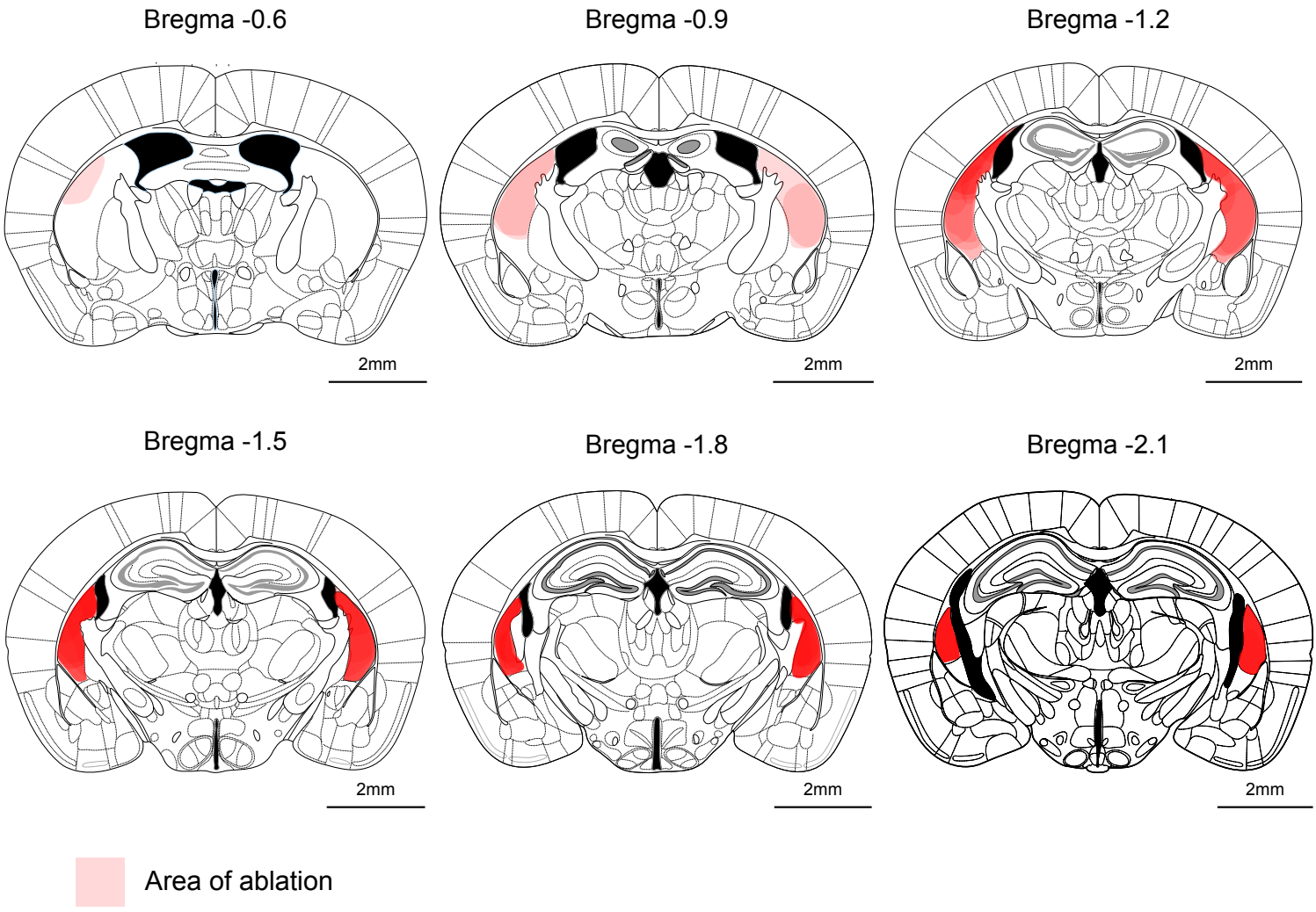

Figure S1. Summary of extent of TS-dopamine axon ablations, Related to Figure 4

Extent of bilateral ablations of dopamine axons with 6OHDA examined by immunohistochemistry with anti-tyrosine hydroxylase (TH) antibody. Ablation areas are marked with red shading, with overlapping shading from ablation mice (n=17). More densely overlapping areas have redder shading. Reference slices are depicted with 0.3 mm spacing (Paxinos and Franklin, 2019).

