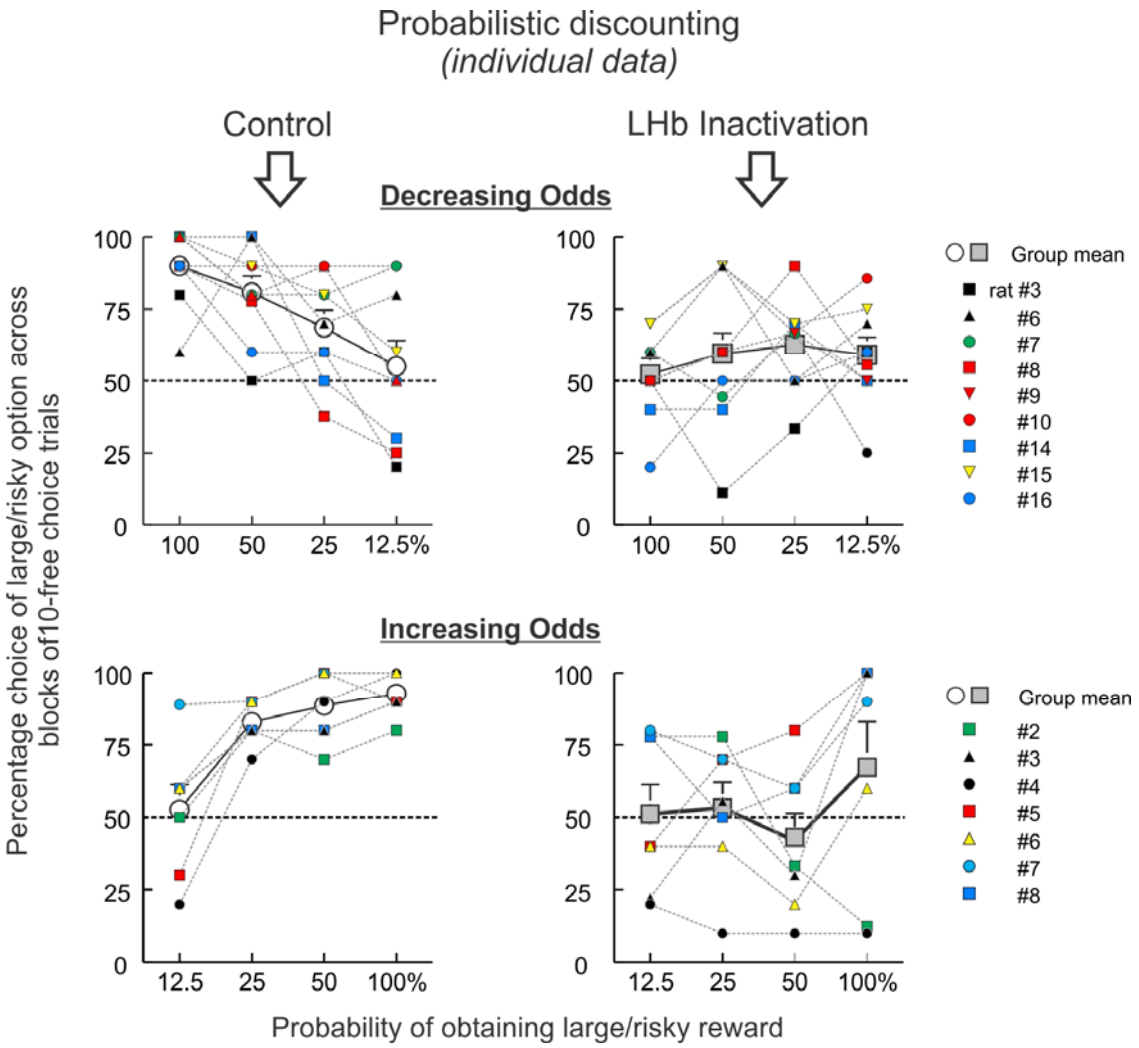
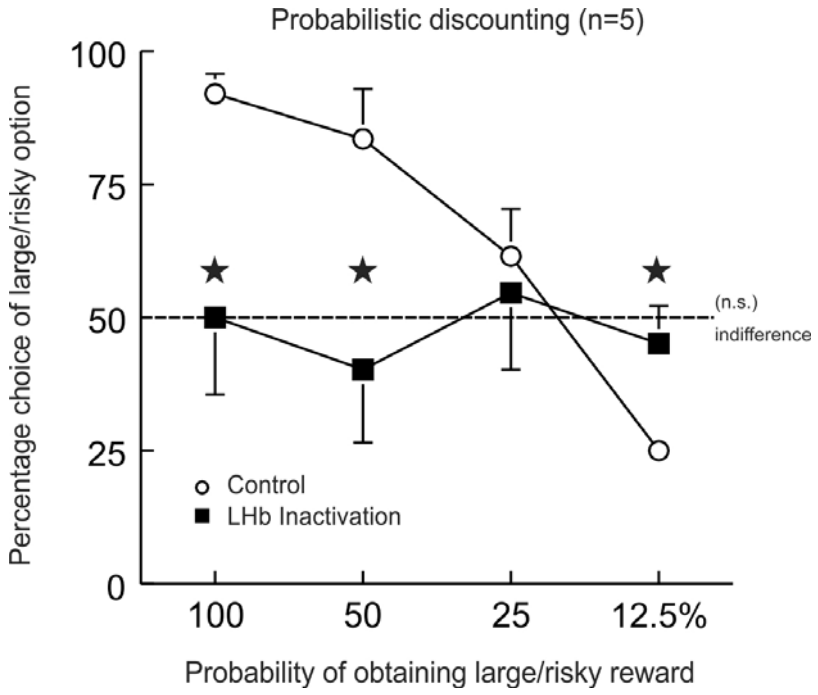
Supplementary Figures and Table
What's better for me? Fundamental role for lateral habenula in promoting subjective decision biases

