

Simulating a Multiple Player Extended Deterrence Game with Agent Based Modeling

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PLS 591 (2011)

Abstract

An extended deterrence game is presented that supports an arbitrary number of protégé for the game's two principal players, an attacker and defender, including protégé with commitments to both the attacker and defender. The game is developed with parameters to support a varying number of protégé for the attacker and defender, varying degrees of protégé reliability for the attacker and defender, and a varying number of protégé with commitments to both the attacker and defender. The impact of the different specifications for the game's parameters are investigated with a series of simulations produced on the Repast agent based modeling platform.

Research Question

Why does variance in the frequency of the attack outcome and surrender outcome for the Multiple Player Extended Deterrence Model exist?

Hypotheses

As the ratio of attacker protégé to defender protégé increases the frequency of attack outcomes will increase.

As the reliability of defender and protégé security agreements increases the frequency of attack outcomes will decrease.

As the reliability of attacker and protégé security agreements increases the frequency of attack outcomes will increase.

As the number of protégé with security agreements to the defender and attacker increases the frequency of attack outcomes will decrease.

Data

Data Source:

All data was produced via simulations developed on the Repast agent based modeling platform. The simulation was written in a combination of the Relogo, Groovy, and Java programming languages.

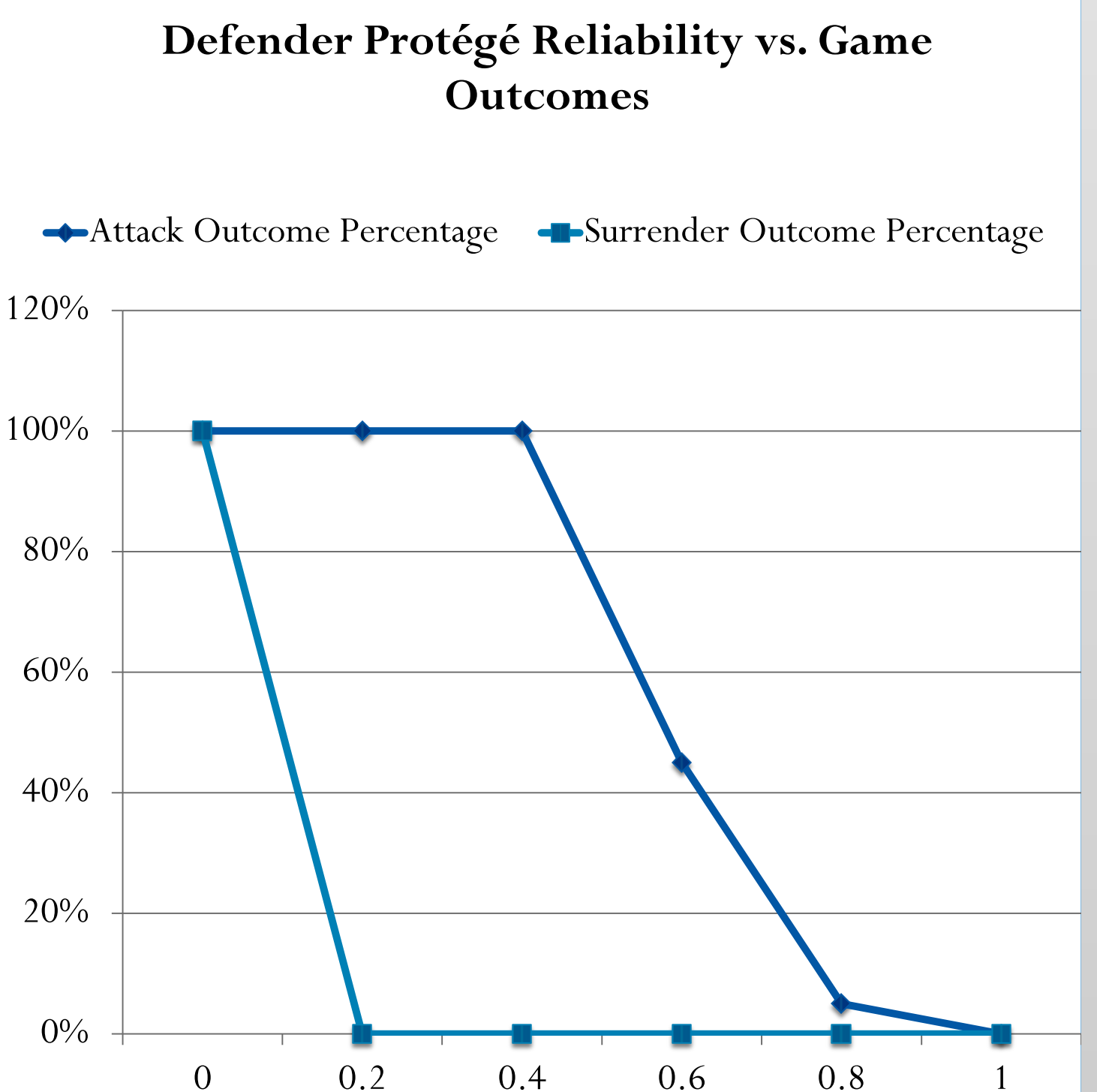
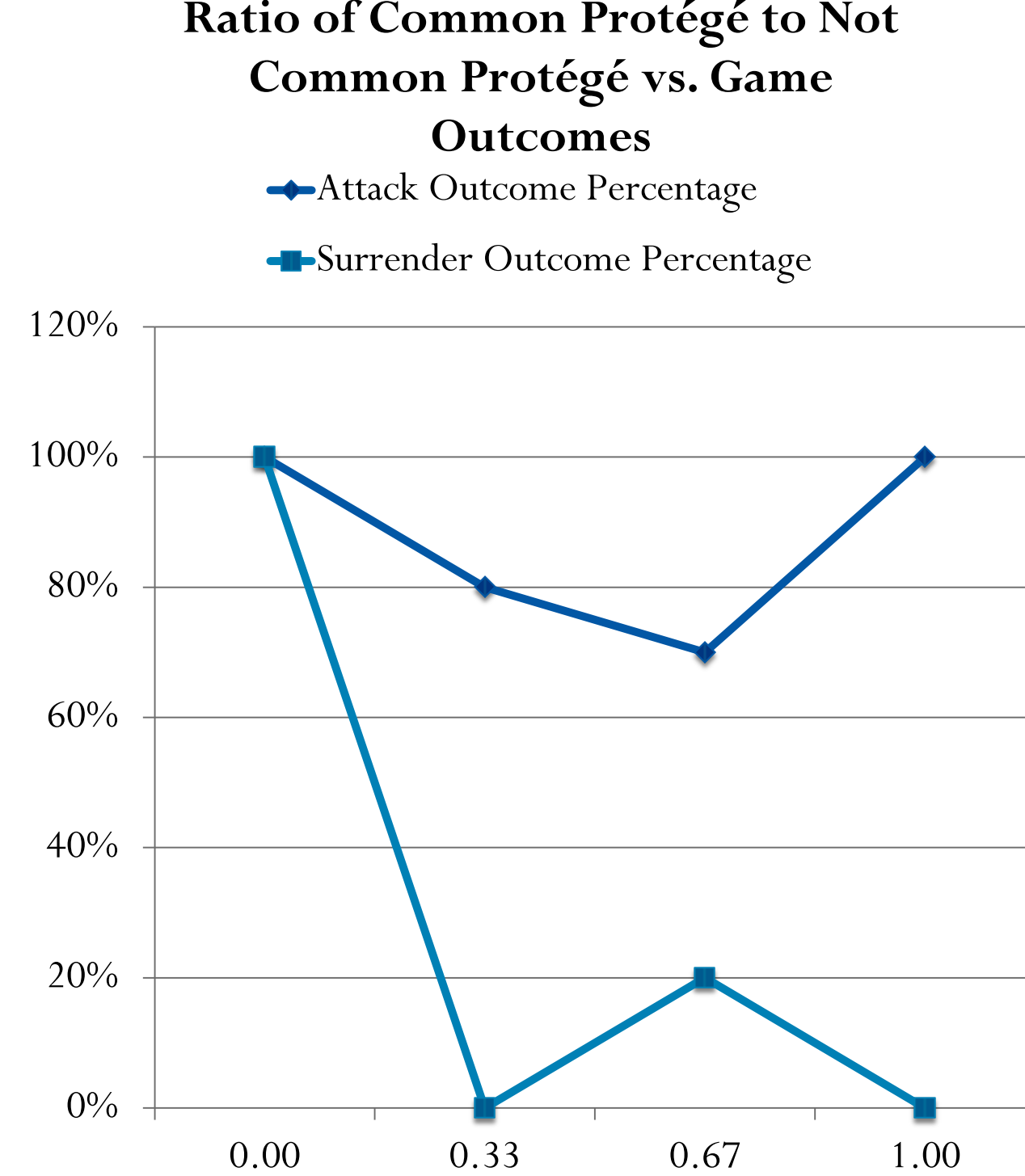
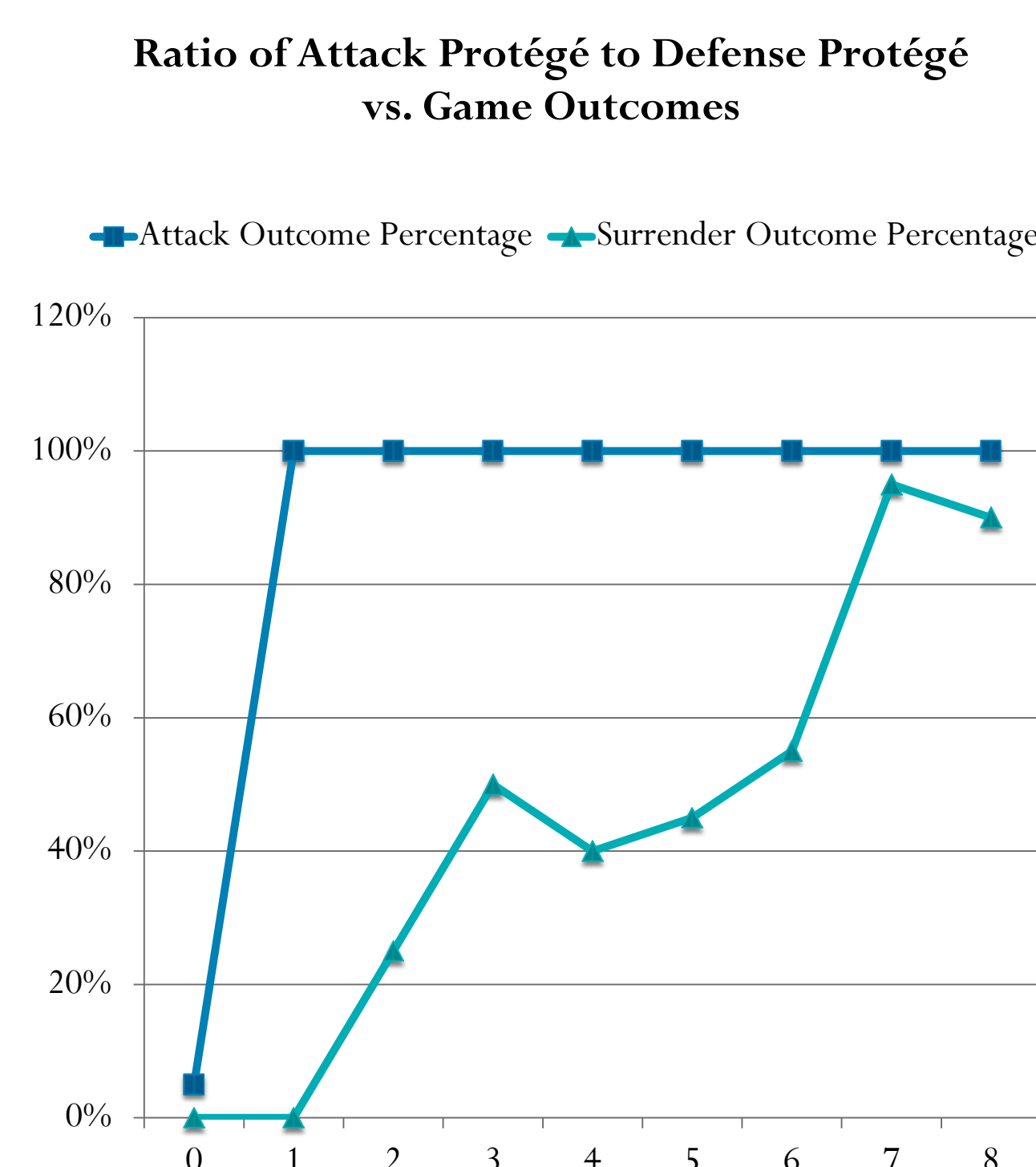
Dependent Variable:

