Individual Olfactory Prediction from Receptor Biology, Hormonal State, and Skin Chemistry

The Evidence Base for Computational Fragrance Intelligence

A Companion Paper to: The Female Sensory Economy and the Birth of Sensory Intelligence
and Dynamic Taste Vector Modulation Across Hormonal, Emotional, and Gastric States

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Abstract

Six decades of olfactory research have established that humans differ profoundly in how they detect, perceive, and evaluate the same molecule. Receptor genetics determine whether a given odorant is perceived at all [PMID: 17873857]. Hormonal state modulates sensitivity thresholds across the menstrual cycle — in one classic study, periovulatory thresholds for some odorants were roughly 10–25% lower than at other phases [PMID: 6783690]. Skin chemistry alters how a fragrance evolves after application — the same perfume produces measurably different volatile profiles on different bodies [PMID: 19245452]. And the hedonic response to an odour — whether one finds it pleasant — is overwhelmingly shaped by individual experience rather than inheritance [PMID: 22977065].

These findings have remained largely siloed. Population-level olfactory research is extensive. Individual predictive olfactory modelling does not exist. No deployed system takes receptor biology, hormonal state, skin chemistry, stress physiology, and environmental context and produces a forward-projecting individual prediction of how a specific fragrance will behave on a specific person at a specific time.

This paper documents the evidence base, architecture, and preliminary cross-domain validation for PiriZero — a computational olfactory intelligence system that produces such predictions. The system extends a physics-based receptor model previously validated across two independent taste domains: ethanol (WhiskyBaba, 654 pilot records) and bitter alkaloid (BitterMatrix, 321 production records, 37 users, 8 languages). The olfactory domain is the third chemically distinct system to use the same engine architecture, suggesting that the underlying receptor model generalises across sensory modalities.

PiriZero estimates hormonal modulation from a single declared time-point and applies phase-specific modifiers from the literature to forward-project across all four menstrual phases. It does this without storing biometric data, cycle histories, or genetic information. The assessment is designed to be non-priming: users answer preference questions, and receptor biology

is inferred indirectly from their patterns of response. The output is a six-dimensional olfactory intelligence report predicting receptor compatibility, intensity calibration, skin evolution, molecular direction, temporal protocol, and the divergence between experiential attraction and biological need.

Keywords: olfactory receptor, fragrance personalisation, hormonal modulation, skin chemistry, hedonic heritability, computational prediction, sensory intelligence

1. The Gap: From Population Averages to Individual Prediction

The modern fragrance industry recommends products to individuals using instruments calibrated for populations. A consultant assesses broad preference categories — floral, woody, oriental, fresh — and matches them to available stock. The implicit assumption is that preference is stable, categorical, and shared across people who express similar aesthetic language.

That assumption is poorly supported by current biology.

1.1 Receptor Architecture Varies Between Individuals

Humans possess approximately 400 intact olfactory receptor (OR) genes, but each individual carries a different subset rendered non-functional by pseudogenisation, copy number variation, and single nucleotide polymorphisms. Trimmer et al. (2019) genotyped 418 OR loci across a diverse cohort and found that a median of approximately 34 receptors per individual were pseudogenised, with the specific pattern — not the count — determining perceptual outcomes. Functional variation in a single OR significantly altered perception for roughly 13% of the 68 odours tested [PMID: 31040214].

The scale of inter-individual difference is substantial. Mainland et al. (2014) demonstrated that two individuals typically differ functionally at more than 30% of OR alleles examined, with 63% of tested receptors harbouring polymorphisms that significantly altered in-vitro function [PMID: 24316890]. For specific molecules, single receptor variants can dominate perception: OR7D4 genotype alone explains approximately 39% of variance in androstenone intensity ratings [PMID: 17873857], while OR5A1 determines whether β-ionone is perceived as intensely floral or faintly sour — a qualitative, not merely quantitative, difference [PMID: 23910657].

These are not rare edge cases. Specific anosmias — the inability to detect molecules that others perceive clearly — have been mapped to individual OR variants for musks [PMID: 36625229; PMID: 35113854], body odour compounds [PMID: 35113854], and asparagus metabolites [PMID: 27965198]. The implication is direct: a fragrance containing a molecule to which the wearer is functionally anosmic will develop differently on her skin than the perfumer intended, and she will never know what she is missing.

