation [TIER 3]. The assumption that hormonal phase sufficiently captures emotional distribution without measuring emotion directly is supported by published literature on hormone-affect coupling but may not hold for individuals experiencing life events, medication effects, or other sources of hormone-independent emotional variance. The feedback mechanism in the successor system (user validates the narrative) is designed to catch precisely these cases, creating a learning loop that handles individual deviation from the population-level model.

4.5 Limitations and Future Directions

The limitations of this study are detailed in Section 2.6. The most significant are the small cohort size (n=9 female, n=7 male), the absence of formal statistical analysis, the uneven bin sizes across conditions (particularly for food state and certain emotions), and the lack of biochemically verified hormonal phases.

Future work should prioritize: larger cohorts with demographic documentation, biochemically verified hormonal phases, balanced food-state sampling, validated emotional assessment instruments, and formal mixed-effects statistical modeling. Prospective validation of forward-prediction accuracy from the successor engine is underway and will be published regardless of outcome.

5. Conclusion

We present preliminary longitudinal evidence consistent with the hypothesis that female taste preference for commercial spirits operates as a coupled system modulated by hormonal phase, emotional state, and food context simultaneously. Within a cohort of 9 female participants generating 654 tasting records across approximately 300 distinct whiskies, the predicted patterns of hormonal taste modulation, emotional gating, and food-state effects were consistently observed in well-sampled conditions — patterns that align with and extend six decades of published psychophysical research.

The male comparison cohort (n=7, 280 records) showed primarily food-state modulation with a structurally stable bitter-astringent core, suggesting that the multi-axis dynamic modulation observed in female participants reflects the specific biological mechanisms (cyclical hormonal variation, hormone-affect coupling) that distinguish female taste physiology — though this comparison requires replication with larger samples.

We propose a stratified modifier hierarchy — from stable genetic receptor configuration through cyclical hormonal modulation, medication effects, food-state conditioning, and episodic life-event shifts — as a theoretical framework for modeling dynamic taste preference. This hierarchy motivated the development of the Sensory Intelligence forward-prediction engine: a system designed to model the coupled biological system rather than track behavioral history, predicting individual taste experience from receptor configuration and current biological state.

The present data represent the observation that justified building the engine. The engine represents the hypothesis that the observation can be formalized and made predictive. Validation of that hypothesis — through prospective prediction accuracy — is the next step, and we commit to publishing results regardless of outcome.

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A. Data Architecture Summary

The WhiskyBaba platform maintained strict separation between product characterization and user response through independent data streams, ensuring that the whisky's taste profile could not be influenced by the taster's reported context or vice versa.

Product characterization stream: Distiller tasting notes were processed through a keyword extraction pipeline against a curated mapping table containing over 2,000 tasting note terms, each pre-assigned 6-dimensional receptor-mapped values. Matched keyword values were summed and normalized to produce a compositional 6D taste vector for each whisky. This vector was stored as a property of the whisky record, independent of any individual tasting event.

User experiential stream: At each tasting event, the participant completed a 22-item questionnaire with calibrated response weights mapped to the same 6D taste space. Responses were summed and normalized to produce the user's experiential vector for that event. Simultaneously, the platform captured the participant's self-reported emotional state (multi-select from 9 categories), hormonal phase (single-select from 4 categories, female participants only), food state (single-select from 3 categories), preference outcome (liked/disliked), and timestamp.

Independence guarantee: The whisky's 6D vector was derived entirely from its published tasting notes. The user's experiential vector and context variables were derived entirely from their real-time self-report. These two streams were linked only at the analysis stage, where each tasting event record associated a whisky's independently-derived taste profile with the user's independently-reported experiential response and context.

The platform described here (WhiskyBaba v1) has since been superseded by a successor system incorporating physics-based production parameter modeling in place of keyword-based vector derivation. The data reported in this paper were collected entirely through the v1 platform as described.

