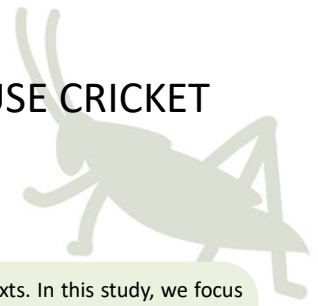


MAGNITUDE DISCRIMINATION AND ITS STABILITY IN HOUSE CRICKET *ACHETA DOMESTICUS*

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The ability to process continuous and discrete quantities is critical for guiding animal behaviour across diverse contexts. In this study, we focus on house crickets (*Acheta domestica*) to investigate magnitude processing. Traditional analyses of animal and human cognition often focus on **group-level effects** derived from aggregated data. While informative, such averaging may obscure important variability and limit the robustness of conclusions. We propose a framework that extends beyond group means by evaluating:

- Robustness across subsets** – consistency of effects under resampling;
- Individual prevalence** – the extent to which effects generalize across individuals;
- Intra-individual stability** – persistence of effects within individuals across time.

Methods

Subjects & Housing

62 adult *Acheta domestica* (31 ♂, 31 ♀), ~7 days post-molt; individually marked with numbered bee-tags under CO₂ anesthesia (Fig 1a)

Standard colony conditions: 30 ± 2 °C, 40 ± 10% RH, 12:12 light:dark cycle

Experimental Setup

White rectangular arena (50 × 35 × 25 cm), opposing walls: vertical black bars (2 cm vs. 4 cm wide, same height; Fig 2a)

Arena rotated between trials, cleaned with ethanol after each session

Procedure

Each cricket tested once/day for 7 consecutive days (n = 62; final dataset n = 55 after exclusions)

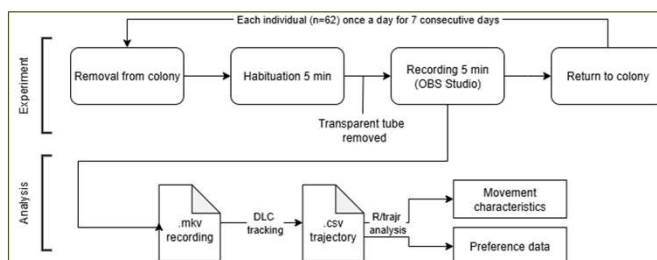
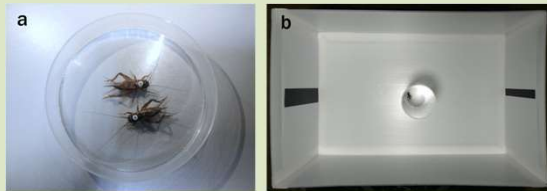
Trial = 5 min habituation in release cylinder + 5 min free exploration

Recorded at 1080p/30fps; trajectories tracked with **DeepLabCut**

Behavioral measures:

- **Time spent** near each bar (in ms)
- **Number of visits**
- **First choice** (thin vs. wide)

Locomotor traits (Emax, sinuosity, velocity, straightness)



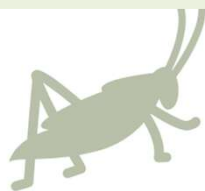
Discussion

Cricket **spontaneously preferred thinner vertical stimuli**, contrary to many taxa where **larger is preferred**. This may reflect **ecological relevance** (grass stems, vertical landmarks).

However, **preferences were not stable within individuals**, suggesting they are **transient/context-dependent** rather than trait-like.

By contrast, some locomotor traits showed moderate temporal repeatability, consistent with previous insect personality research.

Highlights importance of moving **beyond group-level averages** → robust conclusions require examining **subset robustness, individual prevalence, and intra-individual stability**.



Results

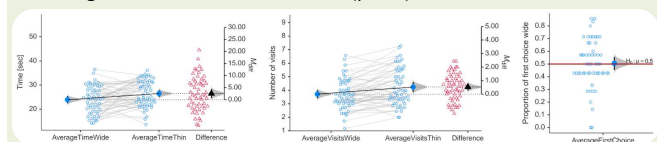
Magnitude Preference (Group Level)

Cricket **preferred thin bars**:

Time spent: $t(54) = -2.69, p = .009 (d = -0.46)$

Visits: $t(54) = -3.98, p < .001 (d = -0.42)$

No significant effect for **first choice** ($p > .5$)



Resampling confirmed **robust group-level preference** for thin bars.

Individual Stability

Low intra-individual stability: only 3/58 showed consistent first choice across all sessions

Autocorrelations of preference strength across days: $r \approx -0.03 \rightarrow$ no meaningful stability

Locomotor Traits

Moderate stability: Emax: mean $r = 0.3$; Sinuosity: mean $r = 0.25$

Low stability: Velocity ($r \approx 0.02$); Straightness ($r \approx 0.07$)

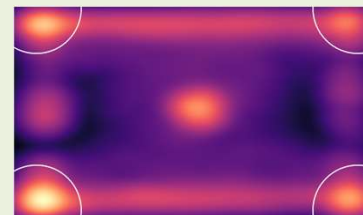
Corner Analysis

To examine whether magnitude preferences were confounded by positional or geometric biases, we analyzed **corner occupancy** (time spent and visit counts) separately for **top vs. bottom corners** at both the **thin** and **wide** stimulus walls (Fig. X).

Cricket spent **more time near thin-bar corners** than wide-bar corners, consistent with overall group-level preference.

No systematic **top vs. bottom asymmetry** was detected, indicating that the effect was not driven by corner geometry or arena orientation.

Visit frequencies mirrored time measures, further supporting the conclusion that **preferences were stimulus-driven** rather than location-driven.



Heatmap of cricket trajectories across all sessions. Brighter colors = longer occupancy. White arcs = analysis zones for corners.

Conclusions

Group-level effect: consistent preference for thin bars.

Individual-level: preferences unstable across days.

Locomotor traits: moderate stability, supporting repeatable "personality" features.

Implication: magnitude discrimination in crickets is **robust at group level but not a stable individual trait**.

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