Agent Based Feedback Models of a "Sense of Should"

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Introduction

- Behavior regulates physiology through the environment, and organisms that regulate their physiology effectively survive. [1,2]
- Control theory defines mathematical frameworks built around self-regulation (e.g., negative feedback control). [3,4,5]
- An open question in social behavior is how social norms exert a causal force on people's behavior. People feel social pressure to conform to others' expectations—i.e., a "sense of should" [6]
- How then do expectations shape social behavior?
- Negative feedback control can go beyond traditional (e.g., game theoretic) approaches in explaining social dynamics.

Methodology

We built a python-based framework to explore control-based dynamics in social settings (i.e., a social sandbox).
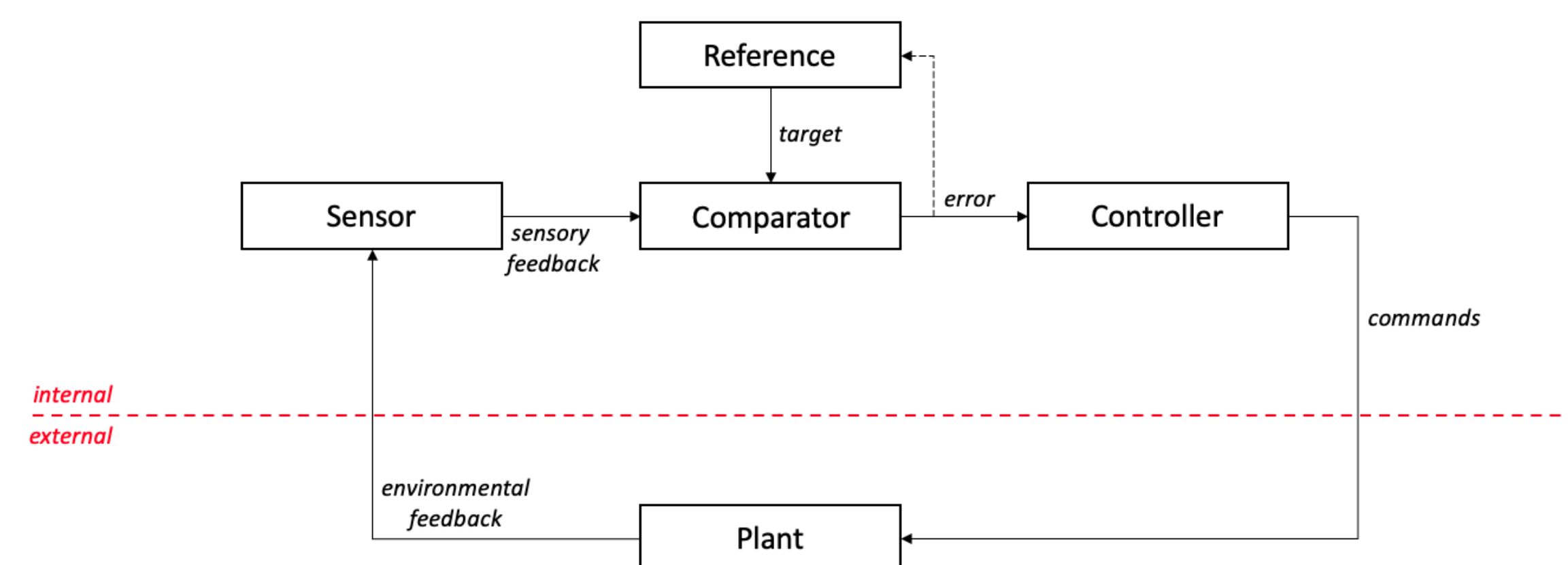
In simple control, agents can:
- Sense and compress sensory signals from the environment (plant).
- Compare compressed signals to a reference.
- Reduce error by updating the reference.