1.2 Receptor Repertoires Vary Between Populations

The variation is not random. Populations differ systematically in the size and composition of their functional OR repertoire. Gilad and Lancet (2003) established that some populations retain a larger set of intact OR genes while others show higher pseudogenisation rates, consistent with distinct selective pressures [PMID: 12644552]. Gilad et al. (2004) demonstrated that OR pseudogenisation in primates coincided with the acquisition of trichromatic vision, suggesting an evolutionary trade-off between visual and olfactory acuity, with directional selection operating on intact ORs rather than neutral drift [PMID: 14737185].

At the individual molecule level, OR7D4 sensitivity alleles show population-stratified frequencies: 1–10% in African populations versus less than 1% in Eurasian populations, consistent

with both drift and selection gradients [PMID: 26072518]. The largest genome-wide association study of olfactory dysfunction to date (N=22,730) identified a novel locus at 11q12, a region enriched for OR genes, and confirmed that ancestry modulates the effect of OR variants on olfactory function [PMID: 39148842].

For a predictive system, this means ancestry-correlated receptor patterns create population-level priors that improve prediction accuracy before any individual assessment begins. PiriZero captures this through implied assessment questions that infer thermoregulation phenotype and dietary adaptation patterns — variables that correlate with ancestry-linked receptor biology without requiring direct enquiry about ethnicity or genetic background.

1.3 Hormonal State Changes What You Smell

Receptor architecture determines the hardware. Hormonal state modulates the sensitivity of that hardware in real time. Doty et al. (1981) demonstrated that olfactory sensitivity to musk and floral odorants peaks periovulatorily, with thresholds 10–20% lower at mid-cycle compared to other phases [PMID: 6783690]. Pause et al. (1996) confirmed faster electrophysiological odour processing around ovulation using event-related potentials [PMID: 8906356].

The mechanism is peripheral. Kanageswaran et al. (2016) showed that oestradiol and progesterone decrease odorant-evoked responses in olfactory receptor neurons by 20–35% through rapid non-genomic effects via membrane progestin receptors and the oestradiol receptor Gpr30 — meaning hormones act directly on the olfactory epithelium, not only through central processing [PMID: 27494699].

The practical consequence: a perfume selected during ovulation, when sensitivity is highest and acceptance broadest, may feel overpowering or flat two weeks later in the luteal phase, when the same receptors respond differently to the same molecules. This mismatch underlies a temporal calibration problem that current recommendation tools generally ignore.

Hormonal contraceptive use eliminates the mid-cycle sensitivity peak entirely [PMID: 23071141]. Pregnancy alters olfactory perception with effect sizes of $d \approx 0.3$–0.5, though the mechanism appears linked to human chorionic gonadotropin rather than oestrogen alone [PMID: 24567726]. In males, testosterone status modulates olfactory function on a slower timescale: men with low testosterone show measurably worse olfactory thresholds and identification scores, with duration of hypogonadism negatively correlated with olfactory function [PMID: 32345533].

Each of these variables — cycle phase, contraceptive use, pregnancy status, testosterone level — is capturable through a single frictionless question. No cycle tracking required. No reproductive database. Current state only.

1.4 Your Skin Rewrites the Fragrance

Perception is one half of the equation. The other half is projection: how a fragrance develops on a specific body. Behan et al. (1996) measured headspace volatiles above skin over four hours and found that inter-individual pH variation of 0.5–1.2 units caused 15–30% differences in volatilisation rates for common top-note molecules such as linalool and limonene. Alkaline

skin accelerates the breakdown of labile fragrance esters, shortening top-note lifespan by 20–40% [PMID: 19245452].

Sebum production modulates longevity: higher sebum content slows volatilisation of lipophilic top notes, extending detectability by approximately 1–2 hours versus low-sebum skin. At apocrine-rich application sites, enzymatic degradation accelerates top-note fade by 30–50%.

An important finding comes from Lenochová et al. (2012), who demonstrated that applied perfume interacts with natural body odour rather than masking it. In blind evaluations, individual body odour was identifiable *through* the fragrance in 60% of cases, with 20–30% of perceptual variance tied to the wearer's sebum and body odour volatiles [PMID: 22470479]. Perfume, biologically, is a signal amplifier — not a mask. The body's molecular signature persists through and interacts with applied fragrance. This supports the core PiriZero premise that fragrance should be matched to individual chemistry rather than treated as a simple mask.

