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The importance of housing

This is a chapter from the e-book:

Basic behavioral neuroscience in rodents.

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INTRODUCTION

Housing is a very common issue when working with rodents. The use of a rodent (rat or mouse) in a behavioral and/or metabolic study often requires animals to be housed individually. However by doing this, the animals' social context is overlooked. As gregarious species, it is widely advised to avoid housing rats or mice individually. However, housing laboratory mice individually may be required to collect data at the individual level, such as measurements of food intake and energy expenditure (often a necessity when performing metabolic studies), or for reasons of social incompatibility (including fighting behavior among male mice).

Higher vulnerability to stress is a common finding in individually housed rodents. After an acute stressor, increased corticosterone levels were found in individually housed mice, while basal corticosterone levels remain unchanged. In the brain, plastic changes were found after social isolation. For instance, a decrease in functional BDNF signaling in cortical, thalamic and midbrain areas was found in chronically individual housed mice compared to socially housed mice.

On a behavioral level, increased expression of distress/anxiety-like behaviors has been reported for individually, compared to socially, housed mice when subjected to standard behavioral tests like the elevated plus maze (EPM) and open field (OF) test. On the other hand, some studies did not observe effects on anxiety caused by variations in housing conditions in male mice, or even reported an increase of anxiety levels on an EPM in socially housed mice compared to individually housed mice. Taken together, these examples indicate that individually and socially housed mice show different behavior in anxiety paradigms, and perhaps other behavioral tests as well. Such variation clearly complicates generalization of experimental outcomes between studies using individually and socially housed mice, and stresses the need for standardization of social housing conditions within and between experiments.

Socially housed BALB/cJ mice in a conventional Makrolon-type cage.

On the other hand, social housing itself can also cause problems in your behavioral analysis. For instance, it is generally assumed that rodents housed together within a cage are phenotypically similar because of their shared cage environment. However, research on social dominance suggests that groups of rats or mice within cages form social hierarchies, and that their behavior and physiology may differ depending on their dominance-subordinate relationships. Therefore, dominance relationships may be a confounding factor in animal experiments. For example, it has been found that subordinate mice show higher levels of anxiety-like behavior compared to dominant mice.

Hierarchal structures are more complex in larger groups (e.g. colonies), potentially causing considerable variability in behavioral, metabolic and even physiological outcomes. For example, social housing with three male mice in the same cage decreases aggressive behavior between mice, where the subordinate mice have social support from each other, decreasing the distress caused by the dominant animal. Surprisingly, effects of hierarchy are less often studied in pair-wise housing conditions, which is becoming standard practice in (metabolic) studies due to increased understanding about potential negative effects of social isolation on the wellbeing and performance of the animals. If we consider experiments in large colonies, many (preclinical) study setups are not practical/feasible to be performed in such a way. Pair-wise housing would thus be a proper, and naturally relevant, setup for experiments in rodents compared to individual housing.

WHICH HOUSING METHOD SHOULD I CHOOSE?

If you summarize all available literature and information, you can find that individual housing basically causes a depressive-like phenotype leading to body weight/fat increase and behavioral changes related to stress, anxiety, and depression. However although social housing is the more more naturally relevant method, it does increase logistical challenges such as identification, hierarchy effects in the cage and even creates testing order effects (there will always be an animals that is tested first, second, third, etc). And if we consider individual housing to be inevitable is some cases, such as with the use of cannulas or other implants implants, when animals elicit too much fighting behavior, or when there is need for metabolic cages.

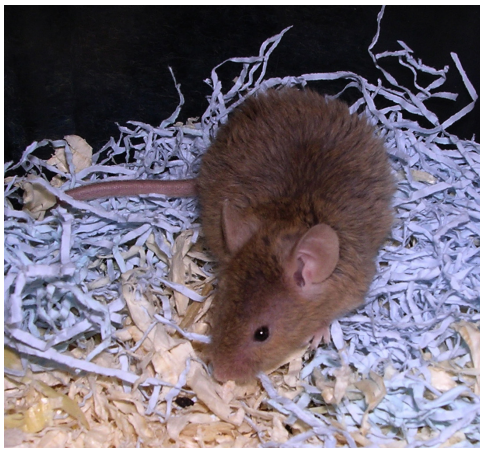
Important!

When socially housing animals, make sure you figure out which animals are dominant and subordinate! This is an essential factor in the analysis of your behavioral data. This can for example be done with a tube test. If you want to know how to perform a tube test, check out the article by Fan et al. that very accurately describes a protocol in mice.

The key is to be pragmatic in your study design. Your choice of housing should fit wat you actually need from your data. For example with food intake: do we always need individual data if we are looking at group effects? Consider measuring food intake of the entire cage. When countering testing order effects, make sure you write out an airtight protocol. Counterbalance groups, time of day, and especially the order in which you test animals from the same cage. Make sure you habituate them to a solitary environment before you subject them to a behavioral test.

CAGE ENRICHMENT

Laboratory rodents require proper sensory and motor stimulation. This is because they naturally exhibit behaviors such as foraging, exploring, hiding and building. Environmental (cage) enrichment can provide this in a laboratory cage. Earlier, social versus individual housing was al-ready mentioned, and this indeed is classified as cage enrichment. Furthermore nest building materials, knawing wood, hiding places (shelters) and running wheels can be considered as cage enrichment. Deprivation of cage enrichment can lead to serious behavioral abnormalities in your laboratory animals.



Nest building material such as shredded paper is commonly provided as cage enrichment.