Melanins are ubiquitous natural pigments found in virtually every organism. In humans, the brown-black pigment eumelanin colors our skin, hair, and eyes. While sunscreens are the best-known function of melanin in the skin, melanins can also bind metal ions and scavenge radicals. The extremely broad absorption spectrum, redox activity, and electrical conductivity of melanins also make them attractive materials for photocatalysis, solar energy conversion, and electrochemical energy storage. However, the unknown microscopic structure of melanin has impeded understanding of structure-function relationships. To gain insight into the chromophores of melanin, femtosecond transient absorption experiments have been carried out on a synthetic eumelanin polymer. Transient spectral holes centered about the laser excitation wavelength are detected at room temperature, proving that eumelanin is made up of a distribution of absorbers. The observed bleach recovery dynamics provide insights into interchromophore couplings for the first time. By combining femtosecond time-resolved infrared (TRIR) spectroscopy with the ability to select chromophore subensembles with a tunable excitation pulse, a vibrational fingerprinting technique is demonstrated that correlates electronic and vibrational properties of melanin's chromophores. Additional experiments disclose deep parallels between eumelanin and disordered carbon nanomaterials such as graphene oxide, graphitic carbon nitride, and carbon dots. It is proposed that common noncovalent motifs and interactions among the chemically diverse chromophores found in this superfamily of carbonaceous materials give rise to their similar photoproperties.