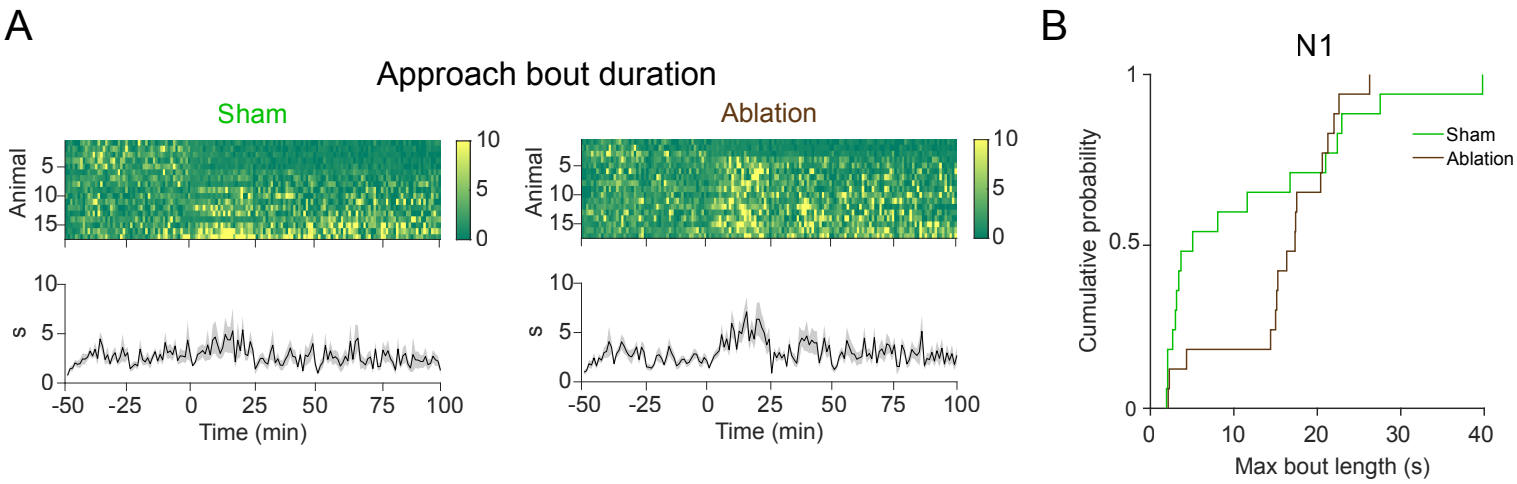

Figure S2. Ablation of TS-projecting dopamine neurons causes an increase in approach bout duration, Related to Figure 4

A. Top: Duration of approach bouts in sham mice (left) or TS dopamine neurons ablation mice (right). Ablation mice tend to exhibit longer bouts, especially on the first day of novelty. **B**. Cumulative probability of each group exhibiting different maximum bout lengths. Dopamine ablation causes maximum bout lengths to increase ($p=0.030$, $n=17$ for sham, $n=17$ for ablation, Kolmogorov-Smirnov [K-S] test).

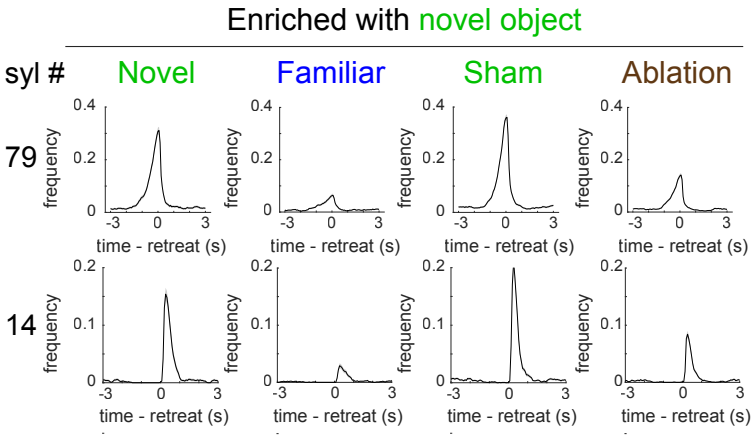

Figure S3. Distinct behavioral patterns in different experimental conditions were revealed with MoSeq, Related to Figure 5

Fraction of retreat-aligned syllable usage for syllables that were significantly enriched with novel object (mean ± SEM).

