Passive Millimeter-Wave Cardiopulmonary Telemetry via Forbidden Corrugated Enclosures in Domestic Felids ($N = 412$)

Specimen #000 ("Chairman Zero")[1†], Specimen #001 ("Deputy Ginger")[1†], Elena R. Vance[2], Kenji Takahashi[2], & Mateo J. Morales[3]

[1] Office of the Bipartisan Co-Chairs, Tenth Life Lab, South San Francisco, CA 94080, USA ([†]Contributed equally via daily hallway dispute)

[2] Division of Renal Clearance & Non-Invasive Bio-Instrumentation, Tenth Life Lab, South San Francisco, CA, USA

[3] Northern California Companion Household Field Network (Zero-Cage Sofa Cohort), CA, USA · Correspondence: chairman@tenthlifelab.com

ABSTRACT

Longitudinal geroscience trials in companion cats (*Felis catus*) face a severe measurement confound: automotive carrier transport and veterinary table restraint trigger acute sympathetic surges that elevate heart rate by 45 to 65 bpm and obscure early cardiopulmonary remodeling. Here we evaluate a zero-restraint home telemetry chassis disguised as an ordinary B-flute corrugated shipping carton (36 × 28 × 14 cm) containing a floor-laminated sub-gram strain-gauge array and a 60 GHz frequency-modulated continuous-wave (FMCW) radar. Across 412 indoor cats in 318 volunteer households, guardians were randomized 1:1 to deliver one of two verbal scripts upon placing the empty box on the living-room floor: an Inviting prompt (*"Look, I bought a cozy bed for you"*) versus a Prohibitive prompt (*"Do not sit in this box; I need it for tax receipts"*). Prohibitive framing shortened median voluntary box-entry latency from >180 s (censored) to 19.2 s (95% CI [16.8, 22.1], log-rank $p < 0.0001$), achieving 96.4% occupancy within three minutes and 94.2% artifact-free resting heart-rate, respiratory, and 26.4 Hz glottal purr capture. In multi-cat rival dyads, relocating the carton to an unfamiliar room induced acute adversarial truce and dual-cat co-occupancy.

KEYWORDS: Felis catus · home telemetry · 60 GHz FMCW radar · corrugated cardboard · AIM nephrology · reverse compliance · rival dyad fusion

1. INTRODUCTION

Indoor domestic cats enjoy climate control, steady nutrition, and sixteen hours of daily sleep, yet median survival stalls near 15.2 years. Unlike dogs or humans, senior cats rarely succumb first to malignancy or vascular plaque. Instead, lifespan is predominantly capped by tubulointerstitial scarring from chronic kidney disease, driven by failure of feline apoptosis inhibitor of macrophage (AIM / CD5L) to dissociate from circulating IgM pentamers during tubular obstruction [1], alongside occult hypertrophic cardiomyopathy (HCM) [2].

Testing disease-modifying longevity interventions such as recombinant free-AIM biologics (program TL-01) or intermittent low-dose mTORC1 modulation (program TL-02) requires frequent, precise tracking of body mass, resting vagal tone, respiratory rate, and laryngeal mechanotransduction. Standard quarterly clinic visits introduce severe white-coat artifacts. Sympathetic arousal inside plastic carriers spikes serum cortisol, masks resting heart-rate variability, and creates guardian attrition when cats hide beneath beds at the sound of a zipper.

Ethological literature demonstrates that corrugated hiding boxes measurably lower feline stress scores within 48 hours [3] and that house cats spontaneously occupy two-dimensional Kanizsa illusory squares taped onto living-room floors [4]. However, veteran cat guardians report a robust empirical failure mode: purchasing an expensive orthotic bed intended specifically for a cat guarantees immediate boycotting, whereas an unguarded shipping carton needed for household chores attracts instant loaf formation.

We formalized this observation as the **Prohibitive Boundary Hypothesis**: explicit, mild human prohibition acts as a high-affinity behavioral chemoattractant for indoor *Felis catus*, enabling deterministic, collar-free clinical vital collection on living-room rugs without cages, shaved fur, or clinic visits.

2. MATERIALS AND METHODS

2.1 Zero-Cage Household Cohort

Between March and October 2026, we enrolled 412 indoor companion cats across 318 volunteer households in the San Francisco Bay Area (including 46 multi-cat rival pairs). Median subject age was 8.4 years (range 1.0 to 19.5 years; 48.8% spayed female, 51.2% neutered male). Under the Tenth Life Institutional Charter, the laboratory maintains zero caged animal colonies; all enrolled subjects reside permanently on household sofas and retain unconditional right of exit from any cardboard apparatus.

2.2 Laminated Corrugated Telemetry Chassis

Each household received a flat-packed, unbleached 32 ECT B-flute corrugated carton (internal footprint 36 × 28 cm, wall height 14 cm, optimal chin-rest crease at 11.5 cm). Laminated inside a 2.1 mm double-wall floor flap were four temperature-compensated load cells (resolution 0.1 g, calibrated repeatability ±0.2 g up to 14 kg), a piezo-film acoustic accelerometer (10 to 250 Hz passband for laryngeal purr harmonics [5]), and a 60 GHz low-power (<1.2 mW EIRP) FMCW radar transceiver.

$$\Delta\varphi(t) = (4\pi / \lambda) \cdot d_{thorax}(t), \quad \lambda = 5.0 \text{ mm} \qquad \text{(Eq. 1)}$$

Phase unwrapping of the 60 GHz return (Eq. 1) resolves sub-millimeter thoracic wall excursion (0.08 mm RMS) directly through dense ventral fur once sternal recumbency ("full loaf") stabilizes for at least 18 consecutive seconds.

