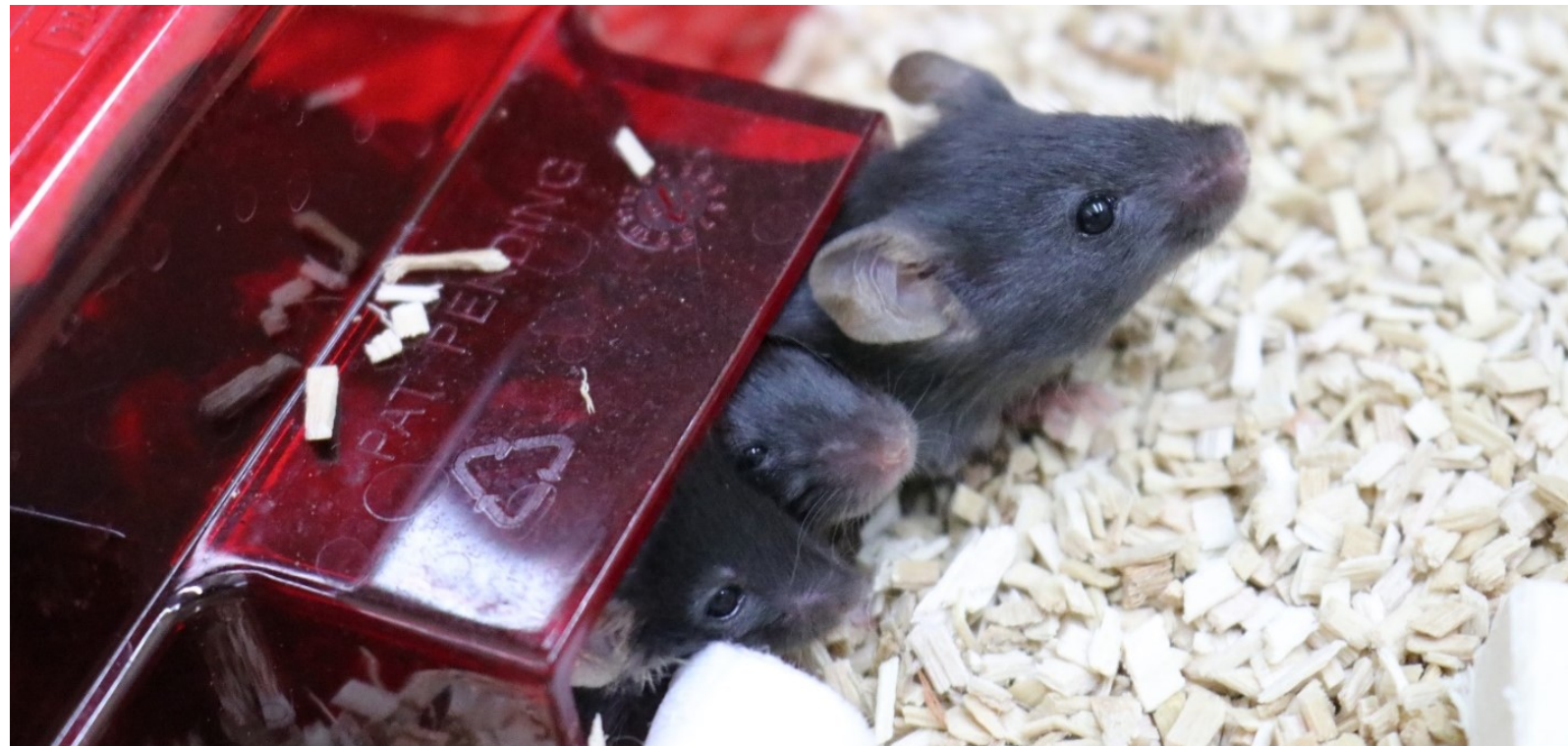


Underchallenged when not at test: Boredom in laboratory mice

Lars Lewejohann



Animal research

Europe 2017: 9.4 Million animals used for experiments

14 Million additional animals

(for tissue and organ samples, breeding and maintenance + surplus)

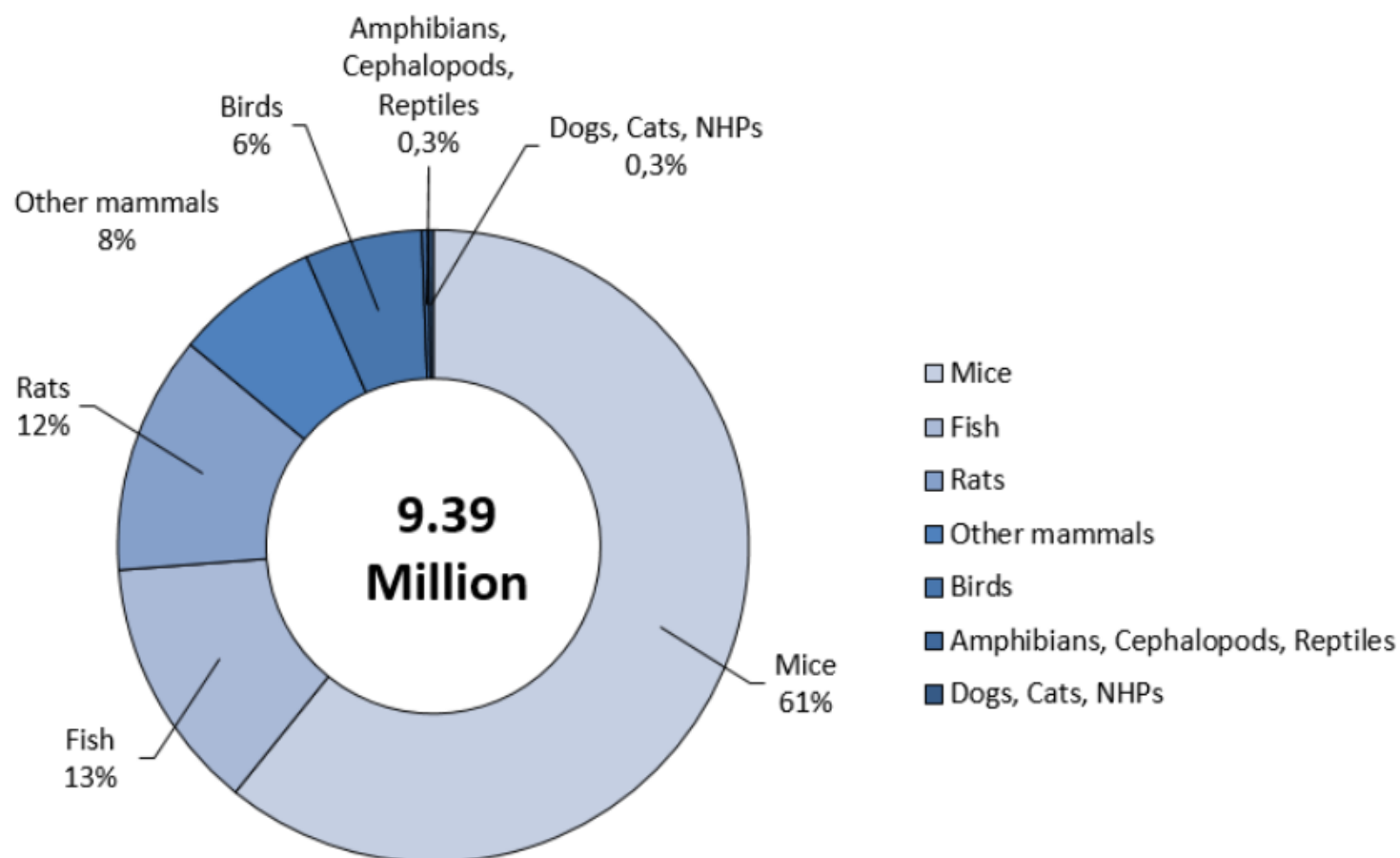
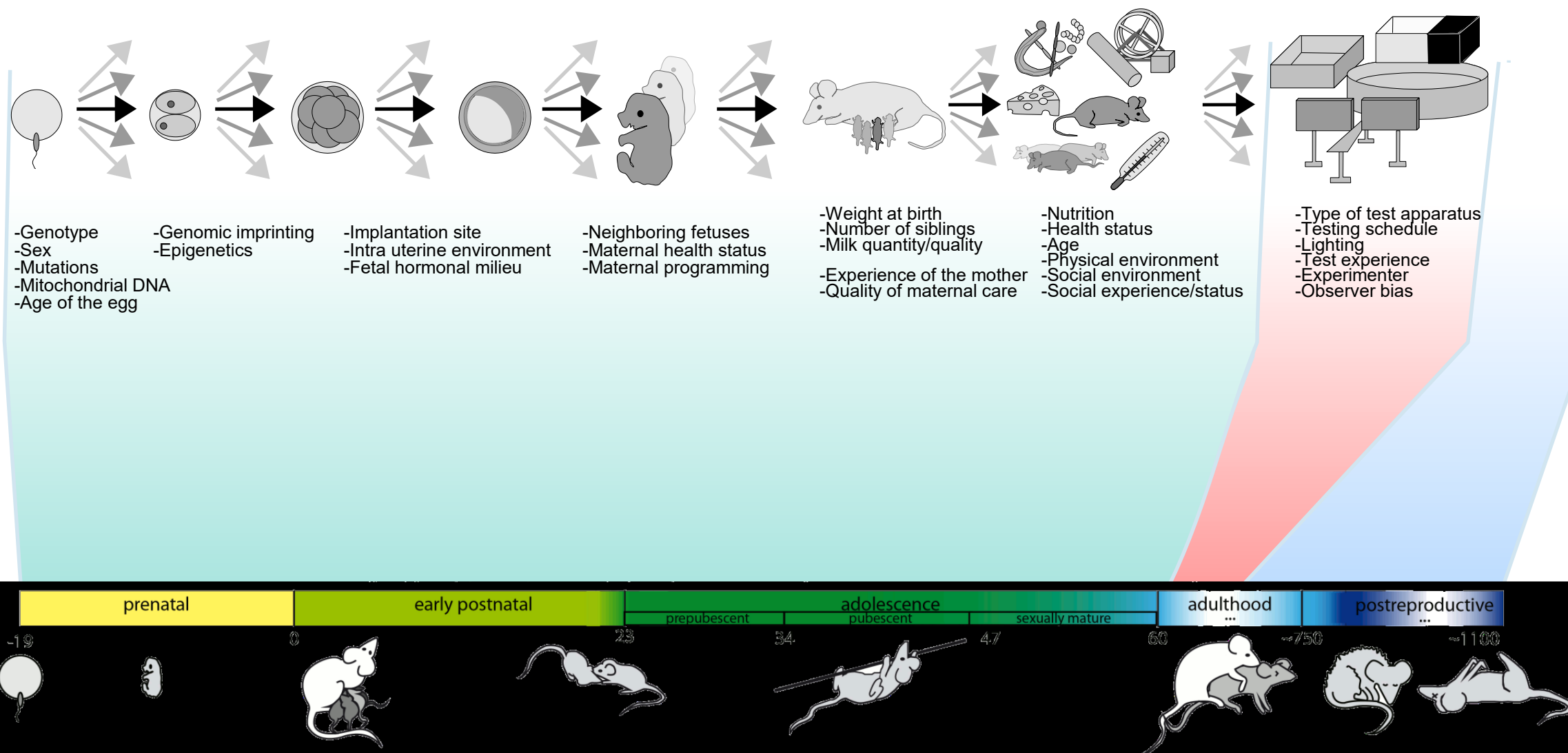