B. Evidence Tier Classification

All claims in this paper are classified according to the following evidence tier system:

Tier assignments for key claims:

Tier	Definition	Usage
TIER 1 — Established	Supported by multiple peer-reviewed studies with PMID/DOI citations	Used freely; cited inline
TIER 2 — Moderate	Supported by limited published evidence or strong theoretical inference from established findings	Used with disclosure; flagged as "consistent with" rather than "proven by"
TIER 3 — Experimental	Observed in our pilot data but not independently replicated	Presented as preliminary finding; explicitly caveated
TIER 4 — Unsupported	No peer-reviewed support	Not claimed in this paper

- Hormonal phase modulates taste sensitivity, particularly for sweet and bitter, though specific patterns vary across studies: **TIER 1** [PMID: 9565832; PMID: 34444669; DOI: 10.1093/nutrit/nuad097]
- Emotional state modulates taste perception: **TIER 1** [PMID: 26122754]
- Medications alter taste perception: **TIER 1** [PMID: 28115648; PMID: 31532870; PMID: 30574604]
- Life events alter appetite and food behavior: **TIER 1** [PMC4214609; PMC7663318]
- Female taste preference in this cohort operates consistent with a coupled multi-axis system: **TIER 2** (each component TIER 1; the coupled-system model is our theoretical contribution)
- The stratified modifier hierarchy as a predictive framework: **TIER 2** (theoretical framework supported by component evidence)
- Specific individual subject patterns (High Emotional-Taste Coupling, Phase-Stable Structural Profile, Negative-Affect Sour Dominance): **TIER 3** (individual case observations from pilot cohort; exploratory, non-pre-registered)
- Forward prediction from receptor profile + hormonal phase is sufficient for useful taste matching: **TIER 3** (architectural claim; prospective validation in progress)
- Specific 6D percentage shifts by phase/emotion reported in Results tables: **TIER 3** (descriptive pilot observations from this cohort, not independently replicated)

This paper is a companion to "The Female Sensory Economy and the Birth of Sensory Intelligence" (BitterMatrix Research, December 2025), which establishes the theoretical framework. The present paper provides the observational evidence that motivated the framework and the forward-prediction engine it describes.

The authors commit to publishing prospective validation results regardless of outcome.

A Note on Authorship and AI Use: The constitutional framework, research methodology, observational findings, and all core concepts presented in this work are the original intellectual contribution of Dr Sumit Kesarkar, Founder and Chief Architect, AshZero Ltd. AI language tools were used in a supporting editorial capacity to assist with paraphrasing technical and mathematical content into accessible English prose, to refine sentence-level clarity, and to cross-reference PubMed identifiers for citation accuracy. No part of the conceptual framework, analytical structure, or research findings was generated by AI. The authorship of this work — its architecture, its arguments, and its conclusions — is entirely the work of Dr Sumit Kesarkar.

This paper is offered as a working document to assist researchers and practitioners in understanding and deploying the engine. It is not submitted for peer review and does not seek academic validation of its findings.

The Female Sensory Intelligence engine and its underlying methodology are proprietary to AshZero Ltd. Licensing enquiries: hello@ashzero.com.

The theoretical framework underlying this study — the Female Sensory Economy thesis, the stratified modifier hierarchy, and the Sensory Intelligence architecture — is detailed in the companion white paper: "The Female Sensory Economy and the Birth of Sensory Intelligence" (BitterMatrix Research, December 2025), available at bittermatrix.com/docs/bittermatrix_whitepaper.pdf.

