The Naked Mole-Rat: A New Model for Psychiatric Research

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Background
Schizophrenia is a debilitating psychiatric disorder that affects approximately 20 million adults across the world. Yet, there is a lack of an appropriate animal model that displays schizophrenic-type behaviors in research. African naked mole-rats (heterocephalus glaber) live up to 30 years in captivity and follow a eusocial hierarchy, a caste system which requires high levels of prosocial behavior to work due to them constantly working together. Humans are known to be social creatures and although we do not live in a eusocial society, we do rely on others and engage in some prosocial behaviors. Psychiatric disorders, such as schizophrenia, alters cognition and is also associated with a deviation from the societal norm. With a rigid societal structure and a longer life span than the typical rodent, detecting antisocial behavior, one of the negative symptoms of schizophrenia, is possible. Additionally a gene named KCC2 is found naturally mutated in naked mole-rats and in some humans with schizophrenia. Previously we found that colony nest carbon dioxide can mask the negative effects of KCC2 mutation, which could indicate staying away from the colony could turn on the gene. The present study examines if NMR who are not spending much time in the nesting chamber, which is their societal norm, may display schizophrenic-type behavior.

Methodology
Four behavioral trials testing for prosocial behavior were conducted over the course of a 15 day period with each task being repeated 10 times. Data was recorded using Radio Frequency Identification (RFID) to track the movement of each naked mole-rat. The animals are all chipped with radio frequency identification (RFID) transponders, and circular RFID readers are placed around the tubes so every time an animal passes between bins, their movement is recorded. Additionally a device named Q-tip that was rolled in sand was used to identify whether or not the naked mole-rat participated in the prosocial task. (Fig 4)

1. Nest Building
RFID chips were put into cut up plastic straws and scattered throughout the colony. The tagged in the straws and naked mole-rats determine who was involved in this prosocial task. (Fig 4)

2. Defense Scent & Sound
To imitate an intruder, a device that makes the sound of a naked mole-rat along with a Q-tip that was rolled in another colony’s toilet chamber was placed in an area blocked off to the naked mole-rats. Fifteen minutes was allotted for members involved in defense to check the area. Any naked mole-rat that passed through the reader by the device during that time was recorded.

3. Tunnel Digging
One of the connecting tubes in the colony was filled with corncob bedding material, which dries hard and acts as a blockade. The RFID reader recorded which animals worked on clearing the path.

4. Colony Expansion
Sand was placed at the bottom of PVC pipes and naked mole-rats involved with foraging would kick the sand up the pipes. Once they got to the top, the floor was grated so any sand would immediately fall back down and the cycle would repeat. This experiment took place over a two day period and the activity of all the naked mole-rats who participated were recorded with the RFID chips.

Discussion
Overall, the data did not show a significant relationship between antisocial behavior and time spent in the nesting chamber. The colony expansion experiment did demonstrate a positive correlation (fig 5). This is the only true foraging tasks, which is typically done by the smaller animals. A reason for this could possibly be because smaller animals need to be in the higher levels of carbon dioxide compared to the larger animals. Two of the naked mole-rats who did not pass through the RFID readers at all during tasks spent the most time in the nest. It could be possible that they are breeders, which could explain why they were in the nest a lot without engaging in prosocial behavior. Future research should account for breeders who naturally wouldn’t be involved and the weight of each naked mole-rat. At this time it is unclear if KCC2 has a role in naked mole-rats displaying negative schizophrenia symptoms. More research should be done in regards to testing for other behaviors, like memory and locomotor/stereotypical behavior, in order to give a complete scope of schizophrenia-like symptoms.

Conclusions
- The colony expansion tasks was the only prosocial behavioral trial that produced significant results. The amount of time working was positively correlated with the amount of time spent in the nest at r(38)= .333, p=.041.
- The nest building, defense scent and sound, and tunnel digging trials did not reveal any correlations.

References

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