Figure 1: Numbers of animals used for the first time by main classes of species in 2017

The Life of Laboratory Mice



Lewejohann, Zipser & Sachser (2011) *Dev Psychobiol*
 Brust, Schindler & Lewejohann (2015) *Frontiers in Zoology*



Gaston La Touche, L'ennui (1893)

Boredom is an emotional state experienced when an individual is left without anything in particular to do, is not interested in their surroundings, or feels that a day or period is dull or tedious.

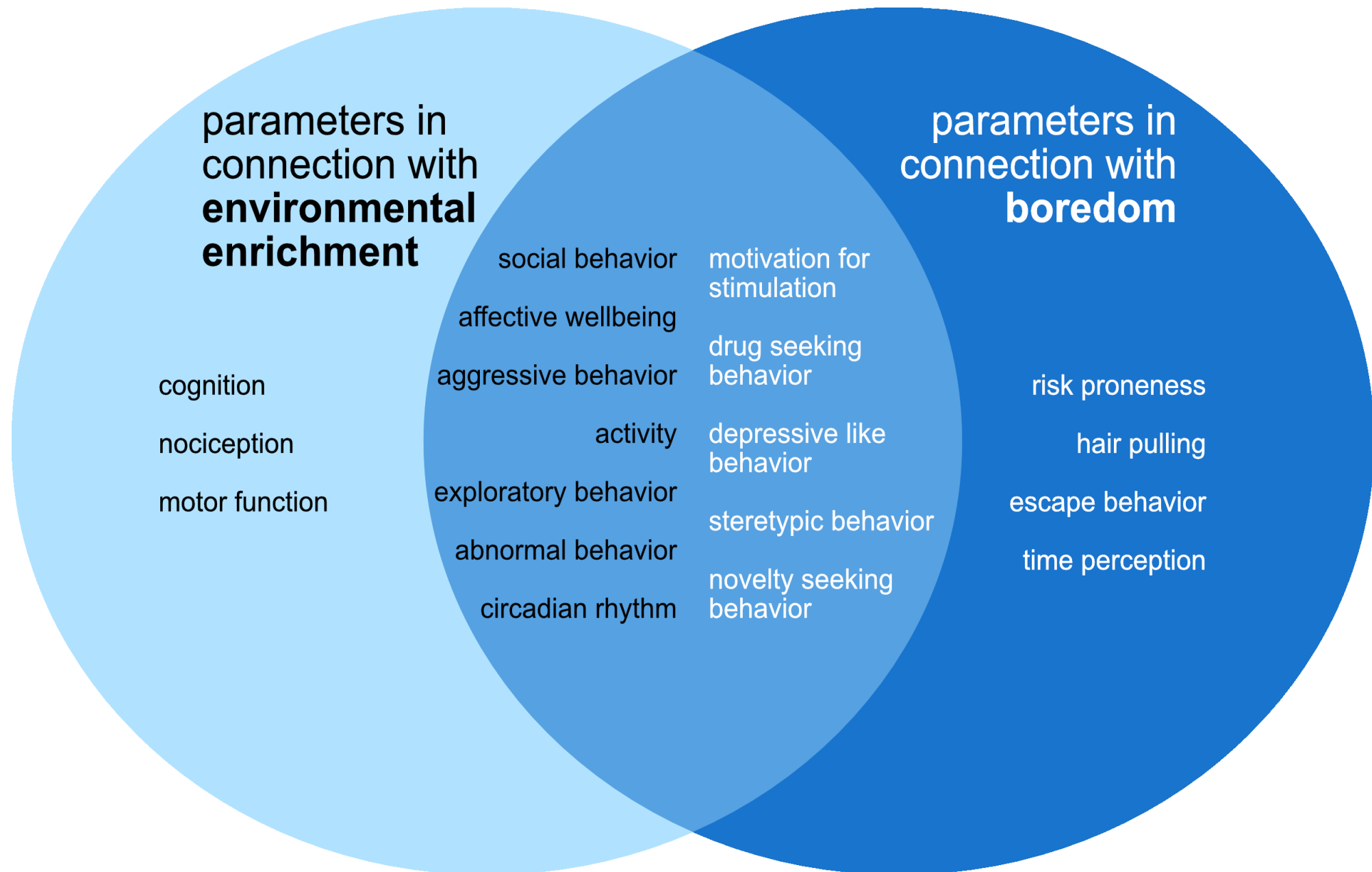


Boredom is similar to mental fatigue and is caused by repetition and lack of interest in the details of our tasks (such as tasks that require continuous attention, waiting at the airport, prisoners locked in cells). Any experience that is predictable and repetitive becomes boring.

www.psychologytoday.com

The Life of Laboratory Mice





Mieske & Hobbiesiefken et al (in prep)

Stereotypic behavior

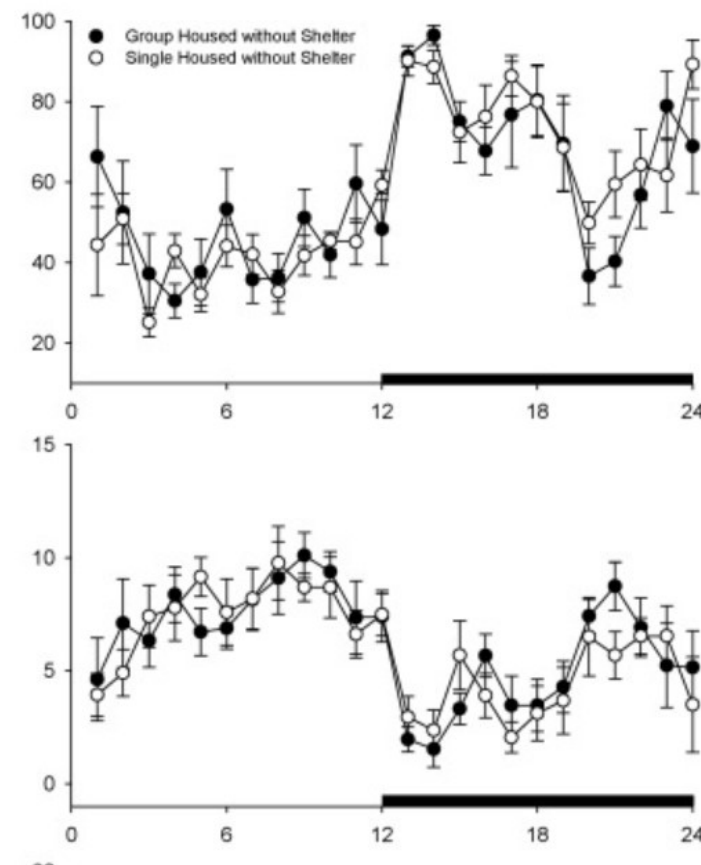
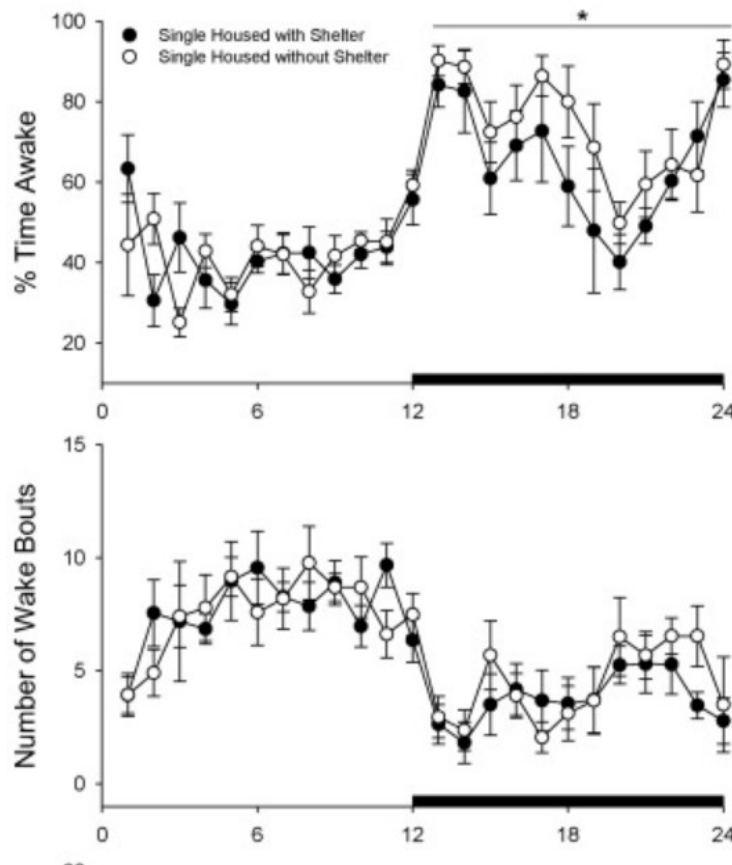