C. Event Pilot Observations

C.1 Context and Scope

The observations reported in this appendix were collected during a structured whisky tasting event on 31 March 2026, organised and facilitated by Téa Nicolae through University of Edinburgh AIESEC Organisation. The event organiser's contemporaneous summary reported 12 participants in the room (9 female, 3 male), spanning an age range of approximately 20 years. Five participants had attended prior pilot events: three had attended both a previous whisky pilot and a coffee pilot, one had attended a whisky pilot only, and one had attended a coffee pilot only. The database recorded 14 unique sessions that completed the feedback step: 13 selected the female calibration pathway and 1 selected the male pathway. These flags reflect the calibration pathway each participant chose during onboarding, not verified biological sex; it is possible that some participants selected a pathway that did not correspond to their sex. The organiser noted that male participants encountered confusion during onboarding when selecting the male pathway, likely due to insufficient verbal instruction at that stage — a point noted for improvement in future event protocols. The discrepancy between room attendance and database records indicates that some participants present at the event did not complete the app flow or submit feedback. All quantitative figures in this appendix are derived from the database export; the organiser's verbal summary is used only for qualitative context and room-level observations.

This appendix is offered in the spirit of the commitment stated in the body of this paper: to publish prospective validation results regardless of outcome.

The event employed a streamlined calibration protocol — necessary for the social context but inherently coarser than the full assessment used in the longitudinal study. This distinction is relevant to interpreting the observations below.

C.2 Quantitative Outcome

The database export contained 27 rows across 14 unique sessions. Two sessions (event_72 and event_73) each submitted duplicate feedback on Arran Barrel Reserve; in both cases the duplicate recorded an identical outcome (“no”) and does not affect the result. After deduplication, the dataset comprises 25 unique session-malt feedback pairs.

All 14 sessions tasted Arran Barrel Reserve. Eleven of the 14 also tasted Talisker Skye; three sessions submitted feedback on Arran only. The two malts produced materially different outcomes:

- **Talisker Skye** (45.8% ABV): 10 of 11 sessions reported resonance (**90.9%**).
- **Arran Barrel Reserve** (43.0% ABV): 9 of 14 sessions reported resonance (**64.3%**).
- **Overall**: 19 of 25 unique session-malt pairs reported resonance (**76.0%**).

The organiser’s verbal summary additionally reported that 7 of 12 respondents expressed intent to continue exploring the platform, and 7 of 12 found the process intuitive, easy to navigate, and immersive. These figures are from the organiser’s contemporaneous notes and are not in the database.

C.2.1 Per-Malt Divergence

The per-malt difference is the most notable feature of this dataset. Of the 11 sessions that tasted both malts, 5 reported resonance with Talisker but not Arran, 5 reported resonance with both, 1 reported resonance with Arran but not Talisker, and none reported resonance with neither. The asymmetry is pronounced: the single non-resonance on Talisker came from a session that did resonate with Arran.

Both malts carried near-identical gap scores — 0.89 for Arran and 0.87 for Talisker — indicating comparable alignment between distiller-stated production parameters and the engine’s physics extraction. The divergence in resonance therefore did not arise from one malt being better characterised than the other.

Several factors may have contributed to the lower Arran outcome, though this sample does not permit isolation of a single cause:

- *Calibration granularity*: The event used a compressed calibration protocol. Seven of 14 sessions did not declare a hormonal phase, meaning those sessions ran on a reduced input signal. However, resonance rates for Arran among sessions that declared a phase (4 of 7, 57%) were not higher than among those that did not (5 of 7, 71%). The same pattern held for Talisker: declared 5 of 6 (83%), undeclared 5 of 5 (100%). At this sample size, no directional effect of hormonal phase declaration on resonance is observable, and the numbers are too small to draw conclusions. The question remains open for future pilots with larger cohorts.

- *Sensory territory adjacency*: Both malts occupy broadly similar sensory territory. When two whiskies present comparable production parameters, the engine may produce comparable alignment profiles for a given individual — and, under compressed calibration, for multiple individuals. If this occurred, it would be consistent with the engine computing correctly from similar inputs rather than failing to discriminate. The qualitative observations below (Section C.3.1) describe participant reports consistent with this possibility.
- *Individual preference*: It is also possible that some participants simply did not enjoy the Arran and said so, independent of calibration or territory effects. The feedback mechanism records self-reported resonance, which includes subjective preference alongside projection accuracy.

