*Maybe we should mention somewhere that the only 2 mutant mice that did enter the sRC were ones for which we don’t have histology. We will never know, but I suspect the mutation was not strong.*

**Results last part:**

We have established earlier that mutants and WT are not distinguishable based on averaged descriptive features of social behavior. For example, they initiate a similar number of approaches, they have a similar social rank (on average), and spend a comparable amount of time interacting with other animals. To understand why mutants are unable to enter the stable rich club, it is necessary to study how they behave not on the global level of the whole experiment, but as a function of time. Indeed, in the same way as the stable rich club can only be determined by studying the evolution of the rich clubs as a function of time, the behavior of WT and mutants can only be deemed identical if both were to follow the similar trends in time.

We are here particularly interested in the fluctuations of the values of common network measurements as a function of time, since different fluctuation levels could explain the mutants’ inability to engage in stable relationships. To make these fluctuations more obvious and remove potential linear trends, we take the time derivative of the timeseries obtained from each measure as a function of time. Moreover, we wish to disentangle the effects of the mutants behavior themselves from the reaction of the rest of the network, so we focus here solely on the graphs obtained from approaches and separate each metric into its ingoing and outgoing variant. The results of this analysis are shown in FIG.   
  
The first thing that we notice is that the outgoing strength (i.e. total number of approaches initiated by an animal) fluctuates significantly more for mutants than for WT. This can be seen in FIG. C, where the derivative of the outstrength of a WT mouse and a mutant mouse from the same group are plotted against each other. While the mean value is the same for both mice, the mutant mouse shows considerably less stability than the WT one. This is corroborated by the fluctuation levels of out-degree (i.e. number of mice approached by an animal at a given time point) which are appreciably stronger for mutants than for WT. This also indicates that the results observed for out-strength cannot purely be attributed to potential changes of motivation in the mutants, as the value of the out degree does not depend on the overall number of approached performed in one day, but only on the number of mice which were approached.   
Outdegree and outstrength are not partner-specific measurements, i.e. they only measure the total number of approaches performed and total number of partners approached at a given time point. As such, they only allow to keep track of fluctuations on a somewhat global level and cannot describe how pairwise interactions between two specific partners are fluctuating. To account for potential pairwise fluctuation effects, **we draw inspiration from the field of temporal graphs** and propose ameasurement that we call the *persistence* to study how connections between two partners are preserved in time and define it as the number of preserved edges between two time steps (see FIG i). Since this definition already involves the comparison of differences between two succeeding timesteps, we do not take the derivative of the resulting timeseries. From this, we observe that mutants on average tend to form less persistent edges that WT, as can be seen in FIG. j where we compare the average persistence value of each animal as a function of its genotype. Taken together, these results suggest that the mutants initiate more erratic approaches than WT.   
  
So far, we have described how the approaches initiated by the mutants differ from those performed by WT mice. It is reasonable to assume that this more erratic behavior could evoke a different response from the network. To see if this is the case, we now turn our attention to the ingoing variants of the descriptive graph measurements. Looking at the time derivative of the in-strength (i.e. total number approaches towards an animal), we see that the mutants are associated with higher fluctuations than WT. The in-strength fluctuations are however not as strongly significant as they are for out-strength. A similar effect is observed for the in-degree (see supplement).   
In-strength and in-degree provide a good indication that WT mice on an individual level might react differently to mutants, but they do not provide a description of the structural response of the network as a whole (merely the sum of pairwise responses). In order to study this, we can turn out attention to measures of similarity (or in other words homogeneity). Arguably, the most intuitive ingoing measure of similarity between two nodes is given by the in-jaccard index. As shown in FIG L, it quantifies the ratio of common neighbors (shown in red) to the nodes to the total number of neighbors to either of the nodes. For a particular animal, if we sum its in-jaccard index with all other animals in the network, we obtain a measure indicating how similar or how homogeneous this animal is in its connectedness to the rest of the network. Analogously to the procedure we have followed so far, we can take the derivative of the summed in-jaccard index as a function of time to study how its value changes depending on the animals. Doing so, we observe that for mutants, the summed in-jaccard fluctuates significantly more than for WT. In other words, the “homogeneousness” of the mutants ingoing connectivity to the rest of the network fluctuates significantly more than is the case for WT mice.