Symptoms of Boredom

Trichotillomania - Barbering



Increased rates of sleeping

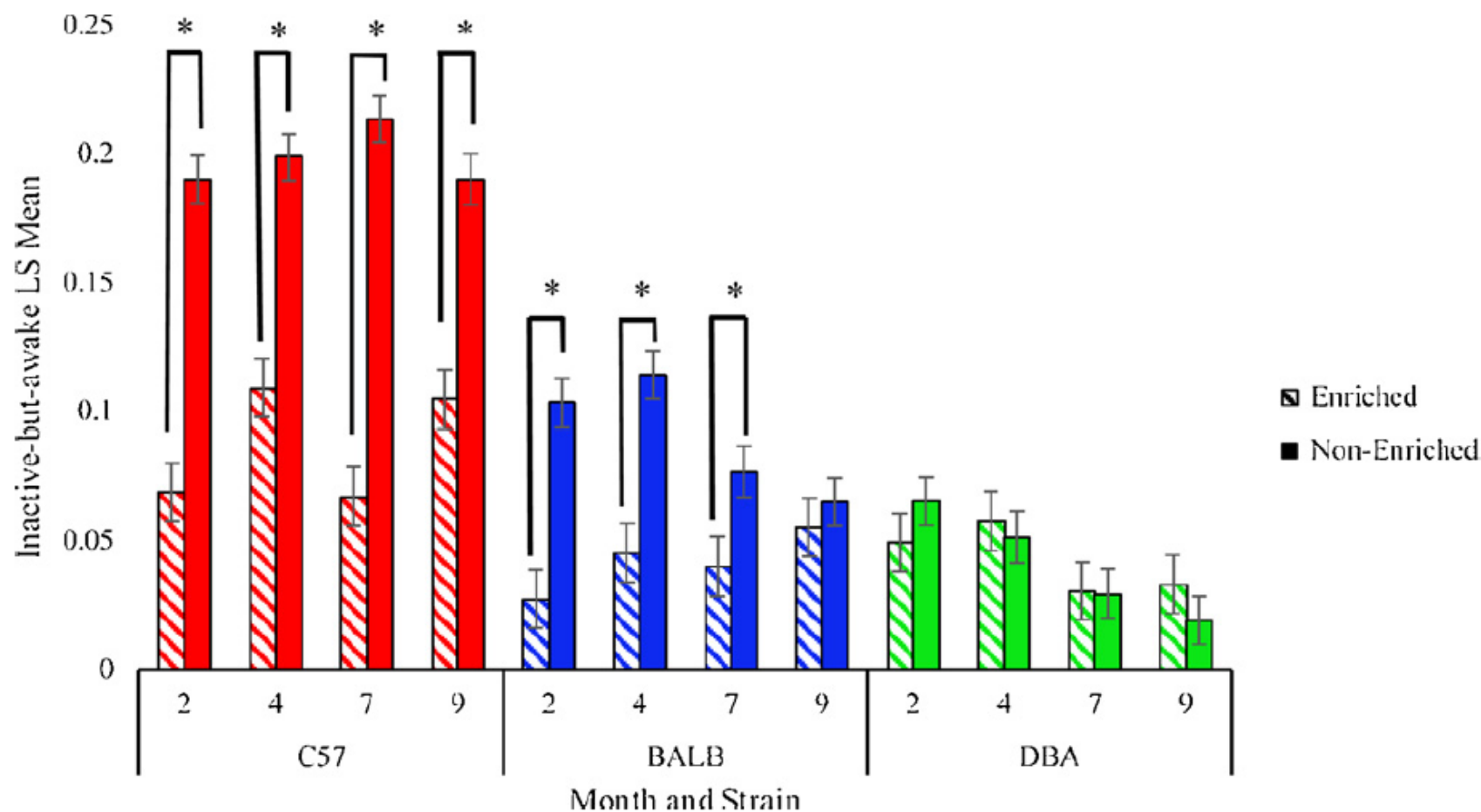


?

Febinger et al (2014) Effects of Housing Condition and Cage Change on Characteristics of Sleep in Mice

Symptoms of Boredom

Inactive but awake



Nip et al (2019) Why are enriched mice nice? Investigating how environmental enrichment reduces agonism in female C57BL/6, DBA/2, and BALB/c mice

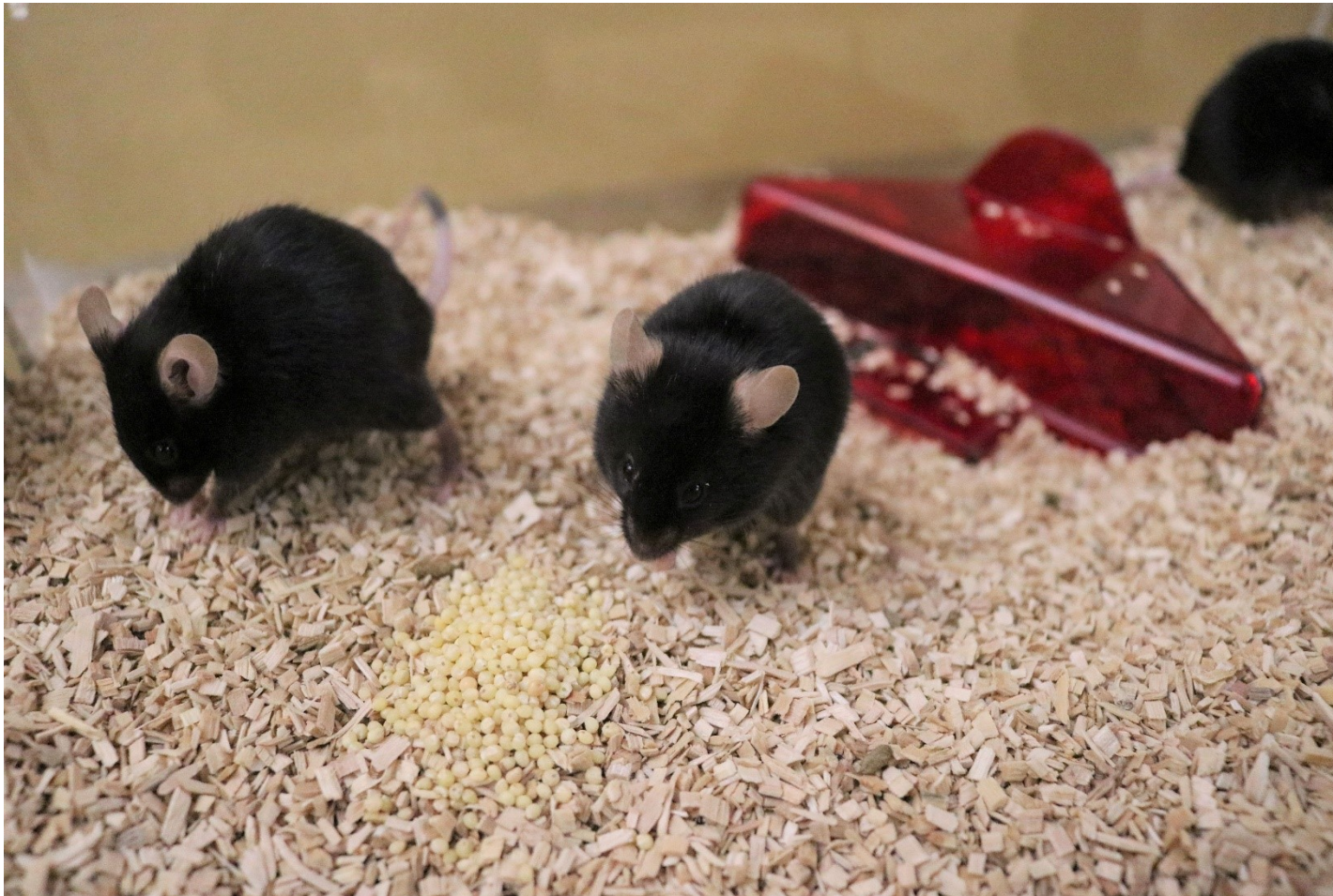
Overeating?