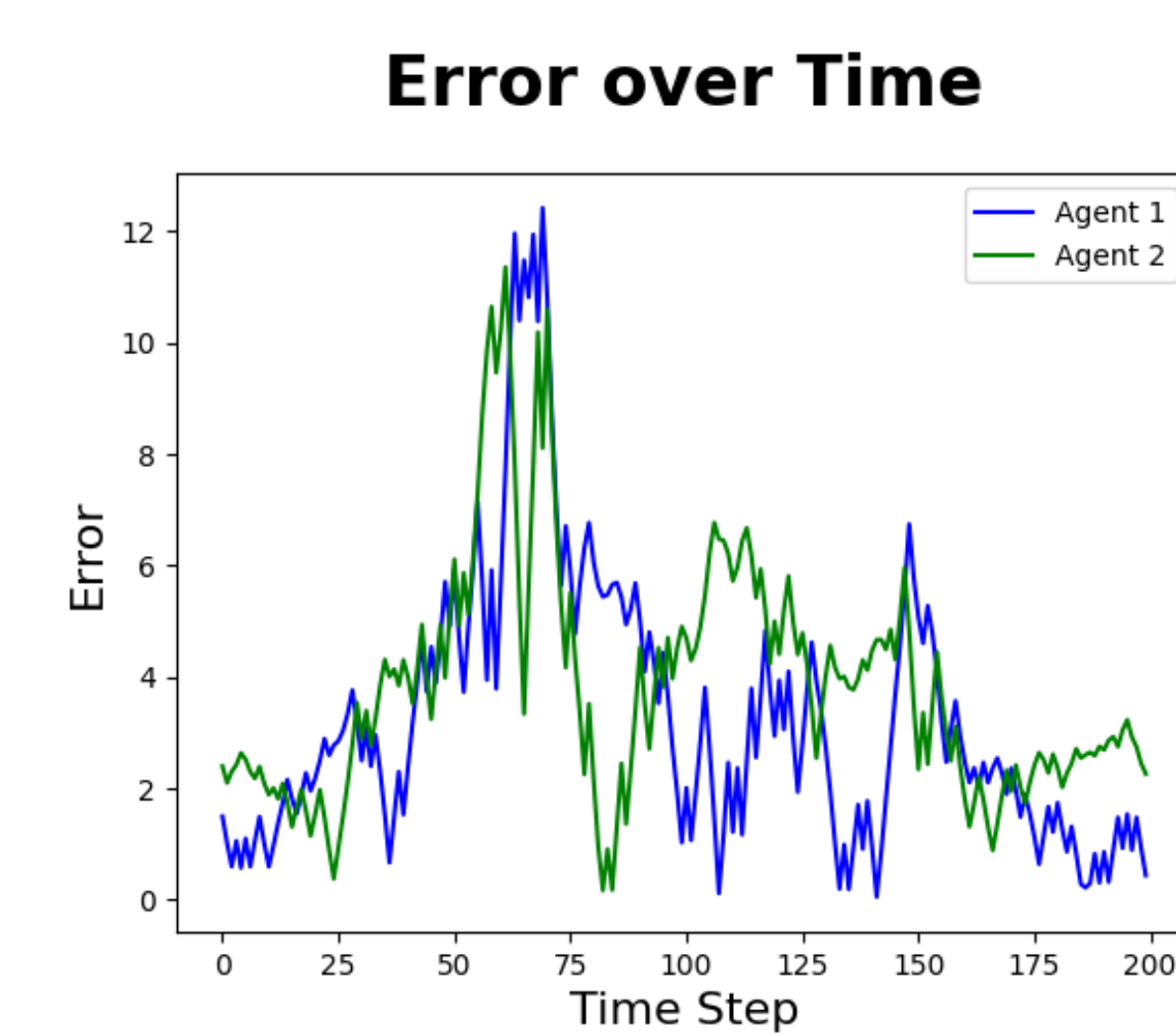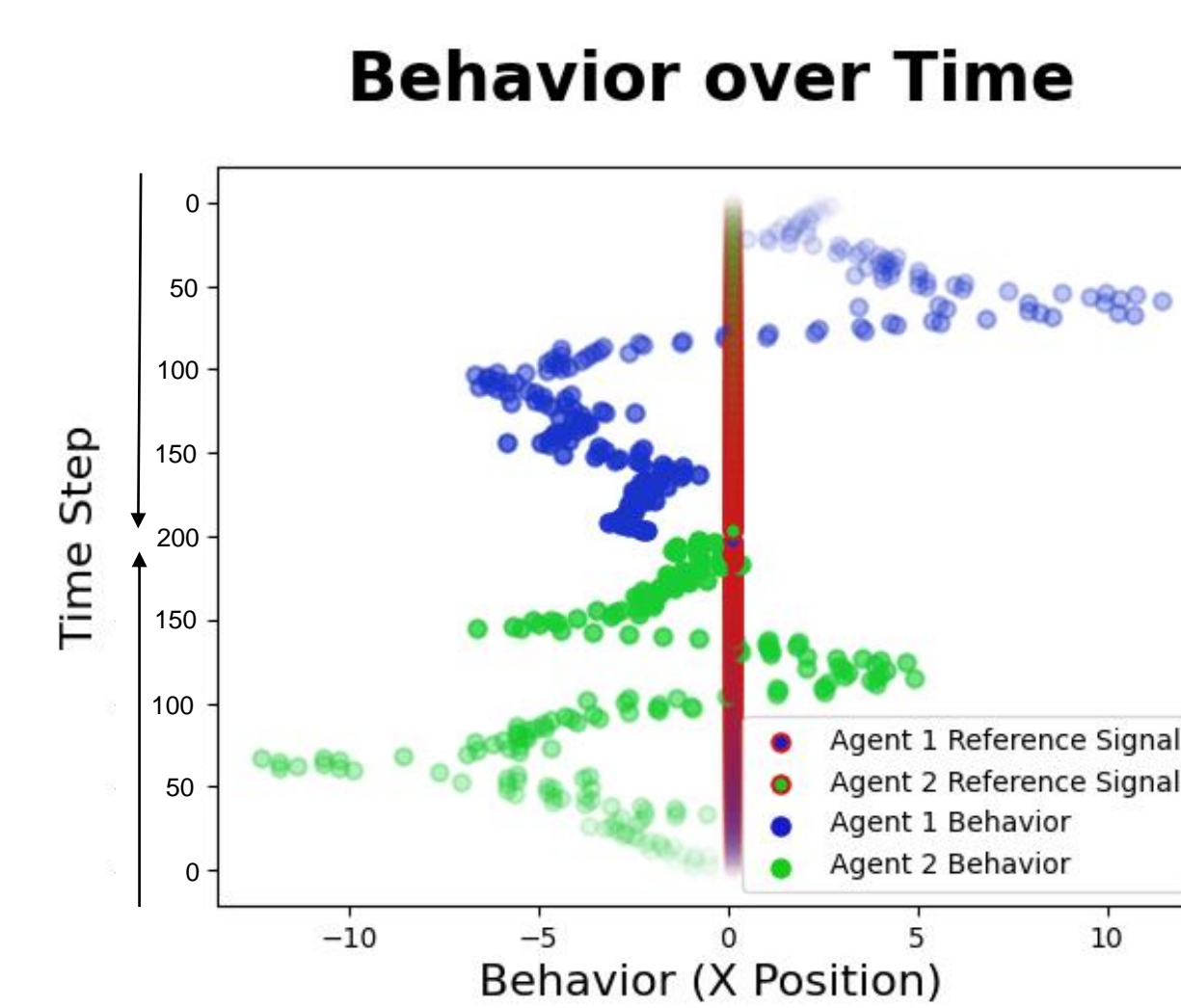- Reduce error by controlling the environment (plant) through behavior.
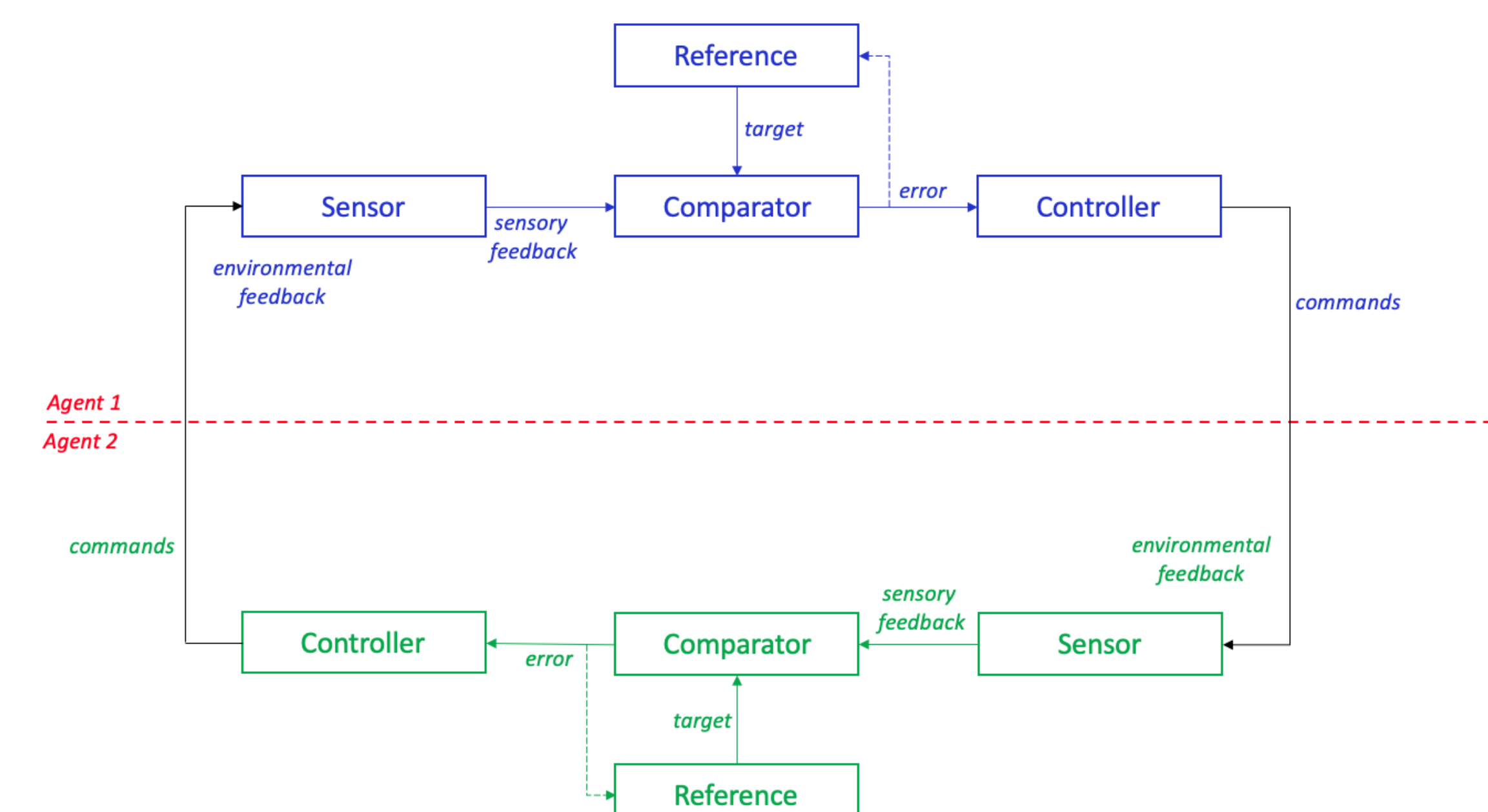
In social control, the environment (plant) is another agent who can perform the same set of control-based actions.
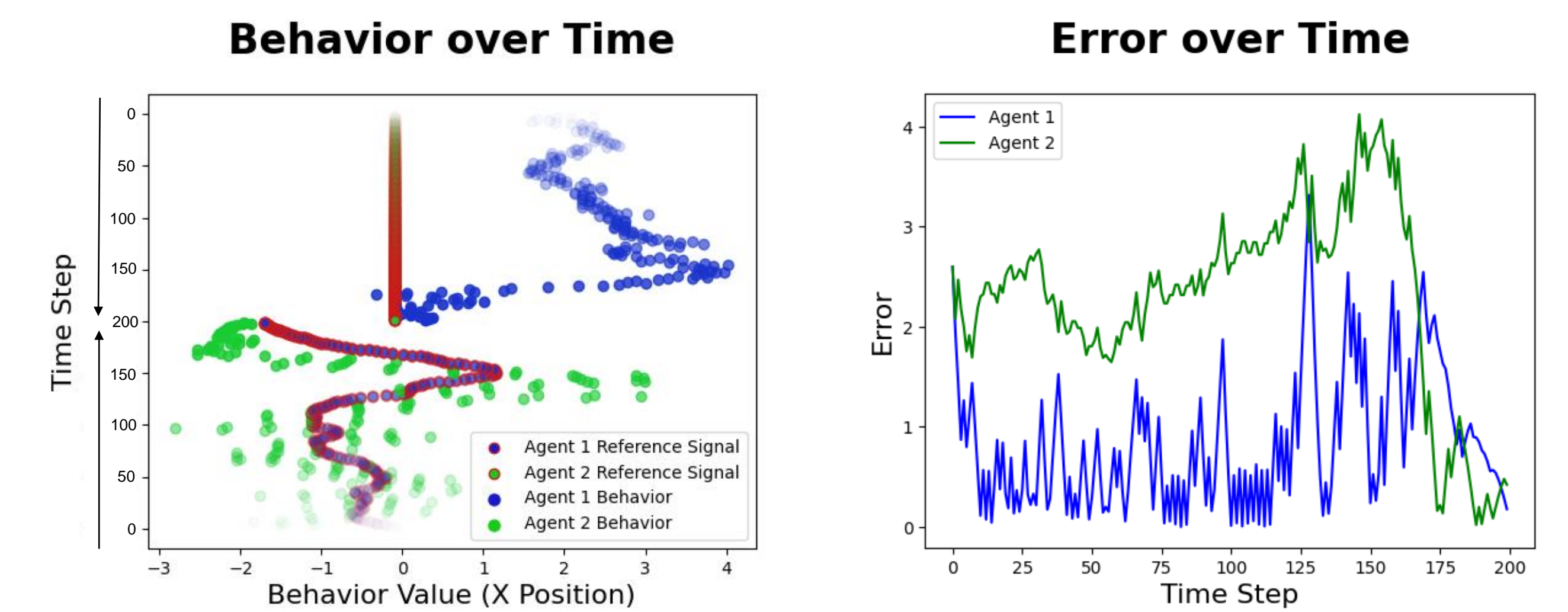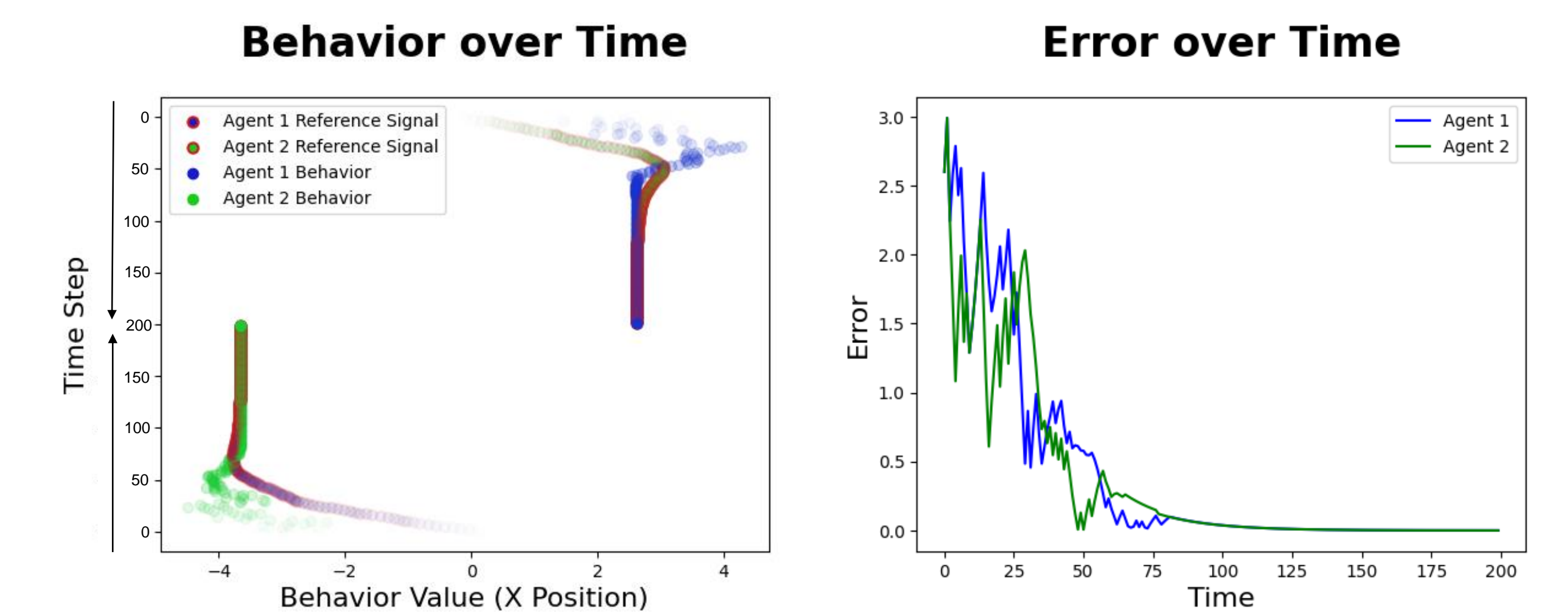
Results

For simple control, we set a static reference signal—i.e., a state that the agent "wants" the environment to be in.

Neither agent adjusts their reference (i.e., "expectations"): they may eventually stumble into equilibrium by manipulating each others' behavior.

One agent adjusts their reference: they slowly reach equilibrium, but the "fixed" agent "gets what it wants".

Both agents adjust their reference: they quickly reach equilibrium. They "accept what they see" and stabilize their social environment.

Conclusion

- In a control-based social framework, agents can "accept what they see", or "insist on an alternative."
- With relatively few assumptions, social dynamics can be simulated to show how agents control the behavior of others merely through their expectations (i.e., reference signals).
- More complex models could allow for more precise control. For example, control models could incorporate hierarchical levels of sensing, compressing, and references [7] and could incorporate learning into forward models in the controller node [8].
- In this model, reference signals are a proxy desires/expectations/goals, but in hierarchical models top-level references would represent biologically necessary homeostatic conditions for an organism.

References

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