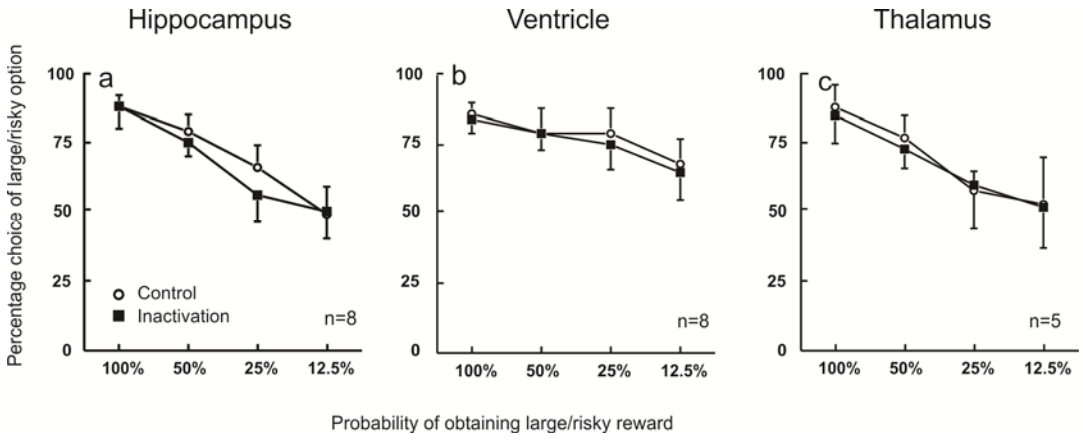
Colin M. Stopper and Stan B. Floresco



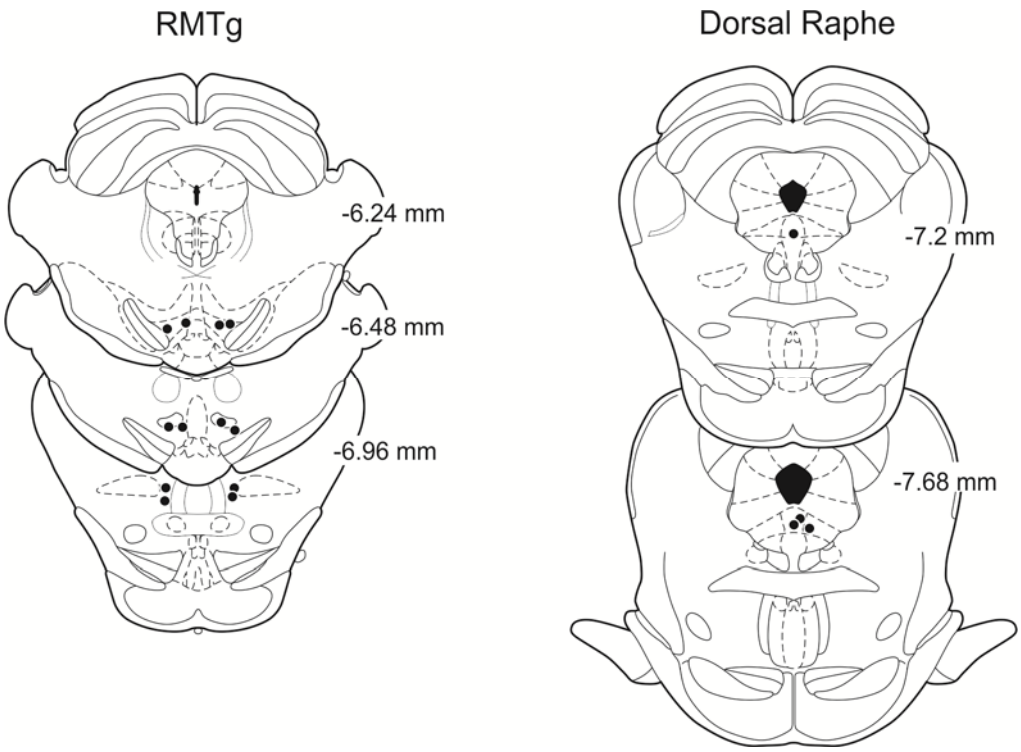
Supplementary Figure 1. Individual data from all rats tested on the probabilistic discounting task following LHb inactivation and control treatments. For clarity, the data have been separated based on treatment and the specific task variant. Under control conditions, all rats shifted their choice bias away or towards the large/risky option in a relatively consistent manner as the odds of obtaining the larger reward decreased or increased over the test session (white circles represent the group means +/- s.e.m.). In contrast, LHb inactivation caused rats to respond in a haphazard manner across blocks, so that when averaged across subjects (grey squares), choice behavior of the group did not differ from chance.



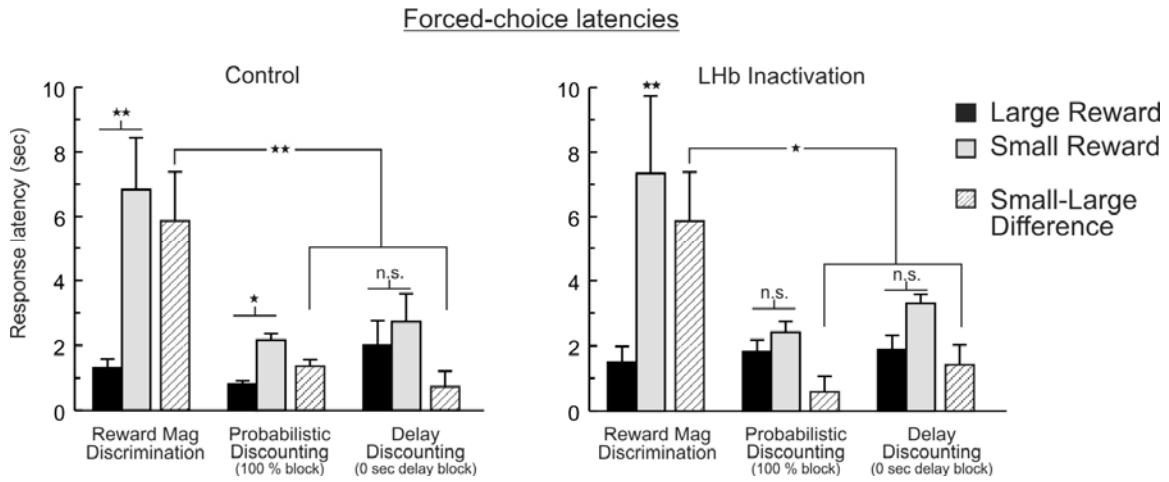
Supplementary Figure 2. LHb inactivation shifted choice towards indifference, irrespective of the direction of bias under control conditions. A separate analysis was performed on data obtained from a subset of animals tested on the probabilistic discounting task that displayed a strong bias towards the small/certain option during the 12.5% block (i.e., a bias away from the large/risky option) (*n*=5). LHb inactivation in this subset completely abolished any bias towards either option (treatment x block interaction, $F_{3,12}$=7.36, *P*=0.005), in a manner similar to the effects observed in the entire group. Moreover, LHb inactivation decreased choice of the large/risky option during 100-50% blocks, but at the same time, increased risky choice during the 12.5% block towards 50%. ★, *P*<0.05 versus control at a specific probability block.



