are several cases: (I) if $w \geq s_1$, define $s''_1 = s_1, s''_2 = s_2 \leq s''_1, s''_3 = s_1$; (II) if $s_2 < w < s_1$, define $s''_1 = w \in [s'_1 + 1, s_1], s''_2 = s_2, s''_3 = w$. It is easy to check that s'' holds both conditions, thus $d(\frac{s''}{\|s''\|}, s) \leq d(s', s) \leq r$ as required. If (III) $w \leq s_2$, it quite simple to see that by setting $s''_1 = w, s''_2 = w - 1, s''_3 = w$ we are closer to s than s'.

Proof of 2: any two candidates which are tied with the score leader of s – c_1 – at states at distance r from s are also tied for the leadership in a state within the same distance r from s. Since if there is any tie between candidates c', c'', either one of them is c_1, or both of them are tied with c_1 in the radius r (as the difference in the score of c_1 in s and the state where it isn't tied for the victory is larger than when it is tied for the win), all candidates which are tied with some other candidate in radius r, are tied with c_1, and hence "can be tied with c_1 in $S_{d,r}(s)$" is a transitive relation. Since any candidate-wise metric is in particular neutral, $H_{d,r}$ is upward closed by the first part.

Let x be the lowest-ranked candidate participating in any tie. By upward-closeness, $(y, c_1) \in H_{d,r}$ for all y ranked weakly above x. Then by transitivity, any edge (y, z) where y, z, are ranked weakly above x is also in $H_{d,r}$, which means that $H_{d,r}$ is a clique. □

Proof of 2 is similar to Meir (**?**), Lemma 2.

Theorem 13. *Suppose agents each have a cliqued epistemic model (not necessarily the same one). Then, iterative voting under Plurality must converge to OD equilibrium, from any initial state.*

Proof. For contradiction, let us assume the theorem is wrong and there is a cycle. That is, there is a sequence of scoring vectors (states) $s^1, \dots s^q$ such that s^{j+1} is the outcome of an agent i making an OD move in s^j, and s^1 is the result of an agent making an OD move in s^q. Let B be the cle, and let $z \in B$ be the candidate with the lowest score in the cycle (if there are multiple such candidates, let z be the lowest ranked in the tie-breaking rule).

Let $s^{q'}$ was be a state where z is at their lowest score, and in which an agent j makes a move, changing their vote from some candidate a to z. This means z was undominated at this point for j, which means all ties with B elements were within the same information set, and moreover, $z \succ^j c$ and $c \succ^j a$ for any $c \in B$ (Since the pivot-graph is a clique, there is a tie between each 2 candidates in B). However, as this is a cycle, there is a step $s^{\bar{q}}$, in which agent j changes their vote from $b \in B$ to a. This means b is dominated, and a is not, but this means there is some tie between a and another candidate x. Since $c \succ^j a$ for any $c \in B$, this means $x \notin B$.

If in $s^{q'}$ x's score was larger than z's, this means there was a tie between x and a was in the pivot-graph for agent j, and by moving to z, this indicates $x \succ^j a$. If x's score was smaller than z's in $s^{q'}$, the score of b in $s^{\bar{q}}$ is larger than that of x (since all scores are larger than that of z in $s^{q'}$), and since $b \succ_j a$, agent j should have preferred to stay with agent b. □

Theorem 14. *Suppose agents each have a concentric, cliqued epistemic model (not necessarily the same one). Then, iterative voting under Veto must converge to OD equilibrium, from any initial state.*

Proof. Assume, for contradiction, that the process does not converge. Let R be the set of candidates whose score changes an infinite number of times, and let $z \in R$ be the candidate which has the lowest score in the cycle (breaking ties using the tie-breaking rule), and let $\vec{s}^q$ be the state where it reaches this abysmal score. That is, some voter j moves from vetoing candidate a to vetoing candidate z. Candidate a's (and any other $c \in R$) score is above z's, as otherwise its own vetoing before would give it a lower score than z. Since this is a cliqued epistemic model, leaving a means it is the favorite candidate of voter j over all candidates with scores above z, in particular, for any $c \in R$, $a \succ^j c$.

At some point in the future $\vec{s}^{q'}$, due to the cycle, voter j will move from vetoing some candidate $b \in C$ to veto a, due to an edge in its relevant pivot-graph, indicating a tie between a and some other candidate x. If x's score at $\vec{s}^q$ was higher than z, then we know a is preferred over it from z's vetoing. If x's score was lower, we know it hasn't changed (as it isn't in R), meaning b is still tied with a as well in the pivot-graph of $\vec{s}^{q'}$ as it was in $\vec{s}^q$, hence voter j will not move (since $a \succ^j b$). □

Other convergence results from (**?**) could be similarly extended for any upward-closed information structure. Theorem 14 with Prop. 12 imply the first non-Plurality result for local dominance.

Corollary 15. *Using any candidate-wise metric, local-dominance converges to an equilibrium when using Veto.*

Discussion and Future Directions

This paper presents a framework to model voting situations in which voters do not have perfect information of the world. Moreover, they do not even have an exact understanding of their uncertainty of the world's state. Hence, their understanding is modeled in a coarser way – as "shades of likelihood" of various voting outcomes, derived from a prospective poll. This framework is robust enough so as to allow us to capture many previously suggested heuristics and strategies of voter behavior under uncertainty. That is, we are able to express these heuristics as rational strategies under particular information structure known to players.

ties that induce them). The fact that ordinal dominance in ciently, stands in contrast to the negative results in Conitzer et al. (**?**), where verifying whether vote a' dominates a is ing assumption on the sharp pivot property that allows us to replace (arbitrarily complicated) information sets with a simple pivot graph representation.

late heuristics from various game-theoretic domains – not limited to social choice – as ordinally-dominant strategies. This might offer an insight into the built-in assumptions inherent in these heuristics, and allow, perhaps, novel formulations of new heuristics and methods, tailored to particular uncertainty structures.

nections between ordinal information structures and existing theories of qualitative uncertainty such as (**?**).

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