Initial Observations on Connected Cage Communities of Mice

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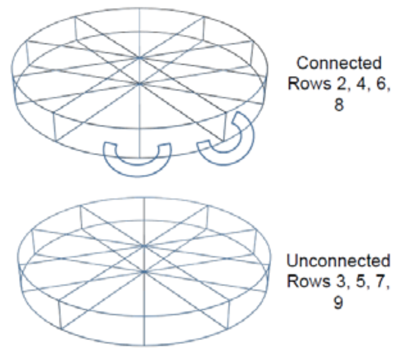
Introduction

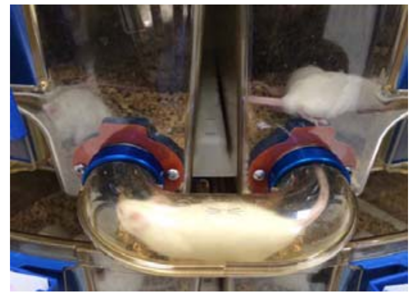
A recent enhancement of mouse IVC rack housing that permits up to 10 adjacent cages to be connected by external tunnels (BlockParty®, Animal Care Systems, Centennial, CO) provided new opportunities to explore laboratory mouse behavior and resultant impacts on husbandry efficiencies.

Materials and Methods

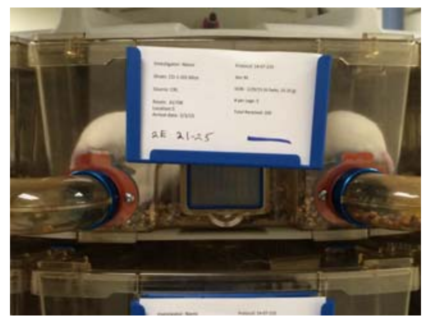
Four hundred 8-week old Crl:CD1(Icr) mice were housed 5 males or females/cage for over 8 weeks in an Optimice® rack (Animal Care Systems, Centennial, CO). All housing was accordance with space recommendations in the Guide for the Care and Use of Laboratory Animals (National Research Council, 2011) and all experimental work was approved by the Standing Committee on the Use of Animals in Research and Teaching, Harvard University Faculty of Arts and Sciences. Animals were provided with food (Lab Diet 5010, Richmond, IN) and water, delivered via automatic waterer, ad libitum. Bedding was 1/8th inch cob bedding, and each cage was also provided with 8-10 g of Enviro-dri® (Shepherd Specialty Papers, Watertown, TN). Mice were housed in cages either isolated or linked (BlockParty®, Animal Care Systems, Centennial, CO) for an entire row so that 50 mice shared the same expanded space in that row. The arrangement of alternating rows of linked or isolated cages for either sex is depicted in Figure 1, with duplicates of each experimental group. No animals were housed on the top or bottom row of the rack. Animals were individually identified via tail tattoo (Somark LabstampTM, San Diego, CA) and observed daily for general health. The following parameters were measured weekly: body weight, number of mice per cage, nesting score per cage (Hess et al., 2008), weight of food in each cage's hopper before and after replenishment, and degree of cage soiling (independent of the maximum interval of 2 weeks between changing as conventionally performed). The mean and standard deviation were calculated within each row for each of the above parameters; a mean of all those numbers was generated to give a single value for each row, followed by a simple 2-way ANOVA to test for significant differences (P<0.05) by sex, or by connected or isolated housing (JMP® 11, Cary, NC).

Figures 1 and 2





Figures 3 and 4



Results

Mice of both sexes were observed moving freely between connected cages during the entire study (Figure 2). At cage change, numbers ranging from 0-20 mice were found in each connected cage. Some males used connecting tunnels as perches to observe and sometimes impede other males entering that cage (Figure 3). Females in connected cages created several group-nesting cages, removing corncob bedding from those cages and replacing it with nesting material from other cages on the same row (Figure 4). The average nest score was lower in connected cages ($p = 0.0023$). The nest scores of connected and unconnected males did not differ. The nest scores of connected and unconnected females differed in their variability ($p = 0.0023$), which supports the observation noted above about their removal of nesting material to one or two cages out of 10. Males soiled cages more heavily than females ($p = 0.0006$) but there was no difference in soiling between connected and unconnected cages for either sex. Food consumption did not differ between connected or unconnected cages, nor did it differ on average between males and females. When a proxy for feed conversion, average weight gain per day, was examined, males gained more weight than females ($p = 0.0005$), which is an expected finding. Connected animals' weight gain differed from unconnected ($p = 0.002$), and this difference was an interaction of sex with connectedness ($p = <0.0001$). Unconnected males gained the most weight per day, and their rate of gain was significantly different from that of connected females. The prior two groups differed significantly from connected males and unconnected females, but the latter groups did not differ significantly from each other. Food chewing was infrequently observed and not associated with a particular caging arrangement or sex.

Discussion

The differential responses of both sexes of mice to connected versus isolated caging in this initial study raises attractive possibilities for more complex behavioral studies, breeding via expanded harems, and other scenarios using this housing apparatus. The lower nest scores in connected animals may be due to the higher thermal load that can be attained through more than 5 animals nesting together, or due to mechanical disruption by the mice. Although female mice seemed to benefit from connected housing, male mice did not, and this may be reflected in the decrease in rate of gain in males housed together. Although one unconnected male cage was removed from the study for fighting, more fight wounds were seen on mice from connected rather than unconnected cages but this was not examined formally. Access to more than one cage may provide some members of a group of male mice with a way to mark and defend territory resulting in a few dominant animals being found alone in cages, while other mice are crowded into a large bachelor group. Further experimentation to better elucidate the response of males to this method of housing is planned. Holding mice in conventionally isolated groups of up to 5 per cage on the same rack at the same time as larger numbers of mice connected to more space on adjacent rows permits more experimental flexibility complemented by control groups in traditional housing.

References

Hess, S. E., Rohr, S., Dufour, B. D., Gaskill, B. N., Pajor, E. A., & Garner, J. P. (2008). Home improvement: C57BL/6J mice given more naturalistic nesting materials build better nests. J Amer Assoc Lab Anim Sci 47(6): 25-31.

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Acknowledgements

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