# NoSeMaze dataset documentation

*Version 1.0, 24.05.2023*

## Description

Data from the NoSeMaze, collected in 2020/21.

* 10 groups à 10 mice
* 38 individual mice
* 20 mutant observations

Temporally aggregated (stable) behavioral features from different domains of the animal’s daily-life:

* hierarchy information based on integrated tube tests,
* reward perception and learning behavior based on an instrumental conditioning paradigm
* social interaction features based on video-monitoring of interactions in an open arena

## Aims

1. Identify a robust behavioral network: which features are associated within and across domains?
2. What are the effects of the mutant on the behavioral network and on the single behavioral features?
3. Are there longitudinal effects on the behavior based on the number of repetitions performed by an animal (e.g., learn animals faster in their second repetition than on the first one)?

## Feature documentation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Domain | Name | Definition | Comments | Histogram of feature |
| General information | Mouse\_RFID | Unique RFID tag of the individual |  |  |
| unique\_identifier | Unique numerical identifier of individual mouse based on Mouse\_RFID |  |  |
| Group | Group identifier. 10 mice participated per group and a total of 10 groups are included in this dataset | Group 9 only has 9 animals because one animal dropped out of the experiment |  |
| Repetition | Indicates the repetition index for this mouse, e.g. a repetition index of 2 means that this individual mouse has already participates in one other group before |  |  |
| fur\_pattern | For continuous video monitoring, the fur of mice was bleached with unique patterns to allow for individual recognition. Every number specifies a unique pattern. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\5_fur_pattern.png |
| Age | Age of mice in weeks upon start of the experiment. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\6_age.png |
| Mutant | Logical value if mouse is a genetic mutant. Mutant mice had a conditional knockout of the oxytocin receptor in the anterior olfactory nucleus. (WAHR=mutant; FALSCH=wildtype) |  |  |
| weight\_pre | Weight in grams at different timepoints. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\8_weight_pre.png |
| weight\_post |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\9_weight_post.png |
| weight\_diff |  |  |
| Hierarchy | rank\_by\_tube | Dominance rank based on tube encounters where dominant mice push out subordinates. Highest rank (1) = dominant mouse. Based on the David’s Score. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\11_rank_by_tube.png |
| DS\_by\_tube | David’s Score computes a dominance value based on wins and losses during tube test encounters. Higher values indicate a more dominant hierarchy position. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\12_DS_by_tube.png |
| rank\_by\_chasing | Chasing events through the tubes. Higher chasing rank (rank 1 is highest) indicates a preference for that mouse chasing other mice through the tube. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\13_rank_by_chasing.png |
| DS\_by\_chasing | David’s Score calculation applied to chasing through tubes. Higher David’s score values for chasing indicate a bias to that mouse chasing others. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\14_DS_by_chasing.png |
| chasing\_pc1 | The chasing network of each group is defined as the number of chases between animals (weighted, directed network). Network centrality measures were computed and the feature space was reduced using PCA. The first PC reflects chasing a lot. |  |  |
| chasing\_pc2 | This PC reflects being chased/followed by many animals. |  |  |
| Learning | log10(baseline\_rate\_mean) | Log transformed baseline lick rate (before odor onset) |  |  |
| cs\_plus\_detection\_speed | “Reaction speed of the mouse”: time to first bin in odor presentation window with lick rate > 0.5 Hz above baseline rate (binsize = 50 ms) |  |  |
| cs\_plus\_detection\_speed\_intraphase\_shaping | Do mice adapt their reaction time to CS+ within one phase (between two reversals)?  Ratio of the detection speed at the beginning and end of phase 3 (first 100 trials after switch to last 100 trials before reversal). Values >1 indicate faster reaction at end of phase. |  |  |
| cs\_plus\_detection\_speed\_crossreversal\_shaping | Do mice adapt their reaction time to CS+ across phases?  Ratio of the detection speed at the beginning and end of experiment (phase 3 versus phase 7). Values >1 indicate faster reaction at end of experiment. |  |  |
| cs\_plus\_pc1 | Lick-behavior based features in reaction to the CS+ were computed and the feature space was reduced with PCA. The first PC reflects the CS+ lick modulation in relation to baseline licking. |  |  |
| cs\_plus\_pc2 | The second PC reflects the ramping of the CS+ response. |  |  |
| cs\_minus\_pc1 | Lick-behavior based features in reaction to the CS- were computed and the feature space was reduced with PCA. The first and second PCs reflect aspects of the CS- lick response in relation to baseline licking. |  |  |
| cs\_minus\_pc2 |  |  |
| switching\_pc1 | Cognitive flexibility of mice: how long do they need to switch their behavioral response to the CS after reversal of reward contingencies? Switch latencies at different timepoints were computed and the feature space was reduced with PCA.  The first PC reflects CS+ switch latency.  The second PC reflects CS- switch latency.  Including the first 6 components to explain ~ 70% of the variance. |  |  |
| switching\_pc2 |  |  |
| switching\_pc3 |  |  |
| switching\_pc4 |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\28_switching_pc4.png |
| switching\_pc5 |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\29_switching_pc5.png |
| switching\_pc6 |  |  |
| shaping\_pc1 | How successful do mice adapt their licking-behavior cross-reversals (i.e., learn about the task structure and acquire a better model throughout the experiment?). The cross-reversal shaping features were reduced with PCA. The first PC reflects the shaping of the CS+ switch response from beginning to end of the experiment. |  |  |
| shaping\_pc2 | The second PC reflects the shaping of the CS+ response in the early phase of the experiment. |  |  |
| shaping\_pc3 | The third PC reflects the CS- switch latency shaping. |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\33_shaping_pc3.png |
| Social interaction | time\_in\_arena\_average | Mice were video-monitored when entering the open-field arena. The average of time spent in the arena (across days). | For 7/99 animal in specific groups in this dataset the videotracking did not work reliably and all social interaction and video-based features are missing (NaN values). |  |
| log10(corner\_to\_middle\_ratio\_average) | The open field was divided into 3 zones (corner, middle, and border). The ratio time spent in the corner or middle of the arena. |  |  |
| ratio\_social\_to\_total\_time\_average | The average proportion (across days) of time that mice spend in social interaction or alone in the arena. |  |  |
| social\_interaction\_pc1 | Social networks were constructed based   * on the number of interactions * the mean time * the summed time of interactions * proportion of time spent in interactions * the mean distance to the other animal during interactions * the number and proportion of approaches * the preference for certain individuals (half-weighted index).   Network centrality metrics were computed for these weighted (and partially directed) networks and the feature space was reduced using PCA.  The first PC reflects sociability.  The second PC reflects mostly approach behavior differences.  The third PC reflects mostly differences in distance during interactions.  The first 9 components explain >70% of the variance. |  |  |
| social\_interaction\_pc2 |  |  |
| social\_interaction\_pc3 |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\39_social_interaction_pc3.png |
| social\_interaction\_pc4 |  |  |
| social\_interaction\_pc5 |  | C:\Users\david.wolf\AppData\Local\Microsoft\Windows\INetCache\Content.Word\41_social_interaction_pc5.png |
| social\_interaction\_pc6 |  |  |
| social\_interaction\_pc7 |  |  |
| social\_interaction\_pc8 |  |  |
| social\_interaction\_pc9 |  |  |