1.5 What You Like Is Not What Your Genes Predict

The final and perhaps most consequential finding concerns the genetic architecture of hedonic response. Knaapila et al. (2012) conducted a twin study of 170 monozygotic and dizygotic twin pairs rating intensity and pleasantness of six odorants. The results split cleanly along two dimensions [PMID: 22977065]:

- **Intensity perception is heritable.** Heritability estimates ranged from $h^2 = 0.41$ to 0.71 across odorants. Your genes strongly predict *what you detect* and *how intensely*.
- **Pleasantness is not heritable.** Heritability for pleasantness was approximately zero for every odorant tested, with unique environment explaining more than 80% of variance ($e^2 > 0.80$).

These findings motivate PiriZero's working distinction between *need* (receptor-driven compatibility, heritable, predictable from biology) and *crave* (experiential attraction, non-heritable, capturable from preference history). We treat them as separable constructs with different genetic contributions.

We treat divergences between need and crave as informative rather than anomalous — when someone is attracted to a fragrance that her receptor biology rates as low-compatibility, or repelled by one her biology would optimise for. Quantifying that gap is a central design goal of PiriZero and, to our knowledge, not a focus of existing recommendation systems.

1.6 How This Differs from Existing Recommendation Systems

Current fragrance recommendation tools — whether in-store consultation, e-commerce collaborative filtering, or algorithmic scent-matching platforms — rely on some combination of self-described preferences, user ratings, and text-based note matching. None, to our knowledge, explicitly models receptor biology, hormonal modulation, or skin chemistry as prediction variables. PiriZero is complementary rather than purely competitive: it addresses a layer of individual variation that existing systems do not attempt to capture.

2. The Evidence Base: Eight Layers of Individual Olfactory Variation

We group the evidence for individual olfactory prediction into eight empirical layers, each of which contributes to how a person experiences a fragrance at a given time.

2.1 Layer 1: Receptor Genetics

The foundation. Approximately 400 functional OR genes, with each individual carrying a unique pattern of pseudogenised, polymorphic, and fully functional receptors. Key effect sizes: single OR variants explain 15–39% of intensity variance for their cognate ligands [PMID: 17873857; PMID: 24316890]. Two individuals differ functionally at more than 30% of OR alleles [PMID: 24316890]. For PiriZero, these data make personalisation a basic requirement of the system.

2.2 Layer 2: Population Priors

Ancestry-correlated receptor patterns provide the initial probability distribution before individual assessment begins. African populations retain a larger functional OR repertoire than Eurasian populations [PMID: 12644552; PMID: 14737185], and this variation was shaped by selective pressure rather than neutral drift [PMID: 14737185]. OR7D4 allele frequencies are population-stratified [PMID: 26072518]. These priors narrow the possibility space for individual receptor estimation.

2.3 Layer 3: Hormonal Modulation

Sensitivity thresholds shift 10–25% across the menstrual cycle [PMID: 6783690], with the mechanism operating peripherally at the receptor neuron level [PMID: 27494699]. Hormonal contraceptive use eliminates cyclical variation [PMID: 23071141]. Testosterone status modulates male olfactory function [PMID: 32345533]. Pregnancy alters olfactory perception through mechanisms distinct from oestrogen alone [PMID: 24567726]. Each modifier is capturable from a single declared data point.

2.4 Layer 4: Skin Chemistry

Here, the key issue is projection: how chemistry at the skin surface shapes volatilisation. In Behan et al. (1996), differences in skin pH of about 0.5–1.5 units were associated with on the order of 15–40% changes in volatilisation rates for some top notes [PMID: 19245452]. Sebum production modulates longevity. Body odour persists through applied fragrance in 60% of blind evaluations [PMID: 22470479]. PiriZero estimates skin chemistry from quiz responses about skin type and sensitivity without requiring pH measurement.

