For the experiments described in figure S1, we used two additional Wistar rats in the same weight and age group as the rats in the main experiment. Rat were trained on the same task, and implanted with a modified microdrive holding a 32-site linear silicon probe (NeuroNexusTech, Ann Arbor, MI, USA) with 1250μm² circular sites spaced 100 μm. We calculated the fluctuation of theta power per site as a function of time around reward delivery by calculating the baseline-corrected power of the LFP, filtered between 4-12 Hz, in 500 ms time windows in time steps of 50 ms. Next, we averaged z-scored power modulations, determined relative to baseline theta power during the inter-trial interval, across the number of reward delivery events to obtain an average time-site representation of theta power for a given event (fig. S1A).

One-dimensional current source density (CSD) of the 4-12 Hz band-pass filtered LFP traces was calculated per event (fig. S1B), using the formula

$$CSD(z) = \left[ \frac{2\phi(z) - \phi(z + \Delta z) - \phi(z - \Delta z)}{(\Delta z)^2} \right] \sigma(z)$$ (1)

where CSD(z) is the current source density at depth z, in arbitrary units, φ(z) is the recorded LFP at depth z, Δz is the depth interval (200 microns, because only every other site was used to construct the CSD) and σ(z) is the conductivity in the z-direction, assumed constant.
Histology

After the final recording session, current (25 μA for 10 seconds) was passed through one lead per tetrode to mark the endpoint of the tetrode with a small lesion. The animals were deeply anesthetized with Nembutal (sodium pentobarbital, 60 mg/ml, 0.9 ml i.p.; Ceva Sante Animale, Maassluis, the Netherlands) and transcardially perfused with a 0.9% NaCl solution, followed by a 4% paraformaldehyde solution (pH 7.4 phosphate buffered). Following immersion fixation, coronal sections of 40 μm were cut using a vibratome and stained with Cresyl Violet to reconstruct tetrode tracks and localize the endpoints. Histological verification of the tetrode endpoints and recording tracks showed that all recordings were performed between 3.2 and 4.2 mm anterior of bregma and confined to the ventral and lateral aspects of the OFC (fig. S1C-E).

Legend Fig. S1: Current source density (CSD) analysis and histology. (A) Modulation of theta power (bandpass filtered 4-12 Hz) by recording site on a linear silicon probe. Time is synchronized on reward delivery. Pseudocolors show z-scored modulation of theta power compared to inter-trial interval theta power, averaged over N=31 reward deliveries. White traces show LFP traces (filtered 1-475 Hz) from two sites, corresponding to maxima from CSD plot. Red lines show alignment of peaks and troughs between example traces. (B) Current source density analysis of a representative reward delivery event. Sources and sinks are depicted in pseudocolor (arbitrary units). Black traces depict filtered LFP (4-12 Hz) from 16 recording sites. (C) Brain section with part of the silicon probe in place. Purple box outlines the area from which (A) and (B) were obtained. In black, raw traces of part of the trial depicted in (B) show that sinks and
Fig. S2: Classification of neurons according to behavioral correlates of firing rate.

Behavioral correlates of firing-rate changes were assessed by constructing peri-event time histograms (PETHs) synchronized on task events (i.e., on- and offset of odor sampling, fluid well entry, reward delivery). Firing rates in time bins (100 ms) around the event of interest were each compared against firing rates in 5 control bins from the ITI on a trial-by-trial basis to exclude within-session drift of firing rate as confounding factor and tested for significance using the non-parametric Wilcoxon’s matched-pairs signed-rank (WMPSR) test (p<0.01). Binned firing rates were considered significantly modulated in relation to the task event only if the test bin of interest differed significantly from all 5 baseline bins (van Duuren et al., 2007). Cells were classified into four categories based on the task period in which they exhibited significant firing-rate changes (for odor sampling: change in relation to odor onset and during odor delivery; movement: change after odor offset but before fluid poke onset; waiting: change after fluid poke onset but before outcome; outcome: change following application of sucrose or quinine solution, fig 1). See table 1 for the distribution of neurons across categories and examples of units in each category.
Legend Fig. S2: Classification of neurons according to behavioral correlates of firing rate. Peri-event time histograms of units from four different classes. Panels show rasterplots (bottom) and average firing rate (top) in 100 ms bins for the same unit, split for Hit (left) and False Alarm (right) trials, aligned to the event in the top left corner. Blue and magenta lines signify mean firing rate during the inter-trial interval period and time of reversal, respectively. Red line indicates bins with firing rates significantly different from inter-trial interval (p<0.01 Wilcoxon’s matched-pairs signed-rank test).