## Dimensionality reduction of feature space using PCA

To reduce the number of predictors and to minimize redundancy between similar features, we performed dimensionality reduction using principle components analysis on the original feature space.

1. We grouped similar features together (e.g., all features describing the lick-frequency response to the CS+).
2. For every group of features separately:
   1. Skewed distributions were log-transformed. If features contained 0-values, min(data)/2 was added to every value before log-transformation.
   2. The values were zscored within feature.
   3. PCA of the matrix with dimensions: observations x features

## Glossary

* Feature
  + Original observation of a behavior, e.g. the baseline lick rate or the time spent in social interaction.
* Tube
  + The NoSeMaze has two main compartments (housing area with food access and open arena with access to the water port) connected by tubes. Mice can freely enter the tubes but only one mouse fits through the tube. If two mice enter the tube from opposing sides, one will have to retract and make way to the other one.
* Phase & reversal
  + Mice can obtain water in an instrumental learning paradigm. When entering the water port, one of two odors is presented to the mice (CS+ with 100% reward probability and CS- with 0%). Animals will receive a drop of water as reward if they respond to CS+ by licking >3 times during a response window. About every 3 days, the reward contingencies of CS+ and CS- switch, so that the previously rewarded odor becomes unrewarded and vice versa. There are 6 reversals, which results in 7 phases (between two reversals).