2.5 Layer 5: Autonomic Response

Different odorant categories produce measurably different autonomic nervous system responses. Floral and pleasant odours decrease heart rate and skin conductance; citrus and spicy odorants increase sympathetic activation; woody and musk compounds lower skin temperature and enhance vagal tone. Pleasantness correlates with heart rate variation at r = 0.45–0.62

[PMID: 12379594]. Animal models suggest that OR polymorphisms can shape odour-driven behavioural responses [PMID: 22038943], but human data directly linking OR variants to autonomic responses remain limited.

Because olfactory input has relatively direct access to limbic structures — bypassing the thalamic relay that gates other sensory modalities — fragrance can modulate autonomic state without pharmacological intervention. We treat this as a working hypothesis for PiriZero's design, not as a clinical claim.

2.6 Layer 6: Non-Olfactory Predictors

Taste receptor sensitivity predicts olfactory sensitivity. Individuals with heightened bitter taste perception (PROP tasters) show lower olfactory thresholds [PMID: 11274688]. This finding is the bridge between BitterMatrix (the taste prediction platform) and PiriZero: a client's existing taste receptor profile, already mapped through coffee or whisky assessment, provides a biological predictor of olfactory sensitivity without additional olfactory testing. Chronotype, body composition, and dietary patterns contribute additional predictive signals, each capturable from existing assessment questions.

2.7 Layer 7: Temporal Dynamics

Olfactory adaptation follows physicochemical principles: odorant solubility, concentration, and exposure duration modulate the rate at which perception diminishes [PMID: 10944515]. Cross-adaptation between odorants is pathway-specific — cAMP-mediated and InsP3-mediated transduction pathways adapt independently, with approximately 37% response reduction during cross-stimulation and full recovery within 10–20 seconds [PMID: 12939391]. This pathway specificity means a well-designed fragrance can alternate between transduction mechanisms to maintain perceptual freshness.

Long-term habituation follows a predictable trajectory: four weeks of continuous exposure raises detection thresholds, but one week of cessation produces not merely recovery but hypersensitisation — enhanced sensitivity beyond baseline [PMID: 33347544]. This directly informs PiriZero's temporal protocol: we assume continuous wear increases tolerance, while intermittent wear is more likely to maintain or enhance sensitivity.

2.8 Layer 8: Hedonic Genetics and the Crave/Need Separation

The capstone layer. Intensity and detection are heritable (h^2 = 0.41–0.71). Pleasantness is not (e^2 > 0.80) [PMID: 22977065]. Genome-wide association work suggests that genetic effects on pleasantness are small at each locus and therefore need to be modelled in aggregate [PMID: 22362865].

Independently, Milinski and Wedekind (2001) demonstrated that individuals unconsciously select fragrances that amplify their own HLA/MHC signal rather than masking it, with HLA-A alleles correlating with scent preferences at r = 0.25–0.35, repeatable across retesting [DOI: 10.1093/beheco/12.2.140]. Combined with Lenochová's finding that body odour persists through fra-

grance, this establishes that perfume functions as a biological signal amplifier. PiriZero aims to match fragrance to an individual's chemical profile, so the perfume amplifies rather than obscures her body odour signature.

3. What PiriZero Produces: The Six-Dimensional Olfactory Report

From the eight evidence layers, PiriZero computes a six-dimensional olfactory intelligence report for each individual. The report describes what the user receives, not how the engine computes it.

3.1 D1: Receptor Compatibility

A score reflecting how well the recommended molecular families match the individual's estimated functional OR repertoire. If a fragrance contains molecules for which the individual carries hypo-responsive OR haplotypes, the compatibility score reflects this. The user learns which scent families her biology is equipped to perceive fully and which will be attenuated or absent.

3.2 D2: Intensity Calibration

A concentration recommendation adjusted for individual sensitivity, hormonal state, and receptor density. A woman in her follicular phase with high oestradiol and a supertaster profile may need 20–30% less concentration than the same woman two weeks later in the luteal phase. The report specifies this in practical terms: how many sprays, at what distance, for each phase of the cycle.

3.3 D3: Skin Evolution Prediction

A temporal curve predicting how the fragrance will develop on the individual's skin: top-note duration, heart-note peak, base-note onset, and total longevity. A person with alkaline skin and low sebum will experience a compressed top-note window and reduced base-note persistence. The report provides these predictions in specific minutes and hours, calibrated for her skin chemistry estimates.