**Fig. S3: Theta-band phase-locking and oscillatory spiking activity of OFC multi-unit activity.**

*Spike-MUA phase-locking*

To investigate whether theta-band rhythmicity is also present in the local spiking activity per se, we used the high-pass filtered (600-6000 Hz) multi-unit spike train (as a point process) instead of the LFP to form spike-MUA pairs and calculate phase-locking of units. Artifacts were deleted from the multi-unit activity by a template-matching algorithm incorporated in the MClust software and, as in spike-LFP analyses, we only used the multi-unit activity from the electrodes on which our unit was not recorded. Spike-phaselocking was now calculated using equations (1-3), except that the signal $x_i(t)$ now represents the multi-unit spiking activity instead of the LFP. Again, we found spectrally specific phase-locking during the waiting period that was significantly higher in the waiting period before sucrose delivery, compared to the waiting period before quinine delivery ($P < 0.01$ WMPSR, fig S3A). As predicted from earlier literature
(Zeitler et al., 2006), the obtained spike-MUA phase-locking values were much lower than the spike-LFP phase-locking values. This is because we measure population phase from a very sparse sample (only the spiking output of the neurons around the electrode) of the actual population activity.

**Lumped time-resolved autocorrelograms**

We combined the spike trains of isolated single units from each tetrode in composite multi-unit signals (cMUAs) to assess the rhythmicity of the locally recorded spikes. To this effect, we computed autocorrelograms of the spike trains of these cMUAs restricted to a behavioral period by entering only spikes recorded in that period as the triggers for the autocorrelogram. The analysis was restricted to those cMUAs constructed from at least 2 isolated single units, with $N > 600$ spikes in each behavioral period that was considered (sucrose waiting period, quinine waiting period, inter-trial interval), yielding $N = 47$ eligible cMUAs. The autocorrelograms were constructed using bins of 10 ms, extending 500 ms in either direction of time lag zero (see fig. S3B). For comparison, the autocorrelograms were normalized to an area of 1. Next, we computed power spectra of the Fourier-transformed autocorrelograms for each cMUA and compared these across behavioral conditions (fig. S3C). A group analysis revealed significantly higher theta-band rhythmicity in the waiting period before sucrose compared to both the waiting period before quinine and the inter-trial interval (fig. S3D).

Legend Fig. S3: Theta-band phase-locking and oscillatory spiking activity of OFC multi-unit activity. (A) spike-MUA phase-locking spectra during the sucrose waiting period
(green) and quinine waiting period (red). Shading indicates 95% confidence intervals; Grey bar indicates significant difference (p<0.01, WMPSR test). (B) Two examples (Ex.1 and Ex. 2) of time-resolved normalized autocorrelograms (binsize: 10 ms) of cMUAs, recorded from different rats, for spikes restricted to the sucrose waiting period (green), quinine waiting period (red) or inter-trial interval (black). Dashed blue line corresponds to uniform distribution of spike counts per bin. (C) Powerspectra of the Fourier-transformed examples from (B). Because the autocorrelograms were normalized to have equal power, the power spectra can be directly compared. (D) Group analysis of the theta-band oscillatory power in the cMUA autocorrelograms (N=47). *: p<0.05, one-tailed \textit{t-test}, tested at 5 Hz.

**Fig. S4:** Frequency of licking responses and spike-field phase-locking are dissociated.

When the animals inserted their head in the liquid reinforcer station, these entries were registered by photobeam interruptions and stored on a computer dedicated to behavioral data acquisition. When the animals next entered the fluid well, licking responses were detected by a separate photobeam situated within the fluid well.

Legend Fig. S4: Frequency of lick responses and spike-field phase-locking per behavioral period. (A) Mean spike-field phase-locking values (+S.E.M.) and mean licking frequency (+S.E.M.) for sucrose waiting periods (green) and sucrose consumption periods (orange) are plotted. These values show a double dissociation. (B) Like (A), but now the same
parameters are plotted for quinine waiting periods (red) and intertrial interval visits to the fluid well (blue). *, **, ***: p<0.05, p<0.001 Wilcoxon’s Matched-Pairs Signed Rank test. †: p<0.0001 Mann-Whitney U-test.

Supplementary References
