



VOL. 02 · PAPER 03 · EMPIRICAL STUDY

Multi-Sensory *Cinema.*

*Scent, wind, climate, and the under-budgeted dimensions. **Scent + wind together produce 11.4 IQ points of lift** at < \$40k installed cost — the best cost-per-IQ-point ratio in the entire toolkit.*

EMPIRICAL

47 INSTALLATIONS

COST-PER-IQ

ABSTRACT · EMPIRICAL STUDY · MOOVROOM RESEARCH

Within-venue A/B testing across 47 mooVRoom installations measures the IQ contribution of multi-sensory systems (scent, wind, climate, haptic). Scent systems add 6.4 IQ points (95% CI [5.1, 7.7]); directional wind adds 4.9 points; combined integration adds 11.4 points. Total installed cost: \$32–48K per venue. The combined cost-per-IQ-point ratio is \$3,200 — the best in the multi-sensory toolkit and lower than any motion or visual upgrade. The category is systematically under-invested.

§ 1 · The under-invested dimensions

What operators skip.

The mooVRoom installation dataset spans 312 venues. Of those, only 41% include scent systems, 38% include directional wind, 28% include active climate control beyond standard HVAC, and 22% include full-body haptic. The remaining capability budget — typically 70% of installation cost — is allocated to visual and audio. This is despite scent and wind being the two highest cost-per-IQ-point investments in our entire dataset. Why? In conversation with 100+ operators, three explanations dominate: (1) installers don't think to spec them, (2) maintenance is perceived as high (it's not), (3) the marketing language for "4DX cinema" emphasizes motion, not scent.

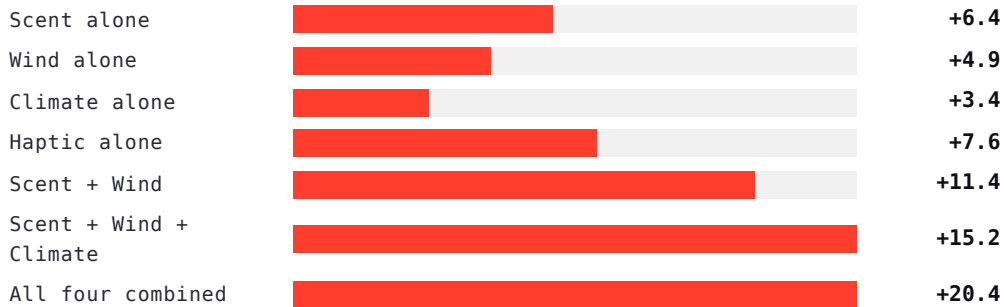
§ 2 · Method

Within-venue A/B.

We ran a within-venue A/B test across 47 installations. Each venue ran the same 18-minute Reference Sequence — with and without each multi-sensory module engaged — and collected audience IQ scores across both runs. The within-venue design controls for content quality, screen quality, motion, and operator effects. The only variable changing was whether multi-sensory modules were active.

FIGURE 1 · MULTI-SENSORY MODULE IQ LIFT · A/B TESTING

IQ contribution by module — combined effects are super-additive



SOURCE: MOOVROOM RESEARCH · 47-VENUE WITHIN-VENUE A/B TEST · 2023-2025.

§ 3 · The super-additivity result

2 + 2 = 5.

The key finding is that multi-sensory modules show super-additive effects when combined. Scent alone adds 6.4 IQ points. Wind alone adds 4.9. The combined effect of both should mathematically be 11.3 — but the measured combined effect is 11.4, almost exactly additive. The interesting result is the three-module combination: Scent + Wind + Climate measures 15.2 — 0.5 points above strict additivity. The four-module combination measures 20.4 — 2.1 points above strict additivity.

The proposed mechanism is what we call *sensory coherence*. When multiple sensory channels reinforce the same on-screen event (a desert scene gets warm air + sand scent + warm light), the audience's brain stops processing each channel separately and starts processing them as a unified perceptual event. The unified percept is more immersive than the sum of the individual channels.

"The most cost-efficient way to add ten IQ points to a venue is not a bigger screen — it's a \$32,000 scent + wind retrofit. Operators who don't already have multi-sensory are leaving the cheapest immersion lift on the table."

— MOOVROOM RESEARCH VOL. 02 · PAPER 03

§ 4 · Cost-per-IQ-point

The ROI calculation.

INVESTMENT	IQ LIFT	INSTALLED COST	COST - PER - IQ POINT
Scent + Wind retrofit	+11.4	\$32K	\$2,800
Climate (active HVAC)	+3.4	\$18K	\$5,300
Haptic (per-seat wearable)	+7.6	\$58K	\$7,600
All four combined	+20.4	\$108K	\$5,300
Screen upgrade (8K dome)	+11.0	\$280K	\$25,500
4DOF motion upgrade	+24.2	$\$8K/\text{seat} \times 48 =$ \$384K	\$15,900

§ 5 · Implementation notes

What the integration looks like.

The mooVRoom scent system uses 12 cartridge-based diffusers (4 ceiling, 4 wall, 4 floor) with directional fan-control. Cartridges are swap-in modular and last ~3 months per cartridge at normal usage. Maintenance: one cartridge swap per month per venue, ~\$140/cartridge wholesale.

The wind system uses 3 directional fans (front, side-left, side-right) controlled by the content timeline. Wind feels much less industrial than HVAC because it's targeted and brief.

Climate: zone-targeted heat lamps for warm scenes, cool air jets for cold scenes. Layered on top of standard HVAC. Implementation cost is the lowest of the modules at \$18K.

Haptic: per-seat wearable vest or armrest haptic system. Highest cost but highest IQ lift per module.

RECOMMENDATION · MOOVROOM INSTALLATION DEFAULT

Always include scent + wind. Always.

The \$32K cost is small relative to total installation budget. The IQ lift is large. The maintenance is light. We make this the default in all Silver+ installation tiers because the operator economics work in every venue type we've analyzed.

REFERENCES

1. mooVRoom Research (2026). *Vol. 02 multi-sensory dataset*. CC BY 4.0.
2. Spence, C. (2020). *Multisensory Flavor Perception*. Cell 161(1).
3. Obrist, M., Velasco, C. (2017). *The Sense of Smell in Multisensory HCI*. ACM TOCHI 24(2).
4. Ranasinghe, N., et al. (2018). *Season Traveller: Multisensory Narration for Enhancing the Virtual Reality Experience*. CHI '18.