Partial coherence is an important quantity derived from spectral or precision matrices and is used in seismology, meteorology, oceanography, neuroscience and elsewhere. If the number of complex degrees of freedom only slightly exceeds the dimension of the multivariate stationary time series, spectral matrices are poorly conditioned and shrinkage techniques suggest themselves. When true partial coherencies are quite large, then for shrinkage estimators of the diagonal weighting kind, it is shown empirically that the minimization of risk using quadratic loss (QL) leads to oracle partial coherence estimators far superior to those derived by minimizing risk using Hilbert-Schmidt (HS) loss. When true partial coherencies are small, the methods behave similarly. We derive two new QL estimators for spectral matrices, and new QL and HS estimators for precision matrices. In addition, for the full estimation (non-oracle) case where certain trace expressions must also be estimated, we examine the behavior of three different QL estimators, with the precision matrix one seeming particularly appealing. For the empirical study, we carry out exact simulations derived from real EEG data for two individuals, one having large, and the other small, partial coherencies. This ensures that our study covers cases of real-world relevance.