Supplementary Methods

Heart-rate variability

In our previous work, we assessed heart rate variability (HRV) as a proxy measure for state anxiety[14]. We calculated the coefficient of variation (CV = standard deviation/mean) of the difference intervals between consecutive R-peaks (inter-beat interval, IBI) extracted from the continuous ECG data as a metric of HRV. In previous empirical studies, states of anxiety have been shown to lower HRV and high-frequency HRV (HF-HRV, 0.15–0.4 Hz, see refs.[14,33,57,115]. However, experiments on the association between trait anxiety levels and HRV/HF-HRV metrics have reported both reductions[116-117] and small or inverse effects[118-119]. Here, we include a complimentary analysis of both HRV and HF-HRV to supplement our self-report measures of trait and state anxiety.

During preprocessing of the ECG signal, we extracted cardiac events (the QRS-complex, R wave peak) using the FieldTrip toolbox. Afterwards, we calculated the latency of each R-peak and the CV of the inter-beat interval (IBI), our proxy metric for HRV across both experimental task blocks. The CV for each participant was normalised to the resting state block (R1: baseline). To estimate the high-frequency content of the HRV (HF-HRV) we used the inter-beat-interval (IBI) time series. First, we interpolated at 1Hz with a spline function (order 3), and subsequently estimated spectral power using Welch's periodogram method (Hanning window, following ref.[120]). Estimates of power were normalised to the average power in R1 and converted to decibels (dB) for statistical analysis.

We conducted a 2 x 2 Group x Block (TB1, TB2) factorial analysis of the HRV/HF-HRV measures (**Supplementary Figure 1; Supplementary Results**).

Supplementary Results

Measures of anxiety

Non-parametric factorial analysis revealed a non-significant main effect of Group (P = 0.57), Block (P = 0.21) and interaction effect (P = 0.91, see **Supplementary Figure 1A**). Analysis of the spectral characteristics of the IBI time series also demonstrated a lack of a significant main effect of Group (P = 0.78), Block (P = 0.68) and interaction effect (P = 0.08) on HF-HRV (**Supplementary Figure 1A**).

Subjective self-reported measures of state anxiety showed a significant main effect of the Group factor (HTA: mean 35.4, SEM 1.9; LTA: mean 27.9, SEM 1.1, P = 0.0001). There was no effect of the factor Block (P = 0.23) or interaction effect (P = 0.22). This analysis demonstrates that the HTA participants were subjectively more anxious than LTA during both task blocks. However, these subjective anxiety states did not result in statistical effects on physiological HRV/HF-HRV.

Total switch rate and lose-shift rate

Examining the total switch rate (trial-to-trial response switches of any kind[10]) as a proxy metric of exploratory response choices, several authors have reported impaired switching strategies in anxiety[10,13,43,61]. We therefore additionally assessed this measure and found that the overall switch rate was significantly higher in HTA than LTA (P_{FDR} = 0.0134 < 0.05, Δ = 0.71, CI = [0.55, 0.82]; mean switch rate in each group and SEM: 0.24 [0.02] in HTA, 0.16 [0.02] in LTA). This result was, however, mainly accounted for by group differences in lose-shift rates, as shown in the main text.
A post-hoc analysis was conducted to explore whether the lose-shift rates or total switch rates could also be explained by a Group x Block interaction. This was not the case: no significant effect of Block or Interaction effect was found in either case ($P > 0.05$), but the significant Group effect on lose-shift and total switch rates remained (P_{FDR} = 0.0034 and 0.0120, respectively).

Bayesian Model Selection

While our BMS was conducted in the full sample of 39 participants, we confirmed that the $HGF_{\mu 3}$ model was equivalently the best model at describing responses independently in each group (LTA exceedance probability = 1; expected frequency = 0.91; HTA exceedance probability = 1; expected frequency = 0.89).

Parameter estimation in the HGF

We used simulations to evaluate the reliability of our estimates for the free model parameters in our implementation of the best fitting HGF model ($HGF_{\mu 3}$). In this model, the parameters that were estimated in each individual were ω_2, ω_3, $\mu_3^{(0)}$ and $\sigma_3^{(0)}$ (**Table S1**).
We simulated behavioural responses of 100 agents for six different values of ω_2 (total 600 simulations), and seven different values of ω_3 (total 700), when observing the input of one of our participants (ID zhanx_25). To determine the accuracy of the estimation of parameter $\mu_3^{(0)}$, we conducted similar simulations in 100 agents for six values of $\mu_3^{(0)}$.
These analyses were implemented using function tapas_simModel.m of the HGF toolbox (loop on om2 and om3, representing ω_2, ω_3, respectively; and loop on the number it iterations, N = 100):

```
sim = tapas_simModel(u, 'tapas_hgf_binary',  [NaN 0 1 NaN 1 1 NaN 0 0 1 1 NaN om2 om3],
'tapas_unitsq_sgm_mu3',123456789);
```