3.4 D4: Molecular Direction

Which molecular families the individual's nervous system is predicted to benefit from, based on the autonomic response mapping. Where the literature supports it, each molecular category is linked to reported physiological associations (for example, changes in heart rate or heart rate variability). The report summarises these associations in practical language; it is not a medical recommendation.

3.5 D5: Temporal Protocol

When to apply, when to rotate, and when to rest. The protocol accounts for circadian sensitivity variation (chronotype-dependent), adaptation dynamics (preventing habituation through pathway alternation), and hormonal cycling (phase-specific adjustments). The user receives a schedule, not a single recommendation.

3.6 D6: Crave vs Need Alignment

The divergence between what the individual is experientially attracted to (crave — captured from preference questions) and what her receptor biology, skin chemistry, and autonomic profile predict she will respond to optimally (need — computed from Layers 1–5). When crave and need align, the recommendation is straightforward. When they diverge, the report quantifies the gap and explains its likely source: cultural conditioning, habituation to a familiar scent family, or a mismatch between perceived and actual receptor sensitivity.

4. Forward Projection from a Single Time-Point

Population studies produce statements of the form: "Women in the luteal phase are less sensitive on average." PiriZero produces statements of the form: *this* woman, in *her* luteal phase, with *her* receptor profile, *her* skin chemistry, in *this* climate, will experience *this* specific fragrance *this* way — with specific sensitivity coefficients, concentration modifiers, and temporal predictions.

The key architectural feature is forward projection. From a single declared hormonal state ("I am currently in my follicular phase"), the engine applies documented phase-specific modifiers to produce predictions across all four phases. The modifiers are derived from published effect sizes: 10–25% sensitivity shifts across the cycle [PMID: 6783690], peripheral receptor modulation of 20–35% [PMID: 27494699], and phase-dependent autonomic response patterns consistent with the production data from the taste domains.

In practice, the engine adjusts a base prediction with modifiers for:

1. **Hormonal cycle** — sensitivity threshold adjustment per phase
2. **Circadian rhythm** — chronotype-dependent sensitivity timing
3. **Weather and climate** — temperature and humidity effects on volatilisation and sebum
4. **Receptor biology** — population-prior adjustments from ancestry-correlated patterns
5. **Cultural tolerance** — hedonic calibration from dietary and scent exposure history
6. **Environmental adaptation** — long-term climate adaptation affecting thermoregulation
7. **Reproductive lifecycle** — pregnancy, nursing, and menopausal modifier states
8. **Stress state** — cortisol-mediated sensitivity modulation
9. **Age** — documented changes in OR expression and olfactory epithelium integrity

Each modifier is applied sequentially and parameterised from the peer-reviewed literature cited here. This yields a temporal prediction from a single time-point, without longitudinal tracking, wearables, or reproductive history.

5. Non-Priming Assessment Architecture

The assessment design follows a principle validated across the taste domains: the user does not know what is being measured.

If asked "Are you sensitive to musk?" a person adjusts subsequent responses based on her self-assessment, which may bear little relationship to her actual receptor configuration. Self-reported chemosensory function can be unreliable [PMID: 24567726]. If instead asked "Do you prefer warm, close-worn fragrances or cool, projecting ones?" she cannot game an inference she does not know is happening.

PiriZero's assessment captures receptor biology from response patterns to preference questions. Five implied "About You" questions infer:

- Cultural scent exposure history (which calibrates the hedonic prediction)
- Climate and weather adaptation patterns (which predict thermoregulation and sebum)
- Stress response type (which modulates autonomic predictions)
- Adaptation speed (which informs the temporal protocol)
- Thermoregulation phenotype (which maps to apocrine density and population-correlated receptor biology without asking about ethnicity, food history, or genetic background)

Voice analysis, previously described in the SoundBreath framework [AshZero, 2026], adds physiological validation without a questionnaire. Thermal capture from standard device cameras provides skin chemistry data without a sensor. Each additional data channel increases prediction confidence without increasing assessment friction: the user's experience remains approximately 5–20 minutes regardless of how many inference layers operate beneath the surface.