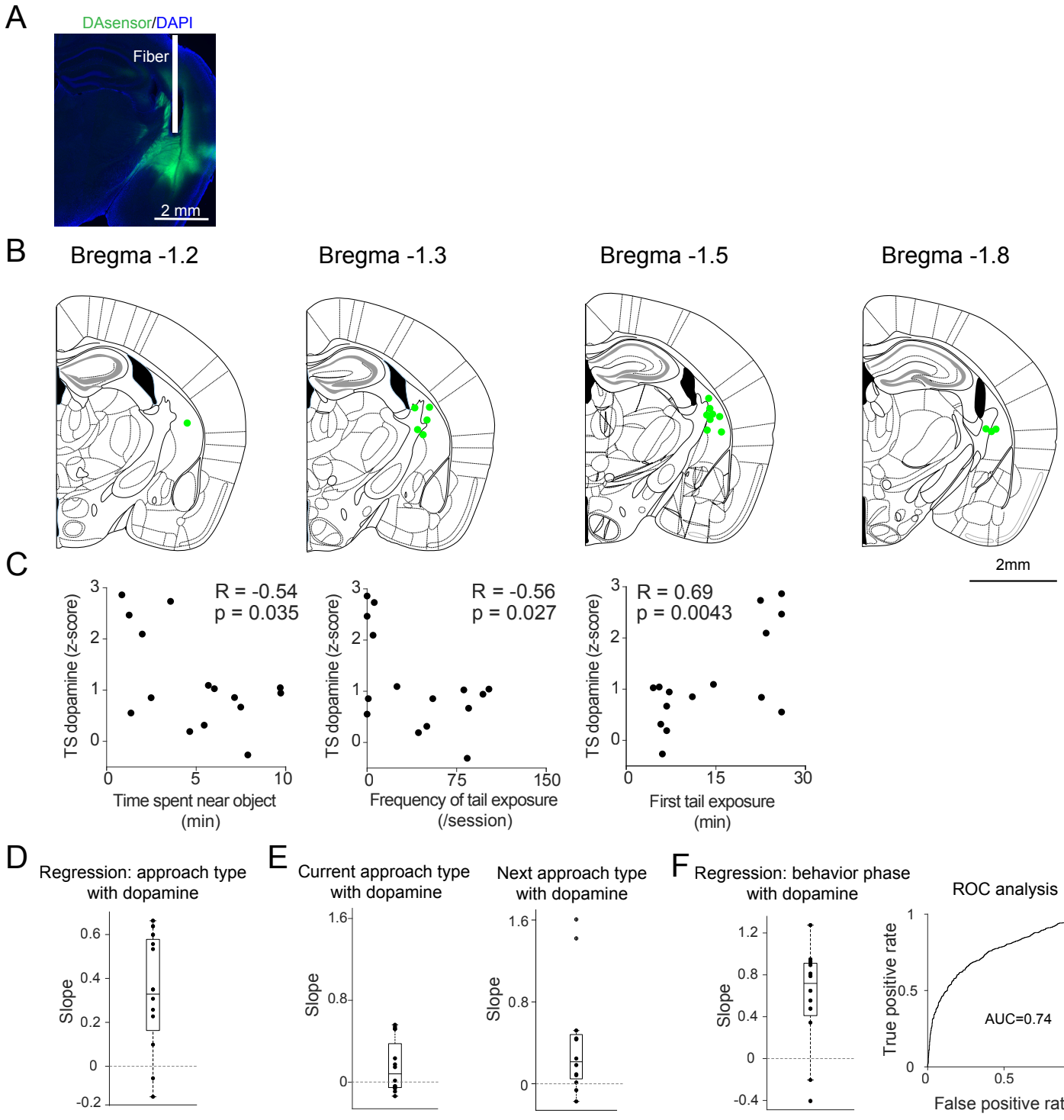

Figure S4. TS dopamine activity was correlated with individual variability in engagement, Related to Figure 6