None of these factors can be confirmed or excluded at $n = 14$. What the data shows is that the engine produced a substantially different resonance outcome on each malt, with the divergence concentrated in sessions that tasted both. **[TIER 3]**

C.3 Qualitative Observations

The following observations are drawn from the event organiser's contemporaneous notes. No attempt is made to identify which database session corresponds to which participant reflection.

C.3.1 Similar Projections Across Distinct Drams

Two returning participants reported confusion and scepticism about their palate affinity results, noting that they received identical results for both drams and that nearby participants appeared to share equivalent outcomes. One explicitly noted an inconsistency: she preferred one dram and disliked the other despite identical affinity scores.

This observation is consistent with two complementary explanations, neither of which implies engine failure. First, the compressed event calibration produces a coarser individual profile than the full assessment; at this resolution, distinct individuals may resolve to similar alignment profiles, and the engine — receiving effectively similar inputs — would produce similar outputs. Second, when both malts occupy adjacent sensory territory, similar alignment scores across drams are the *expected* outcome for any given individual: if the production parameters are comparable, the computed alignment should be comparable. The participant who preferred one dram despite identical scores illustrates that affinity as computed from production parameters does not capture every dimension of subjective preference — a known boundary of the engine's scope, which predicts sensory arrival rather than hedonic response.

C.3.2 Reduced Accuracy for a Returning Participant

A returning participant found her projections vague and hard to relate to at this event, having found them accurate at a prior pilot. She expressed surprise at the difference.

The data does not permit identification of which session or malt this participant's feedback corresponds to. The observation may reflect differences in malt territory between events, differences in the participant's own state, the effect of compressed recalibration, or some combination. It is noted here as reported.

C.3.3 Language Register and the Maker's Voice

One participant, a regular whisky drinker, observed that the projection language differed from conventional tasting notes (e.g., flavour descriptors such as "chocolate"), which she considered subjective. She described the projection language as more objective and compared it to a novel excerpt — initially unfamiliar but engaging upon re-reading, calling it an articulate and animated way of approaching whisky. A second participant wished the narrative included the equivalent of the maker's or reviewer's voice — how the whisky is typically spoken about. This feature exists within the full platform as a comparative section but was not activated in the event configuration.

C.3.4 Accurate But Not Self-Described

One participant reported that the projection did not match how she would have described her own experience, yet acknowledged it was accurate overall — a distinction she found surprising and intriguing. This reflects the difference between body-anchored sensation language (what arrives, where, and in what sequence) and the associative or conceptual framing a taster typically applies after the fact. Both accounts can be accurate simultaneously; neither translates the other. This distinction is intentional in the engine's design: projections describe sensory experience as it lands on the body, not the referential flavour notes a taster would reach for after the fact.

C.3.5 Audience Appeal

One participant remarked that this technology may especially appeal to younger audiences.

C.4 Evidence Tier Classification

- Talisker Skye: 10 of 11 sessions reported resonance (90.9%) under compressed event calibration: **TIER 3** (single pilot event, $n = 11$; self-report; no control condition).
- Arran Barrel Reserve: 9 of 14 sessions reported resonance (64.3%) under compressed event calibration: **TIER 3** (single pilot event, $n = 14$; self-report; no control condition).
- Per-malt divergence observed (90.9% vs 64.3%); contributing factors not isolable at this sample size: **TIER 3** (observed; multiple plausible explanations; prospective investigation required).
- No directional effect of hormonal phase declaration on resonance observable in this dataset (7 declared, 7 undeclared; rates do not trend in expected direction): **TIER 3** (sample too small to draw conclusions; question remains open).
- When two malts occupy adjacent sensory territory, comparable alignment profiles for a

given individual are the expected computational outcome: **TIER 2** (follows from the engine's methodology; independent of sample size).