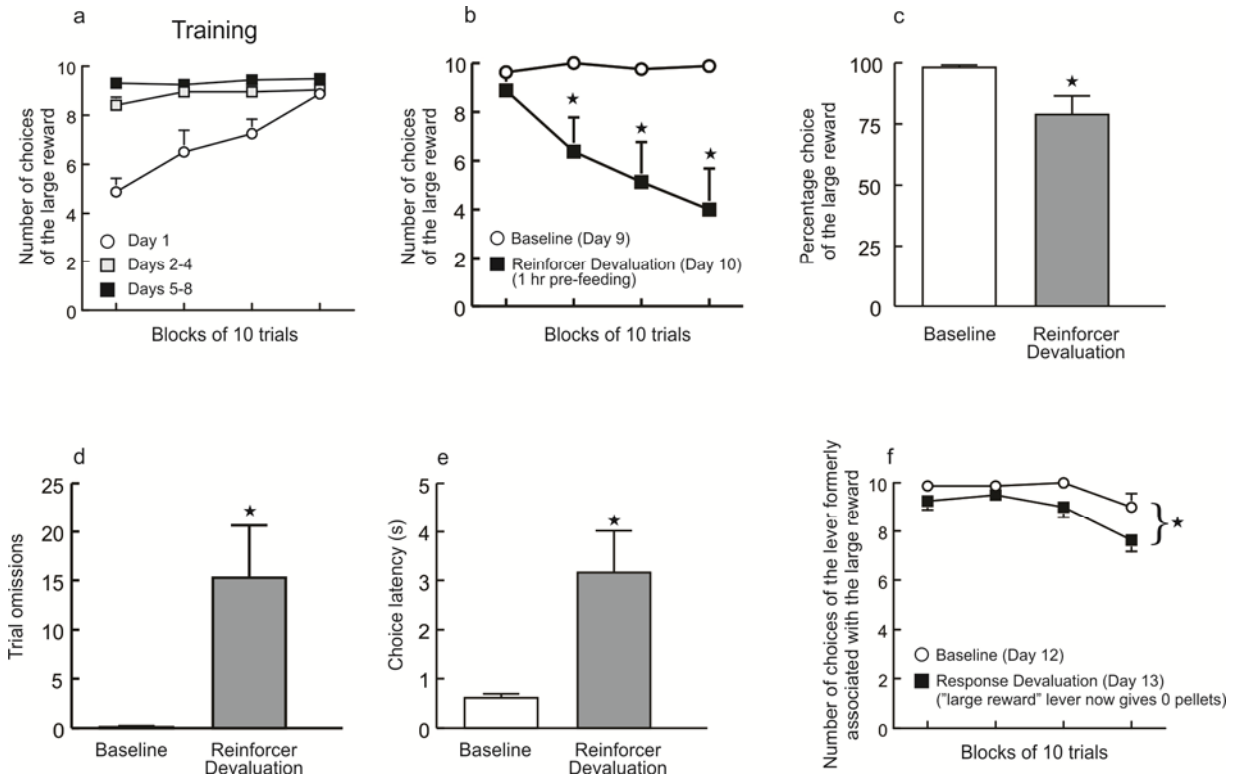
Supplementary Figure 3. Inactivation of regions adjacent to the LHb does not affect decision making. Rats with placements located dorsal to the LHb within the (**a)** hippocampus, (**b)** adjacent to the ventricle or (**c**) ventral to the LHb in the thalamus showed no differences in choice on the probabilistic discounting task following either inactivation or control treatments (main effects of treatment, hippocampus: $F_{1,7}$=0.79, P=0.40; thalamus: $F_{1,4}$=0.5, P=0.84; ventricle: $F_{1,7}$=0.19, P=0.67).