A. Example recording site of dopamine axons (DA sensor expression in green, DAPI in blue). **B**. Location of optic fiber tips used to collect dopamine sensor signals in TS. Fiber tip positions are plotted on the nearest reference slice (Paxinos and Franklin, 2019). Light emitted by neurons directly below these sites could be detected with photometry. **C**. Average dopamine signal in the first 50 trials of each animal plotted against time spent near the object (second from left), frequency of tail exposure (second from right), or time of first tail exposure in session (far right). First tail exposure for mice that never showed tail exposure (3 animals) was set to 25min, the last time point. Pearson's correlation coefficient. **D**. Beta coefficients for regression of dopamine signal with current approach type (p=0.0034). **E**. Beta coefficients for regression of dopamine signal with trial number and current (left) and next (right) approach type (current, p=0.068, next, p=0.031, t-test compared to 0). **F**. Left, beta coefficients for regression of dopamine signal with behavioral phase (p=0.0034, t-test with 0, n=12). Right, receiver operating characteristic (ROC) curve evaluating performance of classification of behavior phase with dopamine activity (AUC = 0.74).

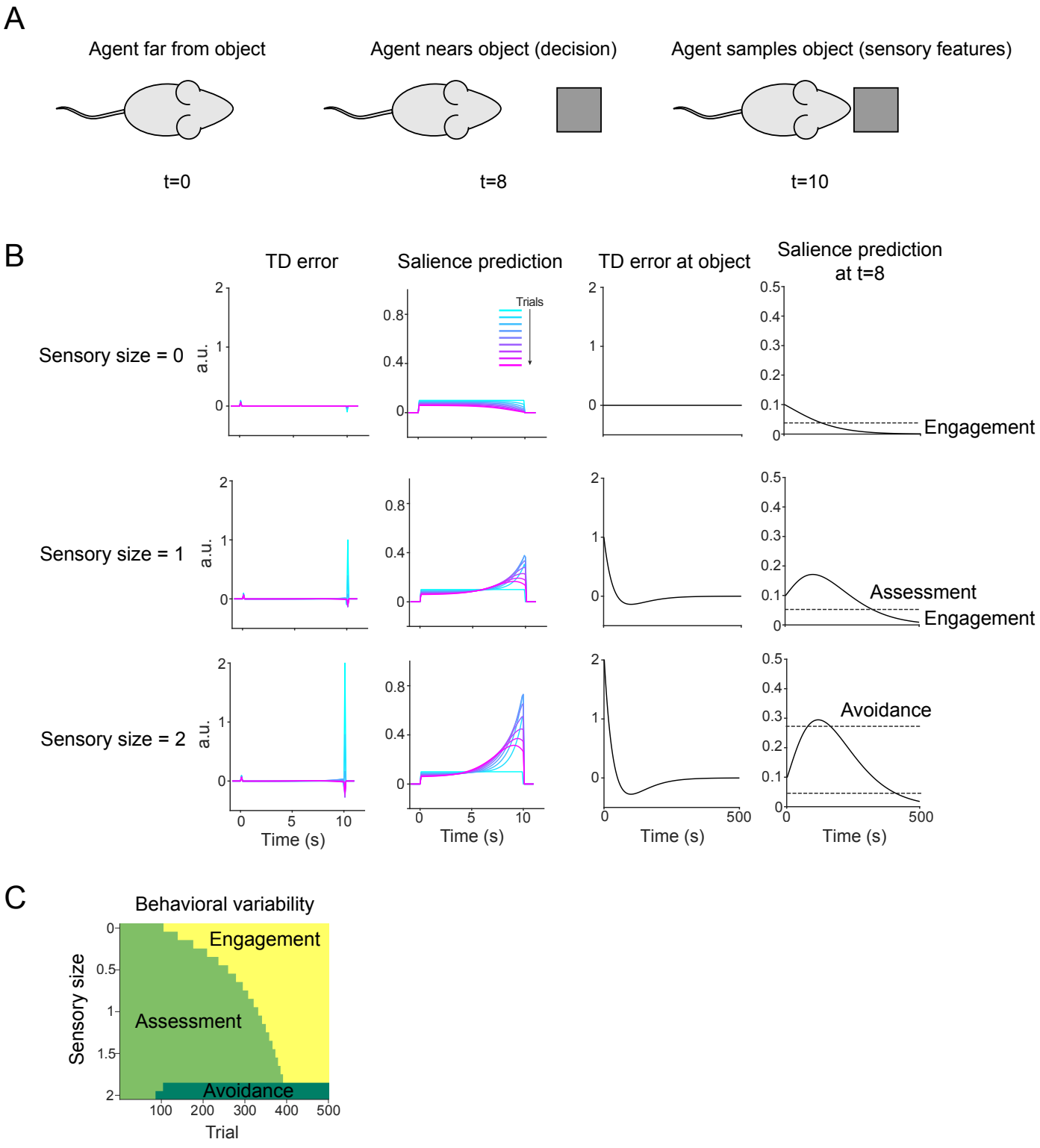

Figure S5. Reinforcement learning model for prediction of sensory prediction error, Related to Figure 8