www.sciencemag.org

Time perception

E.g., by observing restlessness while waiting for a reward



Measuring Boredom

Sensation seeking

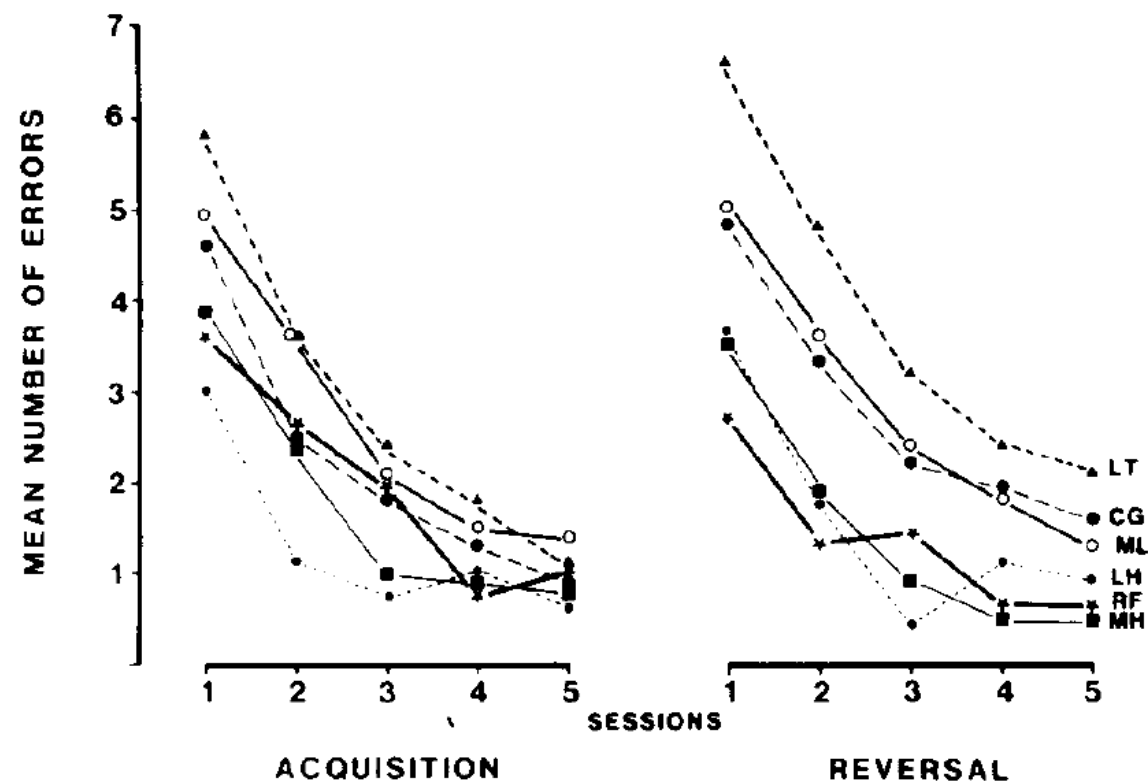


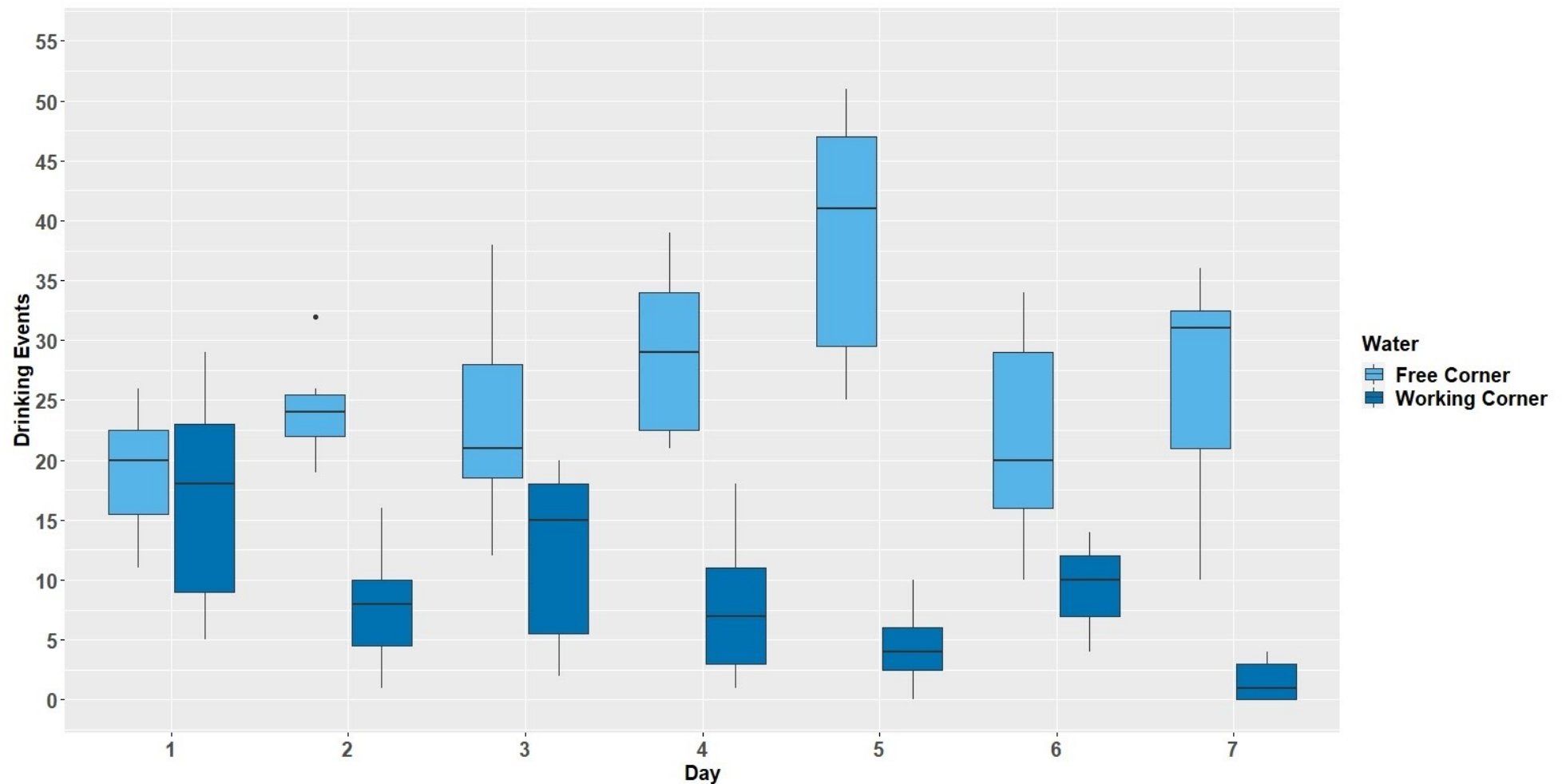
Fig. 2. Mean number of discrimination errors made by animals stimulated in CG (●), LH (●), LT (▲), MH (■), ML (○) and RF (★) during acquisition and reversal phases of the spatial discrimination task.

Cazala (1986) Self-stimulation behaviour can be elicited from various 'aversive' brain structures.

Measuring Boredom

Contra free loading

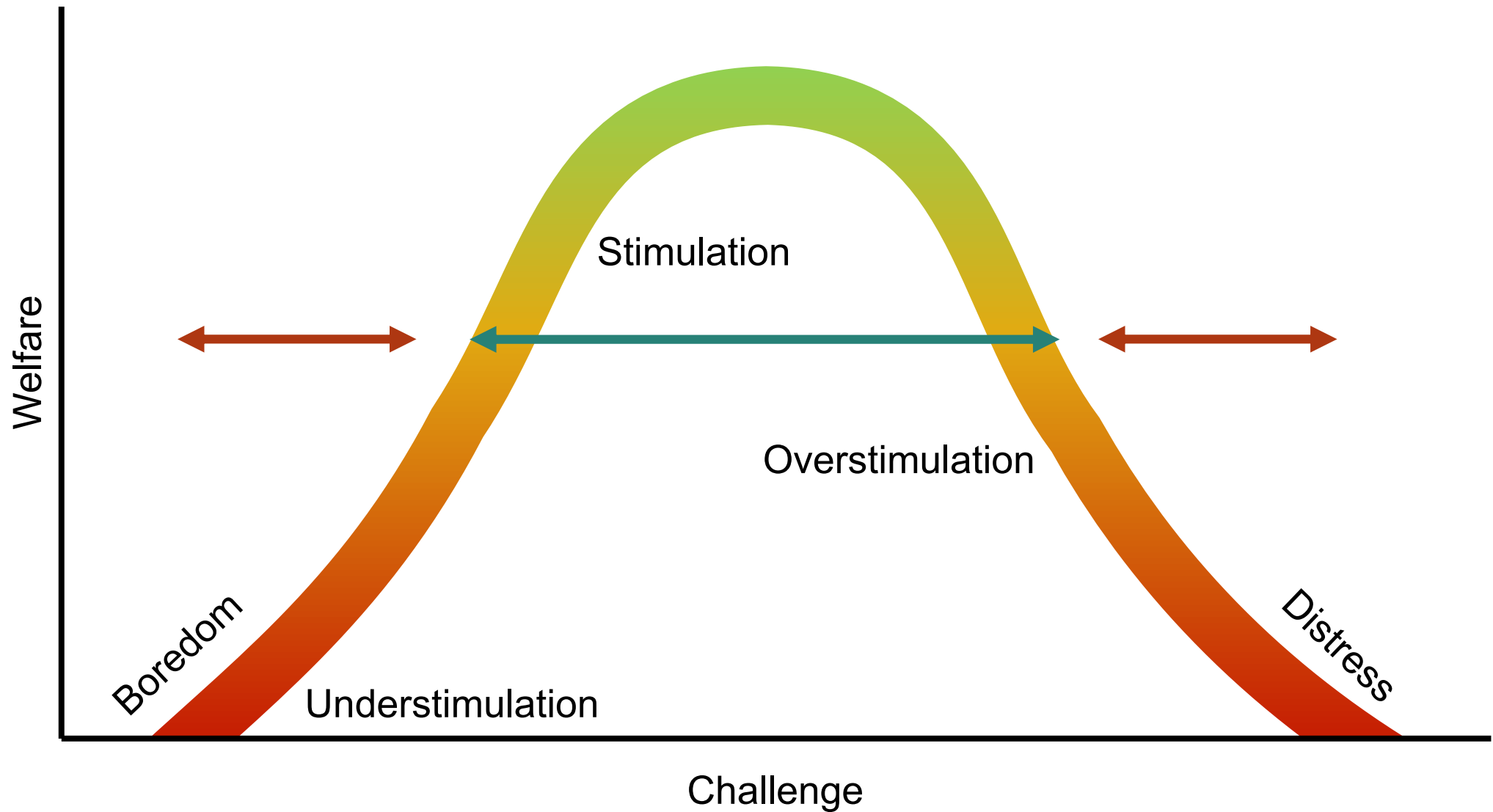
Contrafreeloading is an observed behavior in which an organism, when offered a choice between provided goods or goods that requires effort to obtain, prefers the good that requires effort.