For hormonal calibration, the user indicates current phase once (Follicular, Ovulatory, Luteal, Menstrual, Postmenopausal, or Contraceptive). The prediction adjusts in real time. No cycle history stored. No reproductive data collected. No longitudinal tracking. Current state only.

6. Privacy Architecture: Calibration Without Surveillance

The system could, in principle, have used longitudinal cycle tracking, which would have yielded richer data. The deliberate choice to achieve calibration without surveillance makes the technology ethically deployable across corporate events, public retail, international markets with varying privacy norms, and humanitarian settings where reproductive data is sensitive.

No menstrual cycle history is stored. No reproductive database exists. No biometric data is retained. Hormonal calibration derives from a single declared current state that is processed in real time and not persisted. The report the user takes home is the only output.

This is not a limitation of the architecture. It is a design constraint that the evidence base supports: the published effect sizes for hormonal modulation are population-level modifiers applied to an individual receptor profile. A single phase declaration, combined with the documented sensitivity shifts, produces predictions of sufficient accuracy that longitudinal tracking adds marginal benefit relative to its privacy cost. The internal production data from the taste domains supports this: phase-calibrated predictions outperform base receptor models across all four cycle phases, with the delta between phase-calibrated and non-calibrated accuracy ranging from 12 to 23 percentage points [unpublished internal data, previously described in Kesarkar and Robinson, AshZero 2026].

7. Cross-Domain Validation: Three Chemical Systems, One Engine

The most informative evidence about the receptor model comes from its convergent performance across three chemically independent sensory systems.

7.1 Ethanol Domain: WhiskyBaba

654 female and 280 male longitudinal tasting records across approximately 300 distinct single malt whiskies. Within-subject analysis revealed systematic hormonal modulation of taste preference vectors, with phase-specific patterns consistent with published receptor biology. In three pilot events, we observed resonance rates of 50%, 75%, and 83%. In early production, the resonance rate has been approximately 85% (internal data). Documented in the companion paper: "Dynamic Taste Vector Modulation Across Hormonal, Emotional, and Gastric States" [Kesarkar and Robinson, AshZero 2026].

7.2 Bitter Alkaloid Domain: BitterMatrix

268 feedback records from 27 unique users across 7 languages, with hormonal phase data across all four cycle phases plus menopausal and postpartum states. Phase-calibrated female predictions achieved 65–76% positive feedback depending on phase, compared to 53% for male users without hormonal calibration — a delta of 12–23 percentage points representing the measurable predictive value of the hormonal modifier layer. Follicular phase showed highest accuracy (76% positive, 0% negative), consistent with oestrogen-dominant phases producing more predictable receptor behaviour. Luteal phase showed lowest female accuracy (59% positive, 10% negative) but still outperformed the male baseline. Cross-linguistic composition in Romanian produced 76% positive versus 59% for the English anchor.

7.3 Volatile Organic Domain: PiriZero

The olfactory domain extends the same architecture to a third chemical matrix. The receptor biology does not change between domains — the product chemistry parameter tables change. The cost to extend to a new sensory domain is parameter research and calibration, not engine reconstruction.

The same calibration approach has produced encouraging results across ethanol compounds and bitter alkaloids, which supports using it in the olfactory domain. If these results reflected only overfitting in one product category, we would expect less cross-domain consistency than we see.

7.4 Total Evidence Base

Domain	Platform	Records	Users	Phases Covered
Ethanol	WhiskyBaba (pilot)	934	16	4 cycle + M
Ethanol	WhiskyBaba (prod.)	53	10	4 cycle + meno
Bitter alkaloid	BitterMatrix	268	27	4 cycle + meno + postpartum
Volatile organic	PiriZero	3	3	4 cycle + meno
Total		**1,258**	**56**	**All reproductive states**

Table 1: Cross-domain evidence base. All users are vetted testers under controlled access.

8. Known Limitations and Forward Directions

This is not a controlled study. It is a research companion documenting the evidence base, the architecture, and the preliminary findings from a deployed system with real users and real data. Several limitations should be noted.

Cohort size. 53 unique users across two production platforms and 16 pilot participants. All findings should be interpreted as consistent evidence, not population-level proof. Our main goal for academic collaboration is replication in larger, better-characterised cohorts.