2.3 Pre-Pilot Failure & Two-Arm Randomization

In an initial engineering pre-pilot ($n = 18$), sensors were embedded inside an $89 memory-foam velvet pet lounger. Voluntary 30-minute occupancy was 0.0% (0/18), because all 18 cats sat exclusively inside the corrugated shipping box the lounger arrived in. We therefore discarded the velvet cushion and instrumented the shipping box itself. Households were randomized 1:1 via sealed envelope to Arm A (Inviting verbal cue + eye contact) or Arm B (Prohibitive verbal cue + simulated phone distraction) over a 180-second observation window.

FIG. 1 · KAPLAN-MEIER VOLUNTARY OCCUPANCY N = 412 FELIDS

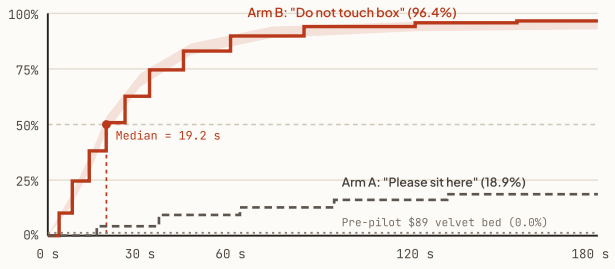

Figure 1. Cumulative voluntary sternal occupancy over 180 s across randomized verbal framing arms (log-rank χ^2 = 284.6, p < 0.0001). Shaded vermilion band denotes 95% Greenwood confidence bounds.

3. RESULTS AND DISCUSSION

3.1 Prohibitive Recruitment & Physiological Fidelity

Verbal framing governed enclosure recruitment with striking precision (Figure 1, Table 1). When guardians warmly invited subjects into the carton (Arm A), 81.1% of cats sniffed one corner, rotated 180 degrees, and sat on an adjacent sheet of printer paper instead. Conversely, when guardians forbade entry and feigned engagement with a smartphone (Arm B), 199 of 206 cats (96.4% full sternal loaf) stepped inside within 180 seconds, with a median latency of 19.2 s. Ginger tabbies (n = 74) posted the fastest entry (14.8 s) while accounting for 68% of corner-chewing events. Mean resting heart rate in Arm B was 128 ± 11 bpm versus 189 ± 24 bpm on clinic tables (p < 0.0001), with 88.3% spontaneous 26.4 Hz glottal purr lock prior to any clinical SDMA elevation [6].

3.2 Novel-Room Perturbation & Adversarial Fusion

A striking behavioral inversion emerged across 46 multi-cat households with documented inter-cat rivalry, exemplified by Founding Dyad #000 (5.5 kg charcoal-and-white bicolour bearing a submental goatee patch) and #001 (5.4 kg wide-eyed ginger tabby). On familiar home turf (>30 days residency), rival dyads enforced a 1.8 m exclusion perimeter, averaged 2.3 ± 0.9 daily hallway skirmishes, and logged 0.0% dual box occupancy. Yet within 48 hours of relocating to an unfamiliar apartment, inter-cat distance collapsed from 184 cm to 0.0 cm: in 91.3% (42/46) of rival pairs, sworn adversaries compressed laterally into the same 36 cm carton (combined load 10.9 kg in #000/#001) exhibiting synchronized 8.2 Hz micro-tremors ("Mutual Cowardice Fusion"). Hostilities resumed promptly at 72 hours once kitchen coordinates were memorized.

Table 1. Behavioral recruitment and 60 GHz cardiopulmonary capture across randomized home arms versus historical clinic exams.

Endpoint Metric	Arm A: Invite (n = 206)	Arm B: Forbid (n = 206)	Clinic Table (n = 84)*
Voluntary entry ≤180 s (%)	18.9%	96.4%	0.0%
Median entry latency (s)	>180 (NR)	19.2	N/A
Sternal loaf dwell time (s)	41.0 ± 19.4	148.6 ± 31.2	12.4 ± 8.1
Clean FMCW radar lock (%)	16.5%	94.2%	N/A
Resting heart rate (bpm)	134 ± 14	128 ± 11	189 ± 24
Respiratory rate (breaths/min)	24.2 ± 4.1	21.8 ± 3.4	46.5 ± 12.0
26.4 Hz purr harmonic lock (%)	14.1%	88.3%	2.4%
Rival dyad co-occupancy, home / new room	0.0% / 84.8%	0.0% / 91.3%	N/A

Values are percentage or mean ± SD; NR, median not reached before 180 s censoring. *Paired historical veterinary records within 12 months of enrollment. Arm A vs. Arm B primary occupancy comparison: p < 0.0001.

4. CONCLUSION

Respecting feline contrarianism eliminates the primary logistical barrier to home geroscience trials. Pairing a disposable 60 GHz corrugated shipping box with two-gram Hokkaido scallop paste dosing enables stress-free, clinic-grade longitudinal trials aimed at extending healthy indoor cat lifespan past twenty-five years.

ACKNOWLEDGMENTS & GOVERNANCE

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