**Electronic Supplemental Material Methods**

*Testing room*

The first four behavioral experiments were conducted in the same testing room (218×373×263 cm) used in our laboratory's previous behavioral experiments [38,37]. Briefly, the testing room was adjacent to the bird housing rooms and birds were allowed into the testing room via trap doors and light manipulation [42]. Within the testing room there were four artificial trees (just trunks) each containing 20 perches with corresponding cache sites distributed equidistantly along the height of the tree (see S1 for testing room details). Each tree also had a top and a base, which the birds frequently landed on. The room also contained 12 perching blocks (9.01×4.5×4.0 cm; 6 on each of the shorter walls, evenly spaced) with one cache site each, making for a total of 100 intended perching and caching sites. Each cache site could be closed via a knotted white string that had to be removed to inspect the content of the site. Both of the longer walls had a one-way window through which all birds were observed.

*Novel environment exploration*

 All birds were naïve to the testing room prior to the novel environment exploration experiment, which began in early December 2014 and followed the same procedures as in [37]. Testing began one hour after lights on and ran over the following two hours each morning until all birds were tested. Each bird was tested individually for a period of 30 minutes and the number of macro-substrates (i.e. the trees, the walls and the floor), the number of micro-substrates (i.e. the perches, planters and tree tops) used by the birds, and the number of flights were recorded by DYK observing through the one-way window. In addition to the intended perching substrates there were incidental perching substrates that were also counted toward micro-substrate totals. Such incidental substrates included door hinges, door stoppers, hinges for the trap door that allowed birds into the testing room and the alcove through which the bird entered the room. The number of new macro- and micro-substrates used by each individual were recorded cumulatively in 2-min blocks during the first ten minutes of the trial. This protocol took into account that the number of substrates were limited and expected to plateau as the trial continued. The number of flights (which included landing on the same substrates) were recorded cumulatively in 2-min blocks over the entire thirty minutes of the trial, as these measures are not limited by the number of substrates. Birds were returned to their cages via light manipulation after 30 minutes in the testing room.

*Response to novelty*

 We tested response to novelty (e.g.neophobia) in each individual’s home cage using an A-B-A design (same protocol used in [39,36]). Individuals were food deprived for one hour prior to lights off and two hours the next morning following lights on before testing. All trials were video recorded. In the pre- and post-trial a familiar white feeder was placed on the floor of the home cage baited with a waxworm. During the neophobia trial the white feeder was replaced by one of four randomly assigned colored feeders with spokes (lime green, orange, pale pink or dark pink; Fig. 2 in [36]). The three trials occurred over three consecutive days (one per day). Trials ended when an individual took the waxworm or after thirty minutes. Latency to touch the feeder, land on the feeder, and take the waxworm from the feeder was scored from videos by DYK.

*Problem-solving*

 Problem-solving trials were conducted in the homecage using a waxworm-baited upside-down test tube plugged with a cotton ball and clipped to the front of each bird’s cage following our previous protocols (Fig. 1 in [36]). Chickadees could see the waxworm, but in order to solve the problem the birds had to pull the cotton plug to let the waxworm drop to the cage floor where it could be retrieved. Problem-solving trials were conducted without food deprivation as the purpose of the experiment was to test how birds spontaneously solve a problem when faced with a highly valued food item. Each trial lasted 1 h and trials were conducted twice per day (one approx. one hour after lights on and one at approx.1400). All trials were separated by at least four hours. Ten trials were given to all birds and an additional ten trials were given to individuals that failed to solve the problem during the first ten trials. All trials were video recorded. DYK recorded latency to first interact with the apparatus, the trial in which a bird first solved the problem, and how long it took a bird to solve the problem on the first and second trial in which it was solved.

*Caching rates*

Caching experiment methods generally followed [38]. Prior to the actual caching experiment, birds were given three hour-long habituation periods (once every third day) in the testing room (excluding the half hour period during the novel environment exploration experiment). Birds were food deprived for one hour prior to lights off the previous day and for one hour the next morning prior to beginning the caching trials. Each chickadee was given four trials, each separated by three days. Daily trial order was randomly assigned using a random number generator. Chickadees were provided with pine seeds, crushed peanuts and sunflower seeds (with and without the shell) in two bowls on either side of the testing room. Chickadees were allowed to cache for twenty minutes during which DYK or EAW recorded what was eaten, what was cached and where an item was cached. Additionally, we recorded the number of false caches (when a chickadee had a food item in its beak and stuck its beak in a cache site but did not cache the item in that location) and the number of re-caches (when a chickadee cached a food item and then removed it and cached the item in a new cache location). All food was removed from cached sites and the floor between trials. Each chickadee was given four trials, each separated by three days. The number of caches was averaged over the four trials.