Kahnau et al (in prep)

Treating Boredom

Stress - The inverted U-shape



See also:

Korte, SM, Olivier, B; Koolhaas, JM (2007) A new animal welfare concept based on allostasis. *Physiology & Behavior*.
 Sapolsky, R (2015): Stress and the brain: individual variability and the inverted-U. *Nature Neuroscience*.

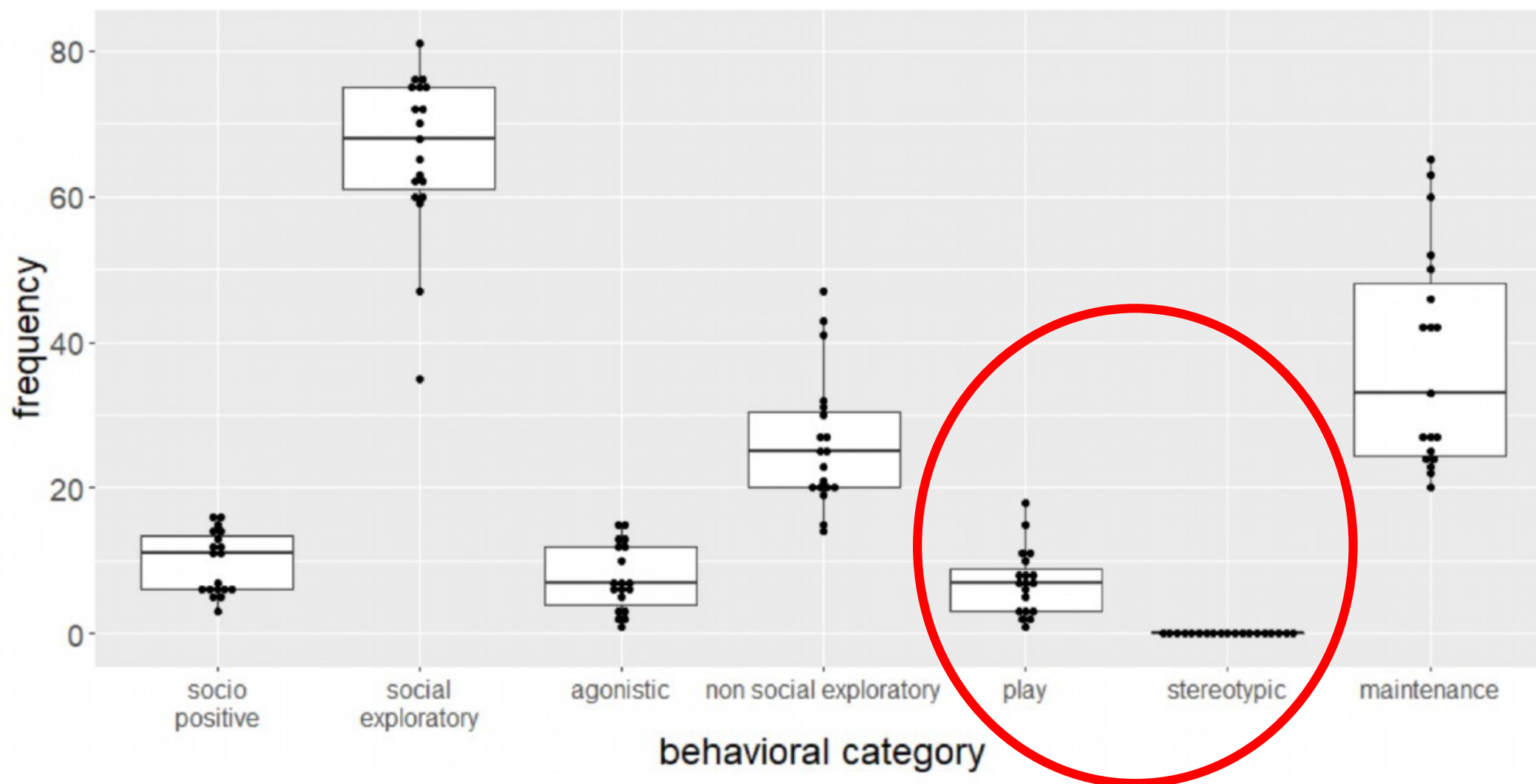
Semi naturalistic housing as a reference housing system



Mieske, P; Diederich, K; Lewejohann, L (2021): Roaming in a land of milk and honey: Life trajectories and metabolic rate of female inbred mice living in a semi natural environment.

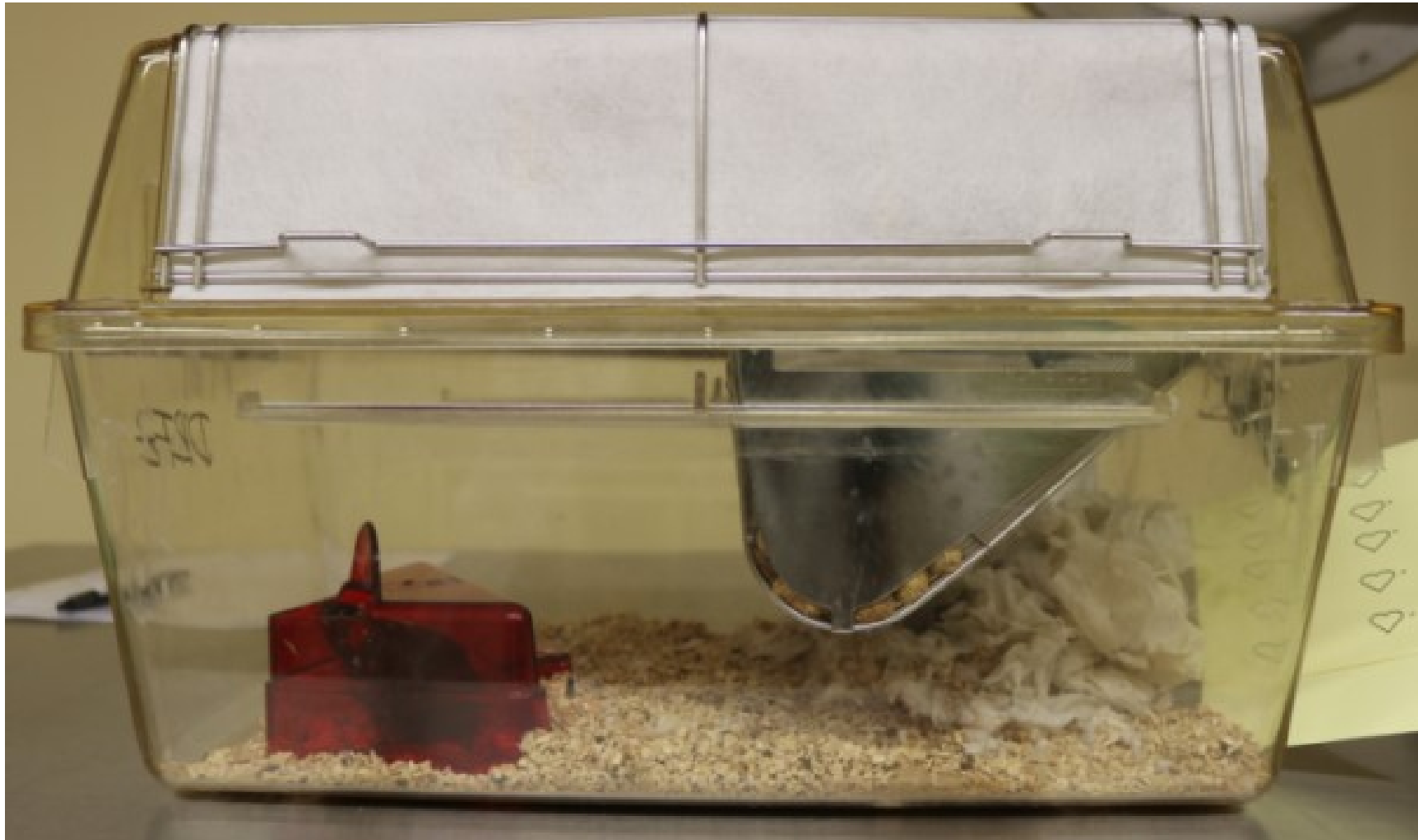
Treating Boredom

Semi naturalistic housing as a reference housing system



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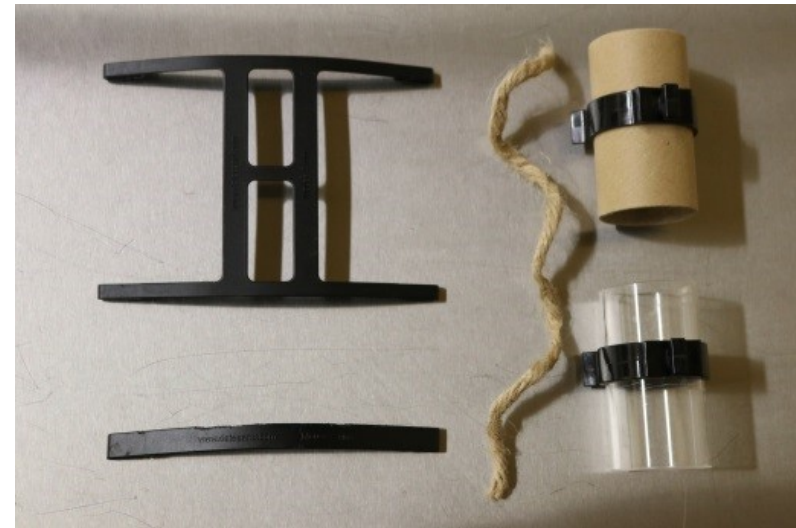
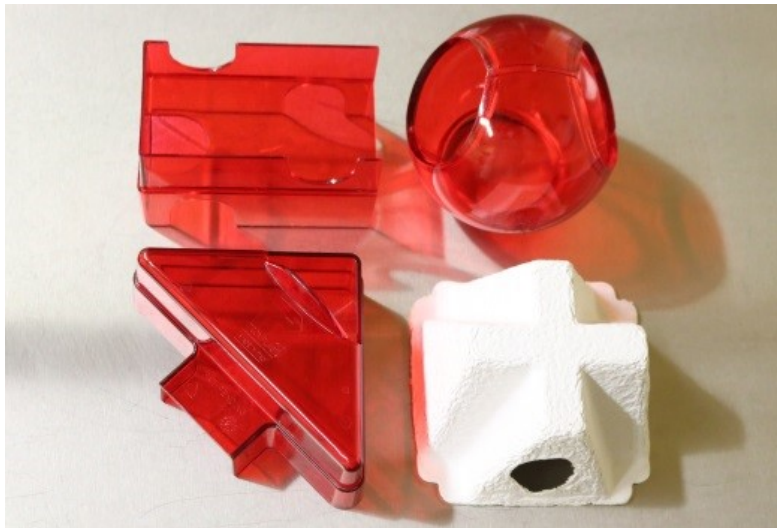
Enrichment