The simulated behavioural responses sim.y and the input u observed by participant #3 were then fitted with the tapas_fitModel.m function, similarly to the way we fitted the standard empirical data in our paritcipants:

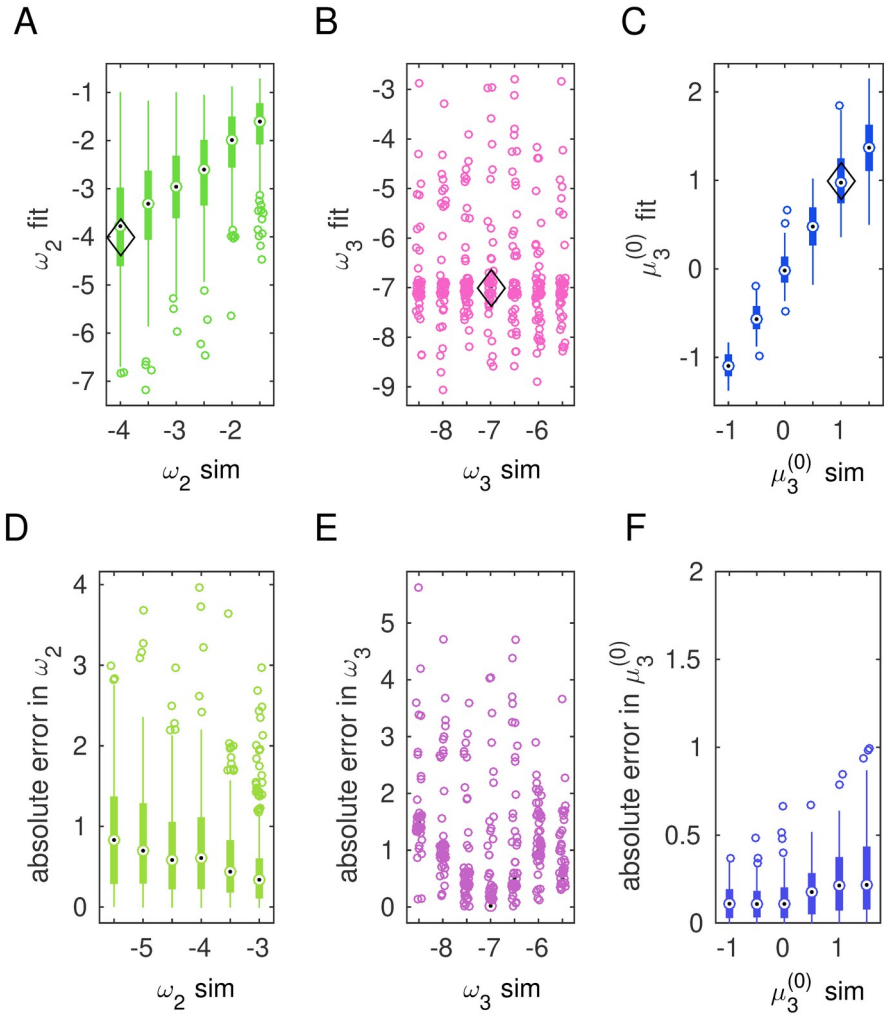
```
est = tapas_fitModel(sim.y, u, hgf_binary_config, unitsq_sgm_mu3_config, optim_config)
```

with

```
optim_config = tapas_quasinewton_optim_config()
unitsq_sgm_mu3_config = tapas_unitsq_sgm_mu3_config()
hgf_binary_config = tapas_hgf_binary_config()
```

Note that in the above analyses the prior values of model parameters and initial values of the belief trajectories were modified in tapas_hgf_binary_config.m to correspond to the prior values for model $HGF_{\mu 3}$ given in **Table S1.**

