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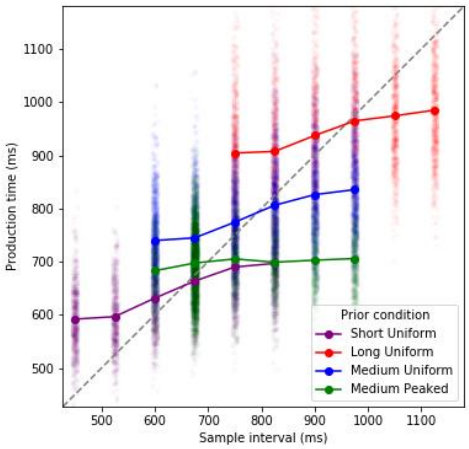
Final Project Part 1: Essay

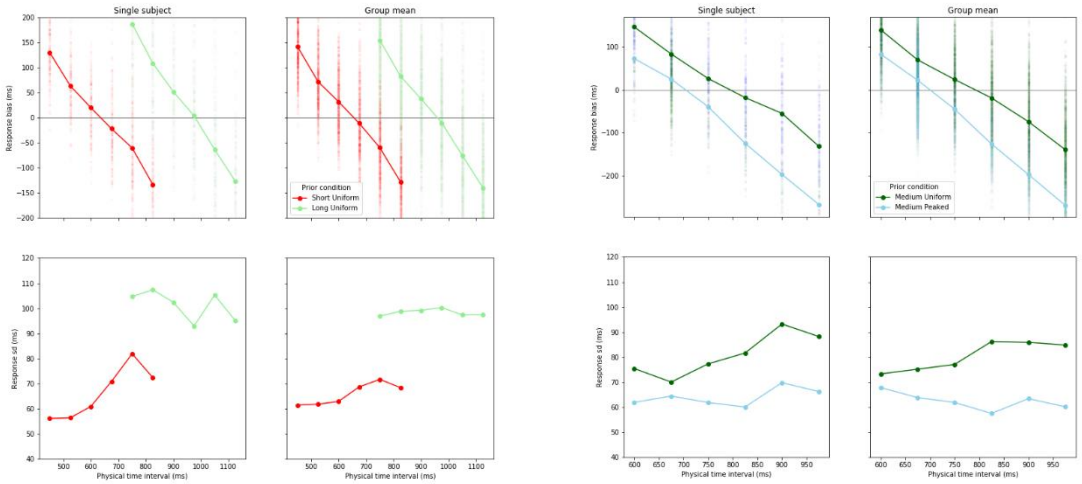
1. **How does your model work? Justify your modelling choices.**

For each condition per subject (block) a new model is assumed, because the time span between the different blocks is assumed to be very large, so that no interferences between the blocks occur. The individual sessions consist of 5 to 6 runs, each randomly between 84 and 96 trials. The sessions terminate as soon as the fractional change in MSE between two consecutive sessions is below 0.08, the last two being assumed to be test sessions. For the experiment timing and therefore also for the model timing, the times described in the paper are used or sampled or realistic educated guesses are used.

The interval is sampled from the respective block, perceived by the subject as integer pulses with rounding and a logistic noise, and stored in its cognitive model/brain (per block), generating an initial uncertainty. After a certain time, an attempt is made to retrieve this pulse, but previous perceived intervals or pulses influence the result. This is simulated by a blended trace, depending on the activation of the pulses, which in turn depends on the frequency of the perceived pulses and the respective time. Thus, a weighted average of the pulses perceived in the respective block is reproduced, which is recalculated in the brain with a logistic noise as an interval. Because of the logistic noise, higher retrieved intervals should also show a higher uncertainty. An additional uncertainty in the form of motor noise when clicking the mouse was not included in the modeling, since this can be assumed to be independent of the retrieved interval and thus too high noise at this point would have distorted the other effects. Likewise, the modeling of the feedback was omitted, since due to the blended trace the feedback would have been able to correct systematic too high or too low estimates, but could no longer be assigned to the individual intervals. However, systematic errors do not have to be corrected in this model, since the logistic noise is always centered on 0.

2. **Show the behaviour of the model in a set of figures similar to Figs 3 and 4 in Acerbi's paper.**





An almost linear decrease in the response bias and a linear increase in the absolute bias with increasing distance to the interval mean can be observed in both conditions for both experiments, i.e. low intervals are overestimated and higher ones underestimated per condition. Thus, there is a strong regression to the mean value of the condition. This effect is particularly strong for 'Peaked Uniform', where the more frequently presented interval is very strongly weighted in the blended trace. For the remaining conditions, in addition to the influence of the mean, the influence of the presented interval is still clearly evident from the increase in production time with increasing interval length. There is also, as expected, a higher value of the standard deviation for conditions with higher mean, caused by the logistic noise in the reproduction of the intervals. Within the conditions, however, at most a small increase in the standard deviations for longer intervals can be observed.

3. **Compare your model to Acerbi's findings. Are there differences in behaviour? If so, what may be the cause of these differences?**

The behaviour of the bias and the standard deviations are relatively similar in the simulated model to the results of Acerbi 2012. Tendencies were slightly higher biases simulated in the model than observed in the experiment, which is caused, for example, by a slightly too high weighting of the mean, i.e., in the final effect, a slightly too low weighting of the last considered interval in the calculation of the blended trace, and accordingly could be adjusted more precisely. Inaccuracies due to sampled and estimated values, as in the time course of the model, could also be a cause. Due to this somewhat stronger regression to the mean value and thus somewhat lower production times with lower logistic noise, the increase of the standard deviation within the condition is also a bit less recognizable than in the paper. The biggest difference, however, can be seen in the 'Medium Peaked', where the regression to the mean value is too strong and actually no increase of the production times with increasing interval length is recognizable. As a result, the standard deviation in the model is relatively uniform here, while it clearly increases in the paper. This can be explained by the fact that the blended trace only models the influence of the mean as a weighted average, but no skewness is modeled for non-uniform distributions. However, this is probably important, because for intervals further away from the mean, the uncertainty due to fewer observations per interval should also be taken into account. The data from the experiment indicate that there could be such an effect. All in all, however, the cognitive model gives results close to the true ones, especially for uniform distributions of the presented intervals.