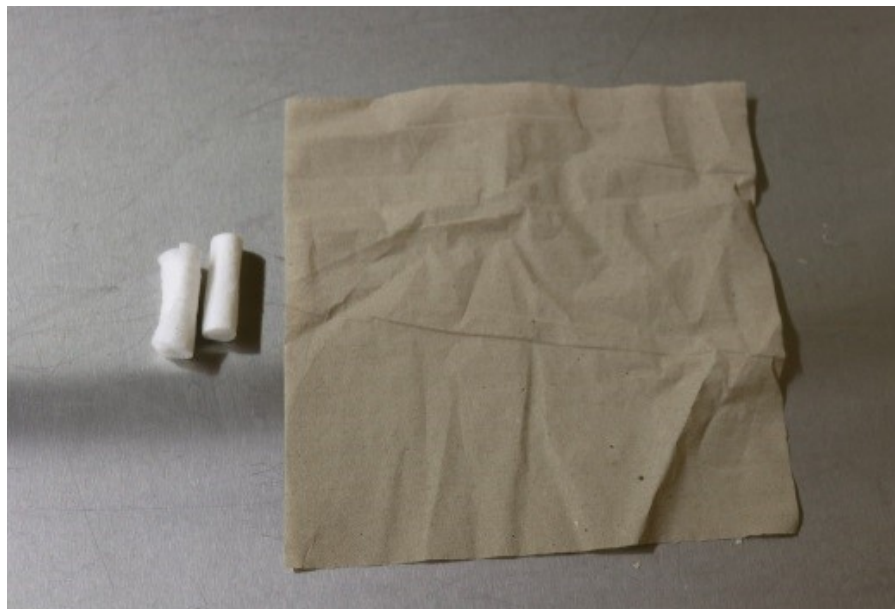
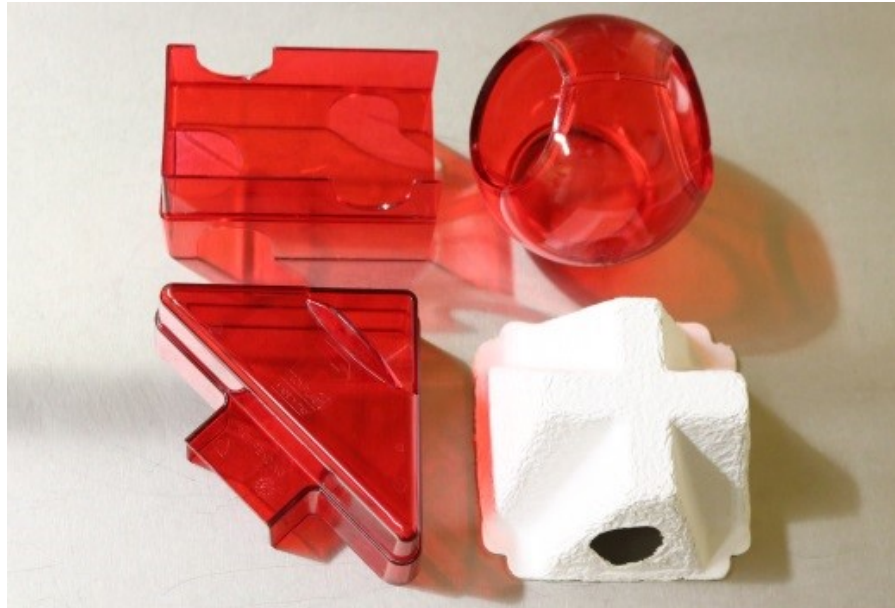
Enrichment