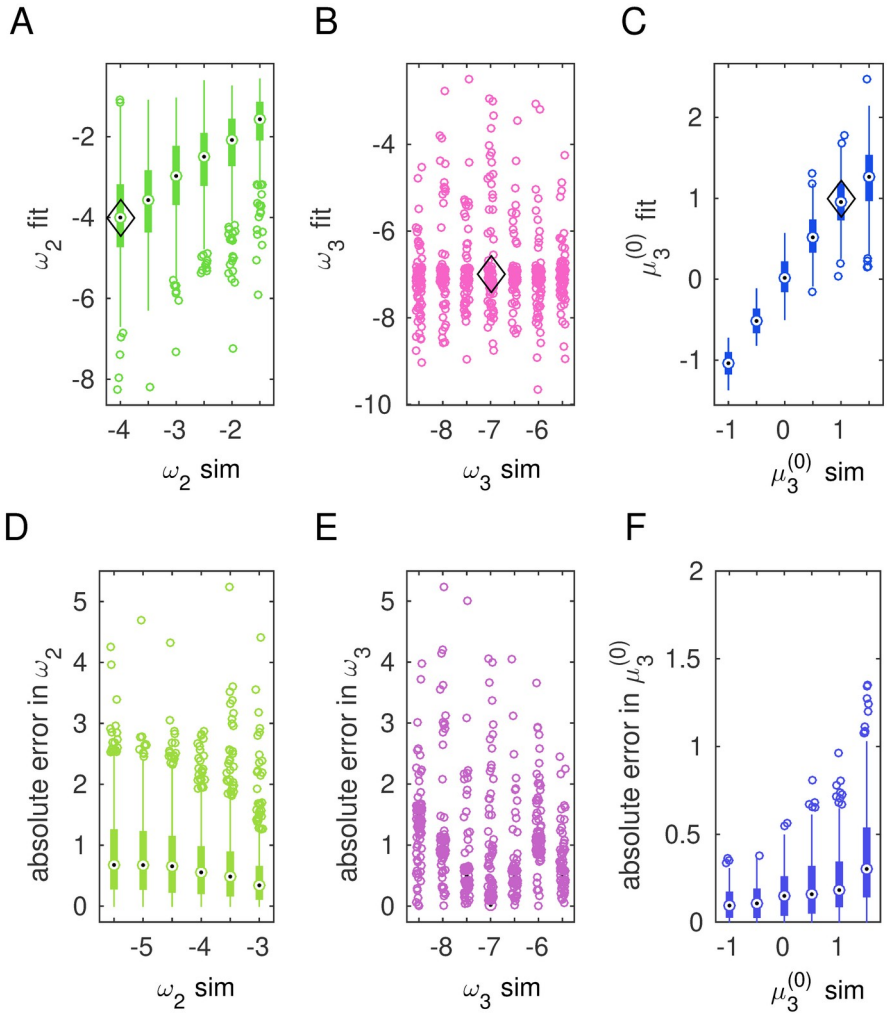
This analysis demonstrated high accuracy for estimating ω_2 and $\mu_3^{(0)}$, while ω_3 was poorly recovered, as reported in previous work[14,98]. See figure below:



HGF parameter estimation using the input observed by one participant (ID zhanx_25). A-C) Boxplots (median, 25 and 75 percentiles) illustrating the results of parameter estimation for ω_2 (A), ω_3 (B) and $\mu_3^{(0)}$ (C). The x-axis represents the set parameters introduced in the simulated responses (labelled "sim"), while y-axis data reveal the corresponding estimated value of that same parameter (labelled "fit"). Parameters ω_2 and

$\mu_3^{(0)}$ were estimated with high accuracy, as there was a high significant correlation between simulated and estimated (fit) values: Pearson R = 0.6306, $P << 1 \times 10^{-6}$ for ω_2, R = 0.9656, $P << 1 \times 10^{-6}$ for $\mu_3^{(0)}$. Parameter ω_3 was poorly estimated: R = -0.0242, P = 0.2668. The prior values of ω_2, ω_3 and $\mu_3^{(0)}$ used in the configuration file for estimating each parameter from the simulated responses were as defined in **Table S1** for the best fitting model ($HGF_{\mu 3}$): ω_2 = -4, ω_3 = -7, respectively (variance 16 in both cases); $\mu_3^{(0)}$ = 1 (variance 1). Prior values are denoted by the diamond shape in the top panels.

A complementary analysis using simulated responses to observed inputs from a different participant (ID zhanx_3) provided similar results.



HGF parameter estimation using the input observed by one participant (ID zhanx_3). Same as the figure above. Estimation of parameters ω_2 and $\mu_3^{(0)}$ was highly accurate: Correlation between simulated and fitted value Pearson R = 0.6512, $P << 1 \times 10^{-6}$ for ω_2, R = 0.9468, $P << 1 \times 10^{-6}$ for $\mu_3^{(0)}$. Parameter ω_3 was also poorly estimated: R = 0.0019, P = 0.9019.

Supplementary References

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