A. Similar bout structure to Figure 7, but agent observes sensory features. **B**. TD learning model that learns prediction of sensory prediction error (here called "salience"). The unexpected sensory features initially create TD error at the object location (first column from left, cyan), which in turn reinforces salience prediction near the object (second column from left, t=8). TD error at object (t=10) starts out high, but decreases across trials since salience becomes more predictable (third column). Salience prediction near object (t=8) gradually increases at first, and then gradually decreases to 0 (fourth column). Color, trial 1-161, every 20 trials. **C**. Development of behavior based on different degrees of sensory size for novel object. Low sensitivity to sensory stimulus (sensory size=0) results in early transition from risk assessment to engagement, whereas high sensitivity (sensory size=2) results in transition to avoidance. Intermediate shaping bonus leads to prolonged risk assessment.

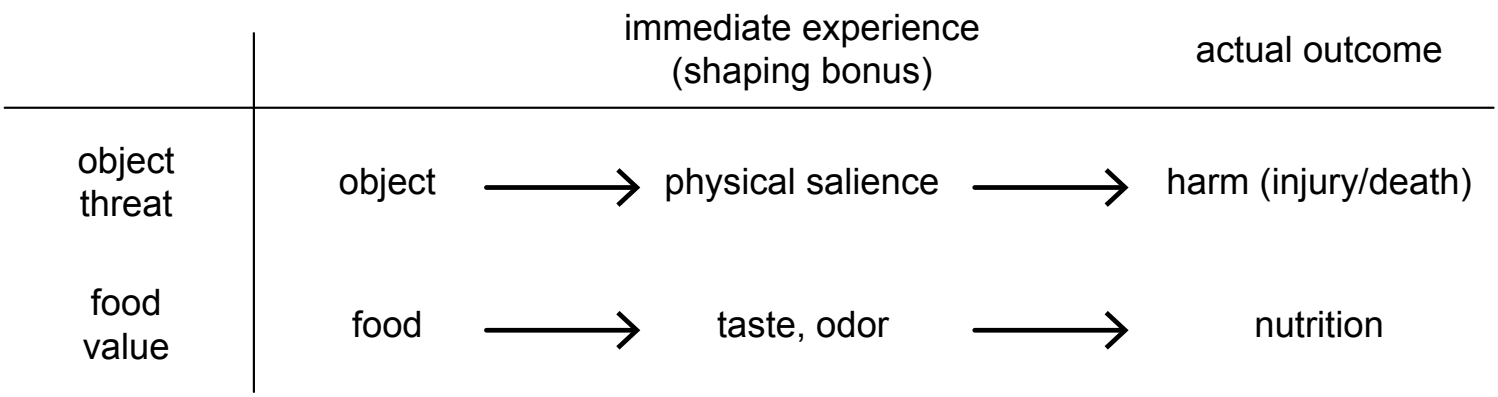

Figure S6. Use of immediate experiences as a preliminary estimation of the actual outcome, Related to Figure 8

Comparison of sequence of events following encounters with food or object. Top row: Sequence of events for threat prediction. Animals may use physical salience to estimate actual harm in the future. Bottom row: Sequence of events for food value prediction. Animals may use taste or odor to estimate nutritional benefit or detriment. Shaping bonus models the estimation at time of immediate experience, before an animal has experienced the actual outcome.