Enrichment - Structural Elements



Enrichment - Nesting and Shelter



Enrichment - Activity and Cognitive Stimulation



Enrichment - Activity and Cognitive Stimulation



Enrichment - Activity and Cognitive Stimulation

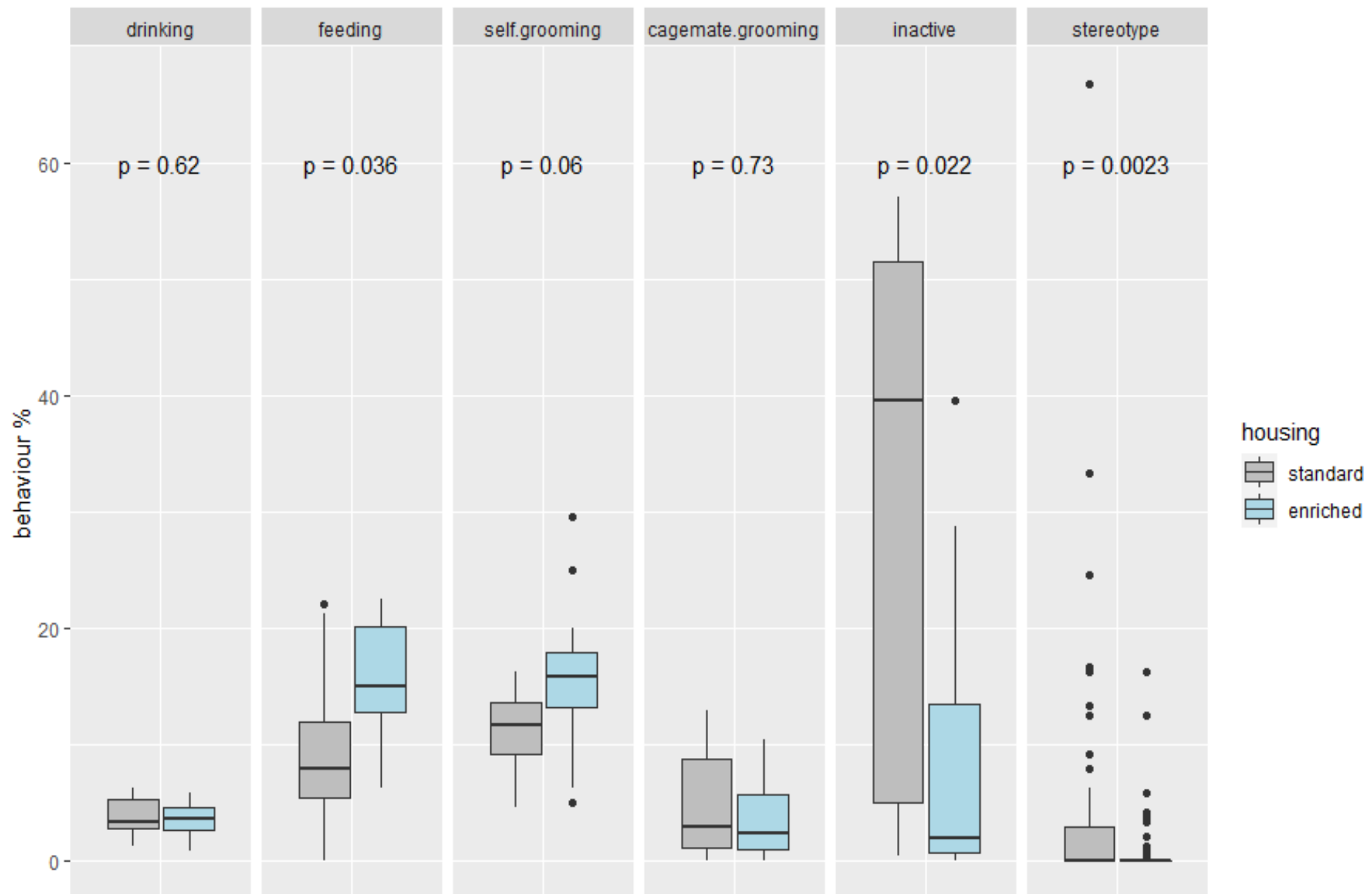


Enrichment - Activity and Cognitive Stimulation





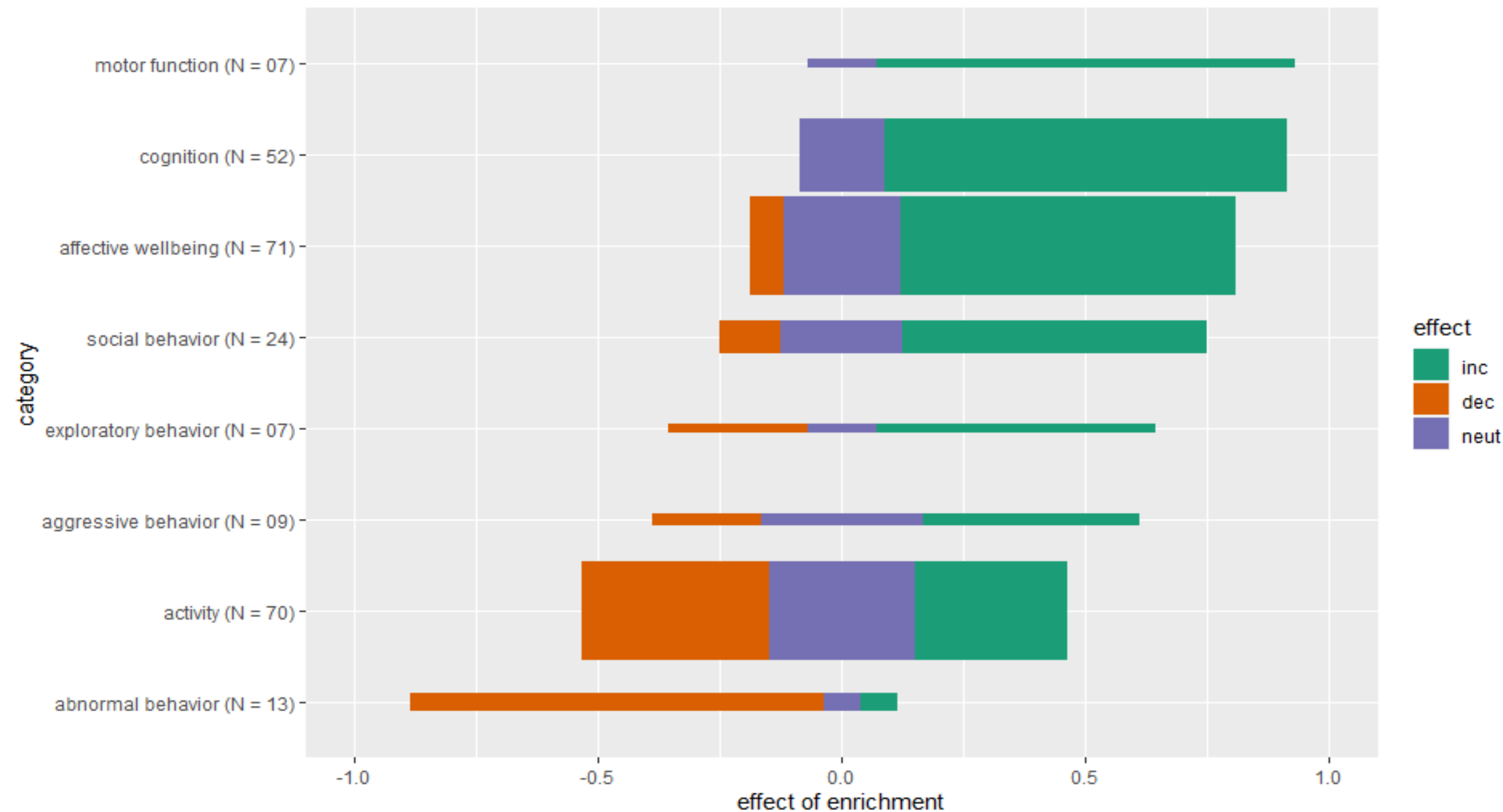
Spontaneous Behavior



Hobbiesiefken et al (subm.): How different types of enrichment are used by female laboratory mice and the effects on home cage behavior.

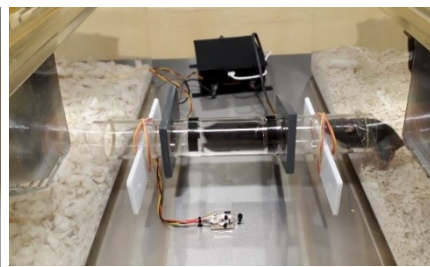
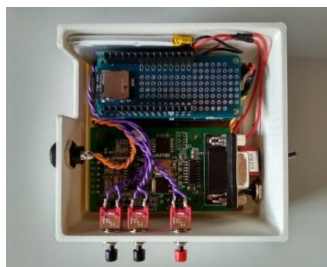
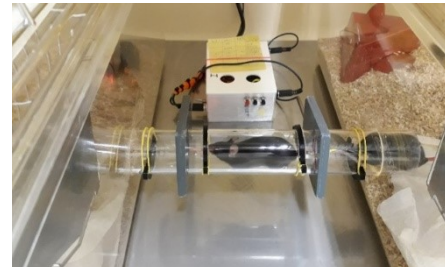
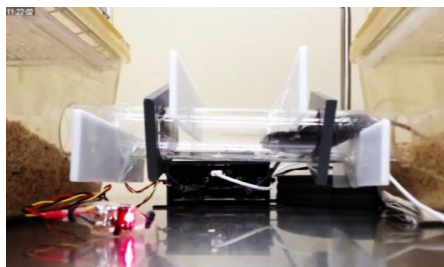
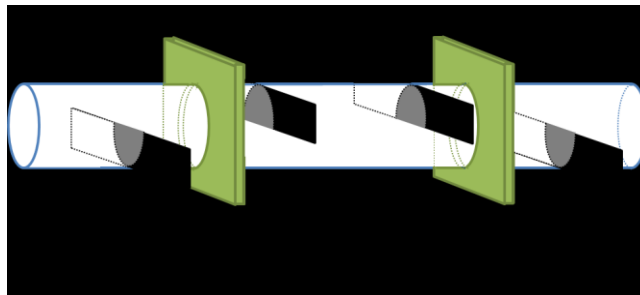
Number of publications showing the effect of enrichment on different parameters

N = 148, parameters are grouped into specially selected categories

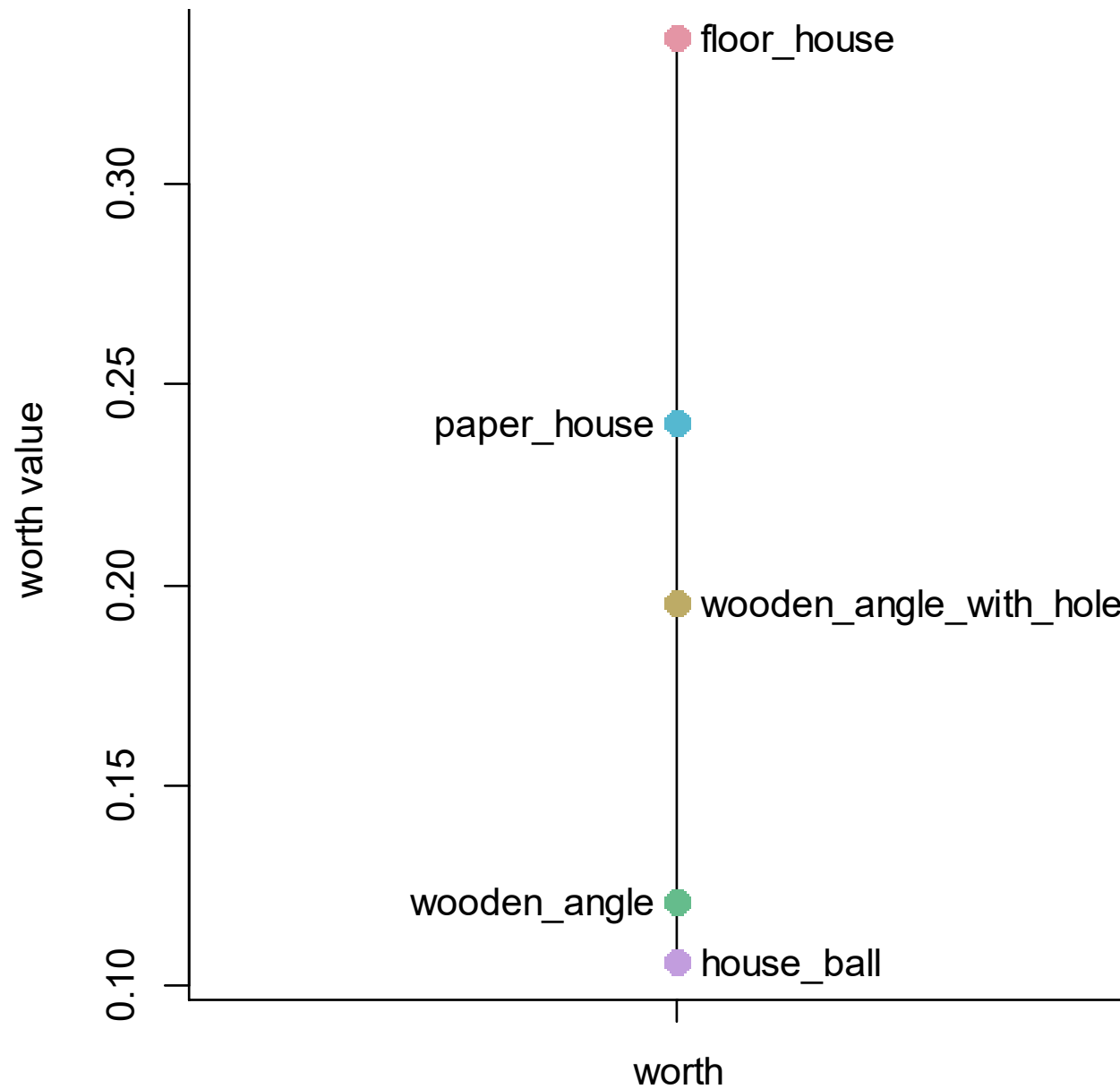


Mieske & Hobbiesiefken et al (in prep)

