APPENDIX

Electroencephalography (EEG) Acquisition

The day before scheduled appointments, participants received an appointment reminder via email. The email included instructions about how to prepare for the study. Following standard guidelines for collecting EEG data in research contexts, participants were instructed to try to get a good night's sleep, to eat as they normally would, to refrain from using any alcohol within 12 hours of the study or any caffeine within 6 hours of the study, and to wash their hair the day of the study but not to use any conditioner or hair products (hair gel, hair spray, etc.).

Because neurological abnormalities can complicate EEG analysis (Pivik et al. 1993), participants who consented to participate in our study were first asked to fill out a questionnaire that screens for Axis I diagnoses (e.g., major depressive episodes, schizophrenic episodes, panic attacks, etc.), use of psychotropic medications, seizure or convulsive disorders, and any history of skull fractures or incidents of lost consciousness. During the earlier sign-up process, participants were given detailed information about these exclusion criteria before being allowed to book an appointment. Likely as a result, only one person was excluded from participation at screening in the lab. To maintain participant privacy, the screening questionnaires were destroyed immediately after eligibility was determined.

During the study, all EEG data acquisition was conducted in a dimly lit private room where the artifact signal generated by lighting was minimized. Additionally, we minimized artifacts from physical movement by asking participants to limit their head, body, and arm movement (Cohen 2014).

Standard EEG recording and analysis were applied in this paradigm. Upon arrival, participants were fitted with an appropriately sized EEG cap based on the circumference of their head. We used 32-channel actiCAP caps produced by Brain Products. The caps use high-quality Ag/AgCl active electrodes with impedance conversion at the electrode level. The electrodes are embedded in the caps in accordance with the international 10-20 system, with FPz as the reference electrode. The caps were populated with electrodes in accordance with standard procedures (see Luck 2014). Eye blinks were recorded by electrodes by electrodes Fp1 and Fp2, in accordance with actiCAP guidelines. All electrode impedances were maintained below 25 kΩ as suggested for active electrodes. The EEG data were captured with Brainvision Recorder software from a Brainvision Brainamp amplifier using a 0.1–70 Hz bandpass and a sampling rate of 500 Hz/channel.

EEG Pre-processing

The EEG data were re-referenced offline to linked mastoid electrodes (Luck 2014). This was done using the EEGLAB plug-in for MATLAB (Delorme and Makeig 2004). Our interest lies in the frontal (electrode Fz) and central/parietal (electrodes P3 and CP5) regions. If the location of the reference electrode is too close to regions of interest in the brain, the data are subject to misinterpretation (Luck 2014). Therefore, offline re-referencing to the linked mastoid electrodes was optimal. The continuous EEG data were filtered using a finite impulse response filter at 1 Hz high pass and 30 Hz low pass (40 dB stop band attenuation with a 0.1 dB ripple) to minimize artifacts.

Bad channels were identified across the session using a combination of three primary measures: extreme amplitudes, lack of correlation with other nearby channels, and high-frequency noise. Any channels that contained non-numerical values were also excluded. Channels that were labeled as bad were removed from the analysis. These channels were interpolated back using a spherical spline interpolation in the EEGLAB plug-in (Delorme and Makeig, 2004). Channels integral to the analysis (Fz, P3, or CP5) were

not excluded for any participant and thus did not need to be interpolated.

The data were processed using independent component analysis (ICA) to identify and remove any potential artifacts (Makeig et al. 2004). ICA is a statistical linear decomposition that creates a sum of components directly proportional to how much each component distinctly contributes to the data. This process is used to remove any potential artifacts that are not contributing to the data. A combination of the ADJUST plug-in (Mognon et al. 2011) and visual inspection of the data by a trained technician helped to isolate artifact components and exclude them from the analyses. Eye-blink artifacts were identified using spatial average difference and temporal kurtosis comparisons. Vertical eye movements and horizontal eye movements were identified using spatial average difference and maximum epoch variance comparisons. Generic discontinuities were identified using spatial feature and maximum epoch variance comparisons. These comparisons were generated using a processing threshold algorithm based on an expectation maximization technique (Bruzzone and Prieto 2000). If an independent component was above the threshold for all the features listed for each component above, then it was marked as an artifact for that artifact class. For example, if a component exceeded the threshold of rejection for both spatial average difference and temporal kurtosis, it was marked for rejection as an eye-blink artifact. After being marked, components were inspected by a trained technician who made final decisions about potential artifacts. Artifact-free data were obtained by subtracting the artifact independent components from the data.

EEG Analyses

Choice uncertainty measure

When participants made their initial and final choices, the StimTracker hardware created an event trigger that was sent to the acquisition software to "mark" the continuous EEG readout. In order to assess choice uncertainty, we took these event markers and created a time period before them. Specifically, we developed a code that would create a new marker 1,400 ms before each initial and final choice. Next we created a 400 ms reference baseline and then a 1,000 ms epoch leading toward their initial and final choices. The EEG data were baseline corrected by subtracting the average activity of that channel during the baseline period. This gave two 1,000 ms epochs (both baseline corrected), each corresponding with the uncertainty relating to the initial or final choice. This was done for each of the 20 disagreement trials, generating a total of 40 epochs for each participant (20 for the initial choice and 20 for the final choice).

Alpha power was then computed over the course of the epochs in the alpha spectrum, 8–12 Hz (Delorme and Makeig 2004). The data were analyzed from electrodes P3 and CP5. Previous research has identified these electrodes as the location of maximal recorded activity (Kubanek et al. 2015). Any epochs involving alpha power measurements that were below 30 $\mu V^2/Hz$ or above 60 $\mu V^2/Hz$ were excluded from analysis as artifacts (Luck 2014).

Expectancy violation response measure

Expectancy violation response values were generated using the feedback-related negativity (FRN) event-related potential. Epochs of 800 ms (with 200 ms prestimulus baseline) EEG were time-locked to the onset of feedback stimuli, and the data were then baseline corrected by subtracting the average EEG activity during the baseline period. The negative peak amplitude of the FRN (between 250 and 350 ms) poststimulus (i.e., after partner feedback) was subtracted from the preceding positive peak amplitude of the P2 component (between 150 and 250 ms). Both components were measured at electrode Fz, as recommended by past research (Holroyd et al. 2003; Luck 2014). This was done for each disagreement trial, thus generating a total of 20 epochs per participant. Following Luck (2014), epochs were excluded where (1) values

were above 100 uV or below –100 uV, (2) the slope of the singular epoch was three or more standard deviations away from the average slope for all epochs for the participant, and (3) data were three or more standard deviations away from the participant's average at the point of measurement. The remaining epochs were used to create a grand-averaged FRN for each participant.