We developed a modular ACT-R model to simulate the entire space of human voting behavior on full size paper ballots. We focus specifically on a case study of a non-standard voting strategy: the strategy votes first from left to right on a ballot and then from top to bottom. We ran this model on 6600 randomly generated ballots governed by 3 different structural variables. The findings suggest that our model’s error behavior is emergent and sensitive to ballot structure. These results represent an important step towards our end goal of creating a self-contained piece of software capable of identifying bad ballot design.