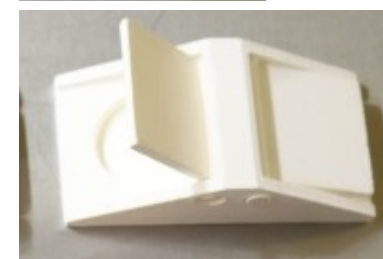
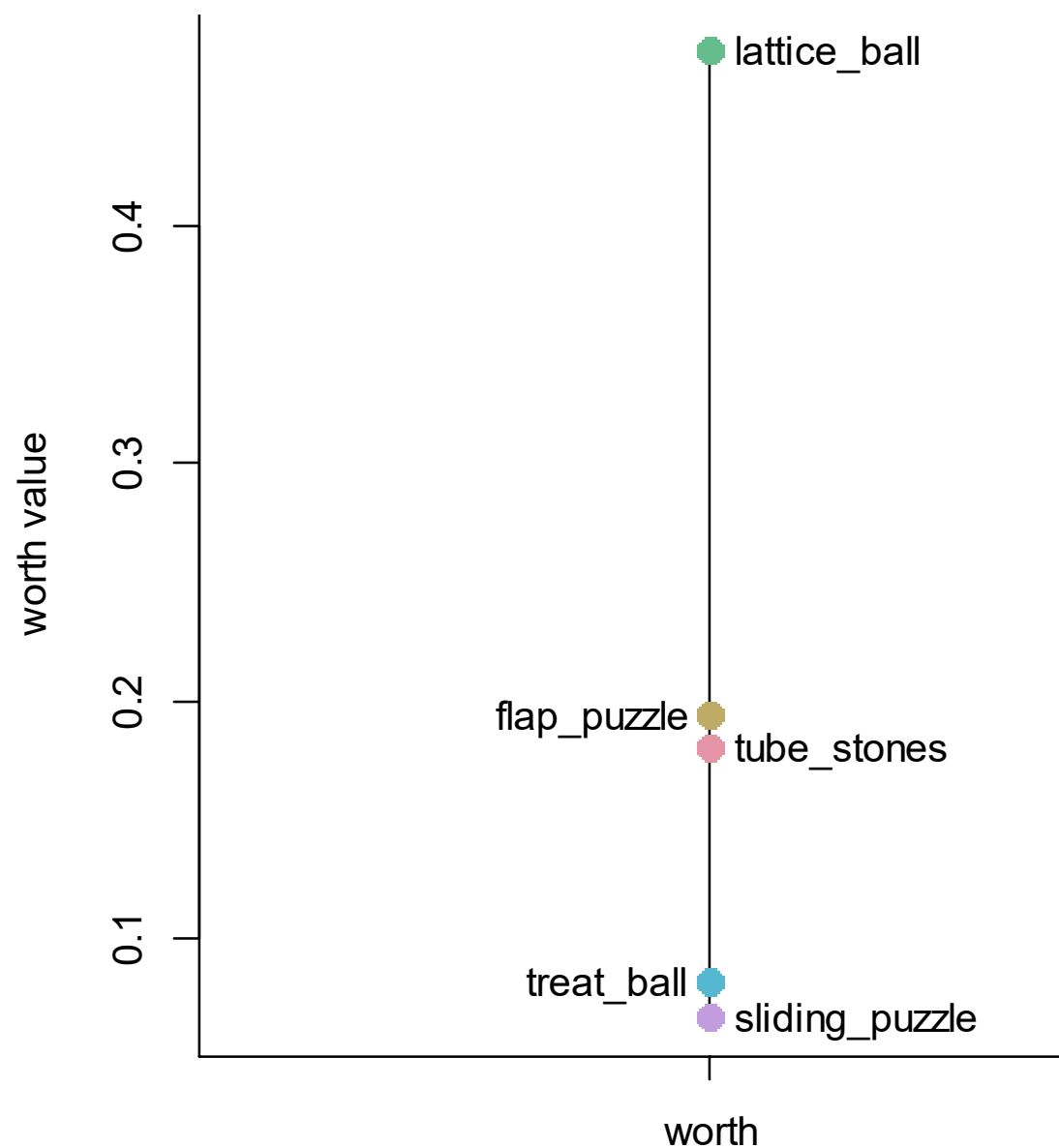
Enrichment from a Mouse's Perspective



Habedank et al. (2021): O mouse, where art thou? The Mouse Position Surveillance System (MoPSS) - an RFID based tracking system
Behavior Research Methods

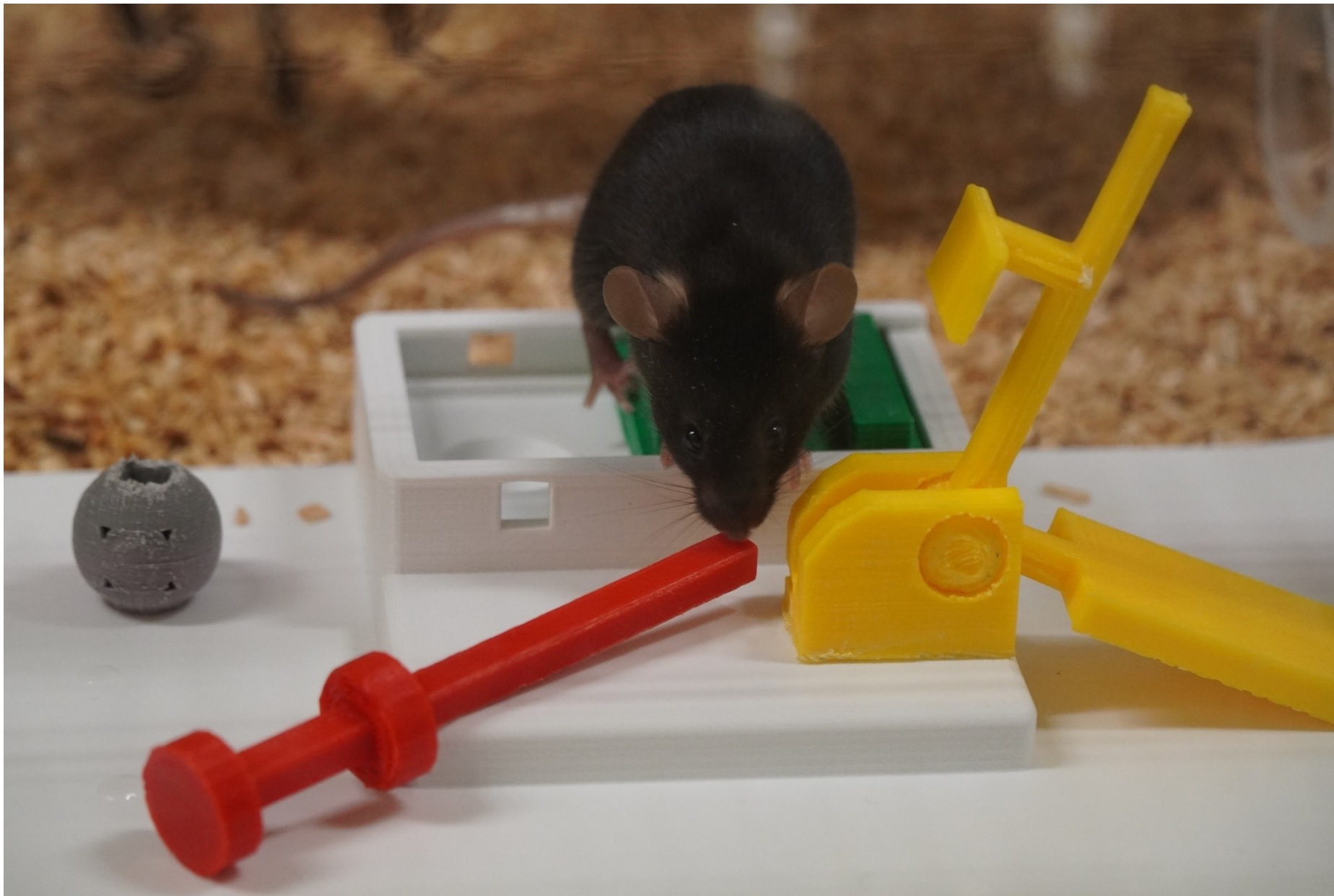


Hobbiesiefken, U; Urmersbach, B; Jaap, A; Diederich, K; Lewejohann, L (2021): Rating enrichment items by group-housed laboratory mice in multiple binary choice tests using an RFID-based tracking system. bioRxiv.



Hobbiesiefken, U; Urmersbach, B; Jaap, A; Diederich, K; Lewejohann, L (2021): Rating enrichment items by group-housed laboratory mice in multiple binary choice tests using an RFID-based tracking system. bioRxiv.

Positive affective states



Positive affective states



Animal Welfare Inside and Outside the Experiment

Category	Minimum	Nesting	Social	Enrichment	Space	Treats	Maximum	Constraints
	food, water, bedding, hygiene status, health monitoring, etc.	nesting material, shelter, a place to sleep comfortable	providing "positive" social contact in social species	e.g., climbing frames, toys, objects to manipulate	providing additional space	providing special treats (e.g., fruits, seeds, sweets, juice, almond milk)	maximizing welfare without limitations related to an experiment	constraints related to planned experiment
Breeding stock	yes	yes	yes	yes	yes	yes (restrictions might apply)	no	yes (e.g., separation, weaning age, attempts to standardize parental influences)
Breeding reserve	yes	yes	yes	yes	yes	yes	yes	no
Biological surplus	yes	yes	yes	yes	yes	yes	yes	no
Managed surplus	yes	yes	yes	yes	yes	yes	yes	no
Sentinel	yes	yes	yes	yes	yes	yes/no (same conditions as animals being monitored)	yes/no (restricted by the purpose and mode of use of the sentinels)	yes (e.g., co-housing for direct contact sentinels, exposure to dirty bedding, or air exhaust in IVCs, social restrictions)
Accompanying animals	yes	yes (if not conflicting with experimental procedure)	yes	yes (if not conflicting with experimental procedures)	yes (if not conflicting with experimental procedures)	yes (if not conflicting with experimental procedures)	no	yes (same housing conditions as experimental animals)
Waiting	yes	yes	yes (if not conflicting with experimental procedures)	yes	yes	yes (if not conflicting with experimental procedures)	no	yes
Experimental animals	yes (certain restrictions might apply)	yes (if not conflicting with experimental procedures)	yes (certain restrictions might apply)	yes (certain restrictions might apply)	yes (certain restrictions might apply)	no	no	yes
Post-experimental animals	yes	yes	yes (should be monitored if switching from single to social housing)	yes	yes	yes	yes	no

Lewejohann, L; Schwabe, K; Häger, C; Jirkof, P (2020): Animal welfare outside the experiment. Lab Anim

Treats



anne 2:47 PM

Unsere Mäuse werden diese Woche 2 Jahre alt 🎉 Heute gab es deswegen "Geburtstagshirse"

📎 IMG_1652 (2).JPG



Animal welfare outside the experiment



Running discs
for aged mice





Thanks for listening!

Lars Lewejohann

www.animalstudyregistry.org

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