Supplementary Figure 4. Location of acceptable infusion placements within the RMTg and dorsal raphe nucleus. Numbers correspond to mm from bregma.



Supplementary Figure 5. Comparison of forced choice latencies during cost/benefit decision making versus reward magnitude discrimination. We analyzed response latencies to select the large and small reward on the forced-choice trials for rats trained on the reward magnitude discrimination and compared them to large and small reward forced-choice latencies displayed by rats performing the discounting tasks during the 100%/0-sec delay blocks. If the larger reward was perceived as considerably "better" than the smaller one, rats should display faster response latencies when forced to choose the larger reward. Conversely, if the two options were perceived as more comparable (even during the 100% or 0 sec delay blocks), the difference in response latencies should be diminished. Displayed are response latencies to press the large (black bars) or small reward lever (grey bars) after saline infusions (left) and after inactivation of the LHb (right) for rats trained on the reward magnitude discrimination, probabilistic discounting or delay discounting tasks (hatched bars represent the difference between latencies). Under control conditions, rats trained on the discounting tasks showed a smaller or no difference in latencies to press the larger vs. smaller reward lever, compared to the large difference in latencies displayed by rats trained on the simpler magnitude discrimination (Task x Reward Lever interaction ($F_{2,24}$=6.90, P=0.004). Furthermore, following LHb inactivation, there were no differences in latencies to respond on the larger vs smaller reward lever on the discounting tasks, but rats trained on the magnitude task continued to display a prominent difference on this measure (Task x Lever interaction, $F_{2,24}$=5.53, P=0.011). ★, ★★ denotes p<0.05, <0.001; n.s.- not significant.



Supplementary Figure 6. Choice behavior during reward magnitude discrimination is under goal-directed control. A separate group of rats was trained on the reward magnitude discrimination task in a manner identical to rats that received LHb inactivation. (**a**) Choice data over the first 8 days of training show the emergence of a preference for the larger reward option. On day 10 of training, rats were given a reinforcer devaluation test. One hour prior to the test session, rats received *ad libitum* access to the sweetened reward pellets in their home cages. (**b**) During the reinforcer devaluation test, rats made fewer choices of the large reward option, relative to baseline performance on the preceding day (Main effect of treatment, $F_{1,7}$=8.78, *P*=0.021; treatment x block interaction, $F_{3,21}$=4.72, *P* =0.011). (**c**) When factoring out trial omissions, devaluation reduced the proportion of completed trials where rats selected the large reward (t_7=2.51, *P*=0.04). (**d**) Trial omissions (t_7=2.82, *P*=0.026) and (**e**) choice latencies (t_7=3.10, *P*=0.017) were increased following reinforcer devaluation. Following this first test, rats were retrained for two additional days on the task under standard food restriction, after which they again were selecting the large reward on nearly every free-choice trial. On the following day, rats received a response devaluation test during which responding on the large reward lever no longer delivered reward (although selecting the other lever still yielded 1 reward pellet). (**f**) This response devaluation caused rats to make fewer choices of the lever formerly associated with the larger reward. (Main effect of treatment, $F_{1,7}$=16.00, *P*=0.005). These results indicate that choice behavior during the reward magnitude discrimination is unlikely to be under automatic, habitual control. ★ denotes $p<0.05$ vs baseline.

Supplementary Table 1. Choice latencies and trial omission data from the reward magnitude discrimination experiment. Values represent means +/- s.e.m.

	Control	LHb Inactivation
Choice latency (sec)	1.17 (+/-0.2)	1.0 (+/-0.3)
Trial Omissions (out of a maximum of 48)	2.0 (+/-2.0)	0.4 (+/-0.2)