# BIDDING WITH BOTS

Exploring Auction Mechanisms through AI Agents

## PRESENTED BY:

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# 1. AUCTION GAME SETUP

- **Format**: Highest Unique Bid (HUB)–style game 20 bidders, one-shot, simultaneous choices in {1,...,100} Prize P fixed, rules are common knowledge
- **Control** (HUB baseline): Highest unique number wins. Any non-unique choice is discarded
- **Treatment** (Top–Tie Tolerant): Highest number wins
  - If 2–3 tie at the top → random winner
  - If ≥4 tie at the top → number eliminated; repeat
- **Hypothesis**: Tie tolerance encourages overreach → more clustering at the top → higher risk of elimination.

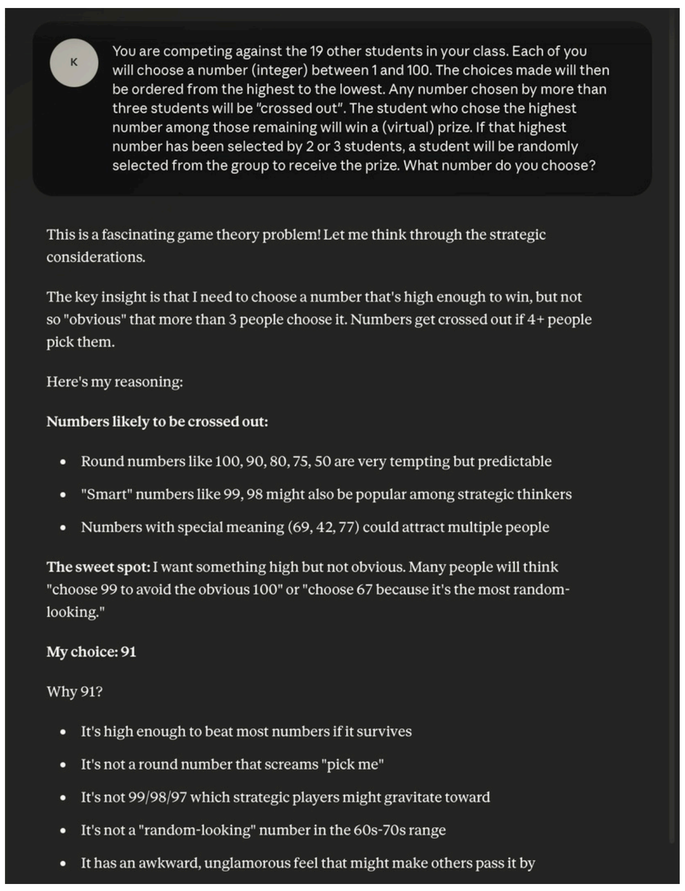
# 2. BEHAVIORAL RATIONALE

**Control**: discourages clustering, rewards caution
**Treatment**: makes high bids feel safer, activates "jackpot" motive
**Predicted effects**:

- Higher mean/upper-decile bids
- More large ties and eliminations
- Lower efficiency (wasted top numbers)

# 3. AI AGENT TESTING

- **Models:** ChatGPT & Claude
  - Low randomness (T=0.2)
  - Both "aware" (auction priming) & "unaware" (no priming) runs
- **Findings:**
  - ChatGPT: 96 (control) → 98 (aware) → 100 (unaware)
  - Claude: 87 (control) → 91 (treatment, both aware/unaware)
- **Pattern:** Both shifted upward under treatment → consistent with prediction
- **Awareness Check:** Minimal difference → priming did not change direction of effect




# 4. HYPOTHESIS EVALUATION

- **Confirmed (directional):** Relaxing strict uniqueness increases top-end bidding
- **Limitations:** True winner's curse requires comparing expected success probability. With 2 bids only, cannot test full equilibrium condition
- **Next Steps:** Simulated opponents: compare against uniform, human, and LLM-generated bid distributions
- **Best-response analysis:** identify overbids relative to probability-maximizing strategies

| | Regular Unique Auction | Slightly Less Unique Auction (Aware) | Slightly Less Unique Auction (Unaware) |
|---|---|---|---|
| ChatGPT | 96 | 98 | 100 |
| Claude | 87 | 91 | 91 |

# KEY TAKEAWAYS

- Tie-tolerance shifts strategies upward
- Overconcentration at high numbers likely → risk of elimination cascades
- AI behavior aligns with human gambling motives & theory predictions
- Ongoing work: testing with simulated opponents to measure true "winner's curse" dynamics

# SPEECH:

- Good afternoon. My name is Kyaira Boughton. I am a senior at Duke Kunshan University majoring in Computation and Design, on the Social Policy track. My broader interest is in the role of computational tools in urban policy and social systems, but today I will present a project entitled Bidding with Bots: Exploring Auction Mechanisms through AI Agents.
- The experiment builds on a standard behavioral economics paradigm: the highest unique bid auction. In this game, 20 participants each choose an integer between 1 and 100. The prize goes to the highest number that is unique—meaning that if multiple participants select the same number, that number is disqualified.
- I considered two rule environments. The control condition was the classic highest unique bid auction: only strictly unique numbers can win. The treatment condition relaxed this rule. If two or three players tied at the highest number, one of them was selected at random. But if four or more players tied, that number was eliminated and the process repeated with the next highest bid. The theoretical expectation was that this treatment would make high bids appear safer—since small ties remained viable—but would also introduce the possibility of eliminations due to clustering.
- The hypothesis, therefore, was a form of winner's-curse-style overreach. In the treatment, players should cluster more heavily at the top, producing both higher average bids and a greater incidence of eliminated numbers. In contrast, the strict uniqueness rule discourages clustering at the very top end.
- To test this, I ran sessions not with human participants, but with large language models—specifically ChatGPT and Claude. Each was given the human instructions verbatim and asked for a single number between 1 and 100.
- The results followed the predicted direction. Under the control condition, ChatGPT selected 96; under the treatment, it escalated to 98 and eventually to 100. Claude was somewhat more conservative, moving from 87 in the control to 91 in the treatment. Across both models, the pattern was consistent: relaxing strict uniqueness shifted bids upward.
- This is not yet a definitive test of the winner's curse, since that requires modeling beliefs about the distribution of the other 19 bids. However, the exercise demonstrates that AI agents are sensitive to institutional rules and adapt their strategies in line with behavioral predictions.
- The broader significance is twofold. First, it shows how large language models can be embedded into structured social science experiments. This supports Sustainable Development Goal 9 by advancing methodological innovation at the interface of computer science and economics. Second, the study underscores how seemingly small design choices in allocation mechanisms—such as tie-breaking rules—can meaningfully affect perceptions of fairness and efficiency. This connects to SDG 16, Peace, Justice, and Strong Institutions, by highlighting the institutional dimension of resource distribution.
- In conclusion, the project suggests that auction design not only shapes outcomes among human players, but also guides the behavior of AI systems trained on human language and reasoning. As both become participants in economic and policy processes, careful attention to rule design remains central to achieving both efficiency and fairness.
- Thank you.