

STATE ANXIETY AND UNCERTAINTY PROCESSING: A HIERARCHICAL GAUSSIAN FILTER STUDY IN GENERALIZED ANXIETY DISORDER**Furkan Bekdemir, Selçuk Özdin***Psychiatry Department, Ondokuz Mayıs University, Faculty of Medicine, Samsun, Türkiye*

BACKGROUND AND AIM: Generalized Anxiety Disorder (GAD) is characterized by persistent worry and heightened sensitivity to uncertainty. Computational models suggest that anxiety may involve excessive belief updating rather than impaired learning. The Hierarchical Gaussian Filter (HGF) quantifies learning under uncertainty through the tonic volatility parameter (ω^2). This study examined how state anxiety relates to uncertainty processing in individuals with GAD.

METHODS: (Ethics Committee Approval must be obtained and the number should be specified). Thirty-six participants, comprising 18 individuals with Generalized Anxiety Disorder and 18 age and education matched healthy controls, completed a probabilistic reversal learning task. Belief updating was modeled using a Hierarchical Gaussian Filter with higher-level volatility fixed to assess tonic environmental volatility (ω^2). Participants completed the State-Trait Anxiety Inventory (STAI) and the Intolerance of Uncertainty Scale (IUS-12). Group differences were examined using Mann-Whitney U tests, and associations were assessed using Spearman rank-order correlations. The study was approved by the Ondokuz Mayıs University Clinical Research Ethics Committee (Approval No: 2026/43).

RESULTS: Individuals with Generalized Anxiety Disorder exhibited significantly higher ω^2 values than healthy controls ($U=51.0$, $p<.001$), indicating increased sensitivity to environmental volatility. They showed lower win-stay and higher lose-shift behavior (both $p<.001$), while overall task accuracy showed a smaller but statistically significant group difference ($p=.033$). Volatility sensitivity was associated with state anxiety (STAI-S; $\rho=0.42$, $p=.010$), intolerance of uncertainty (IUS-12; $\rho=0.39$, $p=.020$), and lose-shift behavior ($\rho=0.55$, $p<.001$). The association with trait anxiety (STAI-T) was weaker and did not reach statistical significance ($\rho=0.32$, $p=.059$).

CONCLUSIONS: Individuals with Generalized Anxiety Disorder tend to update beliefs excessively under uncertainty rather than exhibiting generalized learning deficits. State anxiety was more closely related to uncertainty processing than trait anxiety, particularly following negative feedback. Computational models of uncertainty may help clarify mechanisms underlying anxiety and inform targeted interventions.

Keywords: Generalized anxiety disorder, hierarchical gaussian filter, belief updating, uncertainty processing, reversal learning