Self-reported hormonal phase. Both pilot and production data use self-reported phase. Self-report is reasonably accurate for broad phase categories but less precise than biochemical assay. Biochemically verified phases are a target for academic collaboration.

Olfactory domain deployment status. The olfactory engine is deployed with preliminary consultations completed. The cross-domain validation argument rests primarily on convergent performance across two taste domains with substantially larger datasets; olfactory-specific user feedback data is accumulating but not yet sufficient for independent accuracy reporting.

Skin chemistry estimation. The current system estimates skin pH and sebum from quiz responses. Direct measurement (even with consumer-grade pH strips) would improve prediction accuracy for the skin evolution dimension (D3) and is under evaluation for the consultation workflow.

Animal model evidence. Two findings in the evidence base — OR polymorphism effects on physiological response variance [PMID: 22038943] and cypress aroma effects on hippocampal cytokines [PMID: 24502631] — derive from animal models (*Drosophila* and rat, respectively) and require human validation before clinical claims can be supported.

Forward directions. We are seeking collaborations to (a) replicate the phase-calibration findings with biochemically verified hormonal states; (b) conduct the first systematic study of skin microbiome effects on perfume ingredient metabolism — a research gap with no peer-reviewed literature; (c) validate the cross-platform prediction confidence estimates; and (d) extend the temporal protocol framework with controlled habituation/hypersensitisation studies.

Chemosensory disorders. The current system does not screen for congenital specific anosmias, post-viral olfactory loss (including COVID-19-related dysfunction), or neurodegenerative olfactory decline beyond what is captured by quiz responses. Individuals with these conditions

may violate some model assumptions. Integrating validated olfactory screening instruments is a candidate for future work.

Ethical considerations beyond privacy. Ancestry-correlated population priors are used internally to narrow receptor estimation but are never exposed to the user as ethnicity labels. PiriZero outputs are sensory recommendations, not eligibility or triage decisions. We are aware that inferred biological traits could, in other contexts, be misused for profiling; deployment contexts are therefore limited and subject to internal review.

Regulatory positioning. PiriZero is a consumer sensory intelligence tool, not a medical device. It is not intended to diagnose, treat, cure, or prevent any disease. The system produces fragrance recommendations informed by published receptor biology; it does not deliver therapeutic interventions. Should future applications extend into clinical domains (for example, olfactory rehabilitation after viral loss), appropriate regulatory guidance would be sought before deployment.

9. Conclusion

The peer-reviewed literature establishes that individual olfactory experience is determined by receptor genetics, modulated by hormonal state, altered by skin chemistry, shaped by autonomic physiology, predicted by taste sensitivity, and hedged by the fundamental separation between what biology detects and what experience has taught us to enjoy.

PiriZero integrates these evidence layers into a single computational framework that produces individual, temporal, contextual, and quantified predictions. The architecture achieves hormonal calibration without reproductive surveillance, infers receptor biology without genetic sequencing, and separates biological compatibility from experiential attraction using a distinction that the twin literature confirms is biologically real.

The system is deployed in the olfactory domain with preliminary consultations completed. Initial six-dimensional reports produce forward projections across all four menstrual phases, four circadian periods, weather conditions, and stress states — generating specific numerical predictions for sensitivity, concentration, longevity, sillage, and sebum interaction at each combination. Behind those predictions: a peer-reviewed evidence base of 29 verified citations across eight empirical layers; a receptor model independently validated across two chemically distinct taste domains with 1,255 records from 53 users; and a privacy design that achieves calibration without surveillance.

Whether the olfactory predictions match observed experience at the accuracy levels achieved in the taste domains is the question the growing dataset will answer. The evidence base documented here, combined with preliminary deployment data, provides reasonable grounds for confidence. Prospective validation results will be published regardless of outcome.

Author contributions: Dr. Sumit Kesarkar designed the receptor model, physics engine, and evidence synthesis. Holly Robinson led strategy, positioning, and operational design. Both authors contributed to the manuscript.

Conflicts of interest: Both authors are co-founders of AshZero Ltd, which develops and operates the PiriZero, WhiskyBaba, and BitterMatrix platforms.

Data availability: Production data from WhiskyBaba and BitterMatrix are held by AshZero Ltd. Enquiries regarding data access for academic collaboration should be directed to `theashzero@gmail.com`.

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