*One-trial associative learning task*

 A one-trial associative spatial learning task was conducted in the testing room using similar methods to those in [38]. Birds were food deprived one hour before lights off and two hours after lights on the following morning, when trials began. A randomly chosen cache site (of 100 available sites) was baited with a waxworm and all cache sites were in the open position (knotted string not covering the cache). During the pre-trial, each bird was allowed into the testing chamber and the trial concluded when the bird pecked at the worm. The lights were immediately shut off by the experimenter (either DYK or EAW) and the chickadee was not allowed to eat the waxworm. Chickadees were returned to their cages for a 20 min retention interval, after which the birds were allowed back into the testing room with all cache sites closed by the knotted string. The trial lasted until a bird found the baited cache or thirty minutes elapsed. The number and location of each incorrect cache site opened was recorded. Only trials where a chickadee was successful in finding the waxworm were counted. Each chickadee received four trials (one every fourth day) each one with a unique cache site. For those birds that never found the waxworm, a fifth and final trial was conducted. Performance was averaged over all successful trials.

*Repeated associative learning task*

 A repeated associative spatial learning task followed similar protocol as in [38]. Each bird had a randomly chosen unique cache site (never the same cache site used in the one-trial experiment), which was openly baited with a waxworm and remained constant throughout the experiment. Every chickadee was given three pre-trials where all cache sites were open and in these three trials a chickadee was allowed to find and eat the waxworm (all birds rapidly found and ate the waxworm). Each chickadee received these trials and the subsequent repeated association trials every other day. During the repeated associative learning trials, chickadees were allowed into the testing room with all cache locations closed and their unique cache site containing a waxworm. Trials lasted 25 min or until the chickadee opened the correct cache site and ate the waxworm. Once an individual found the worm they were given an additional 5 min to eat the worm undisturbed before being returned to their cage. DYK or EAW recorded all incorrect cache sites a bird opened until it found the rewarded site. If an individual did not find the reward in a 25 min trial that trial ended and was not considered its first trial (this occurred with two birds). Nine trials were conducted followed by a 10th long-term retention trial (that occurred seventeen days after the 9th trial).

*Brain Histology*

 Following all behavioral experiments chickadees were anaesthetized with an overdose of Nembutal© and their brains were prepared for histological analysis using our laboratory’s well-established protocols [38,43,40,41]. Chickadees had their brains removed following a transcardial perfusion with 10 minutes of 0.1 M phosphate-buffer solution, then 15 minutes of 4% paraformaldehyde phosphate-buffer solution. Following brain removal gonadal inspection of the abdominal cavity for each bird was conducted to determine sex. Brains were put through a series of post-fixation solutions starting with a 4% paraformaldehyde solution for a week then two sucrose solutions until the brains sank (15% and 30% sucrose, respectively). The brains were then flash frozen in dry ice and stored in a -80°C freezer. Brains were sectioned at 40 µm sections with a Leica c 3050s cryostat and every 4th section was mounted for Nissl staining. The remaining sections were placed in cryoprotectant and stored in a -80°C freezer. Every 12th Nissl stained section was used for estimating hippocampus volume and neuron numbers. Additionally, every 16th section was used for estimating telencephalon volume (a measure that is highly correlated to overall brain size in chickadees [31,34]) using Stereo Investigator software and a Leica microscope fitted with a camera and connected to a computer. DYK measured the telencephalon and hippocampus blind to the site of origin for all brains using a Cavalieri estimator with a grid size of 1200 mm and 200 mm, respectively, following our laboratory protocols [38,41]. The total number of neurons was estimated using the Optical Fractionator method with a 250mm grid, a 30x30 mm counting frame, a 5mm dissector height and a 1mm guard following our previous work [44]. Brain cells were classified as neurons based on the following features: 1) having 1 or 2 dark stained nucleoli, 2) containing nucleoplasm, and 3) having dendrites projecting from the neuron soma. The two brain hemispheres were measured independently and summed together for the overall estimate.