Frequency of the attack outcome within each set of specifications for the game's parameters.
Frequency of the surrender outcome within each set of specifications for the game's parameters.

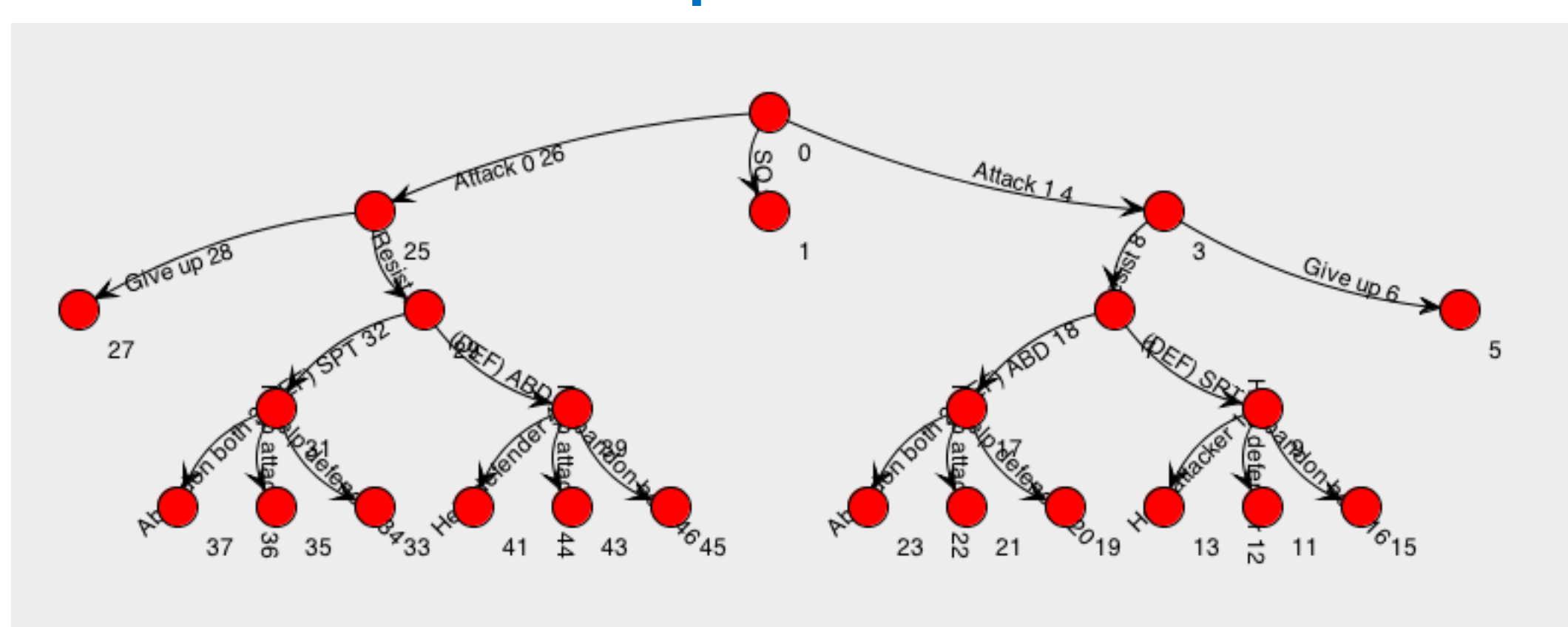
Independent Variables:

Number of protégé for the defender
Number of protégé for the attacker
Reliability of each protégé, defender, and attacker's commitments to one another
Number of protégé with security commitments to both the defender and attacker

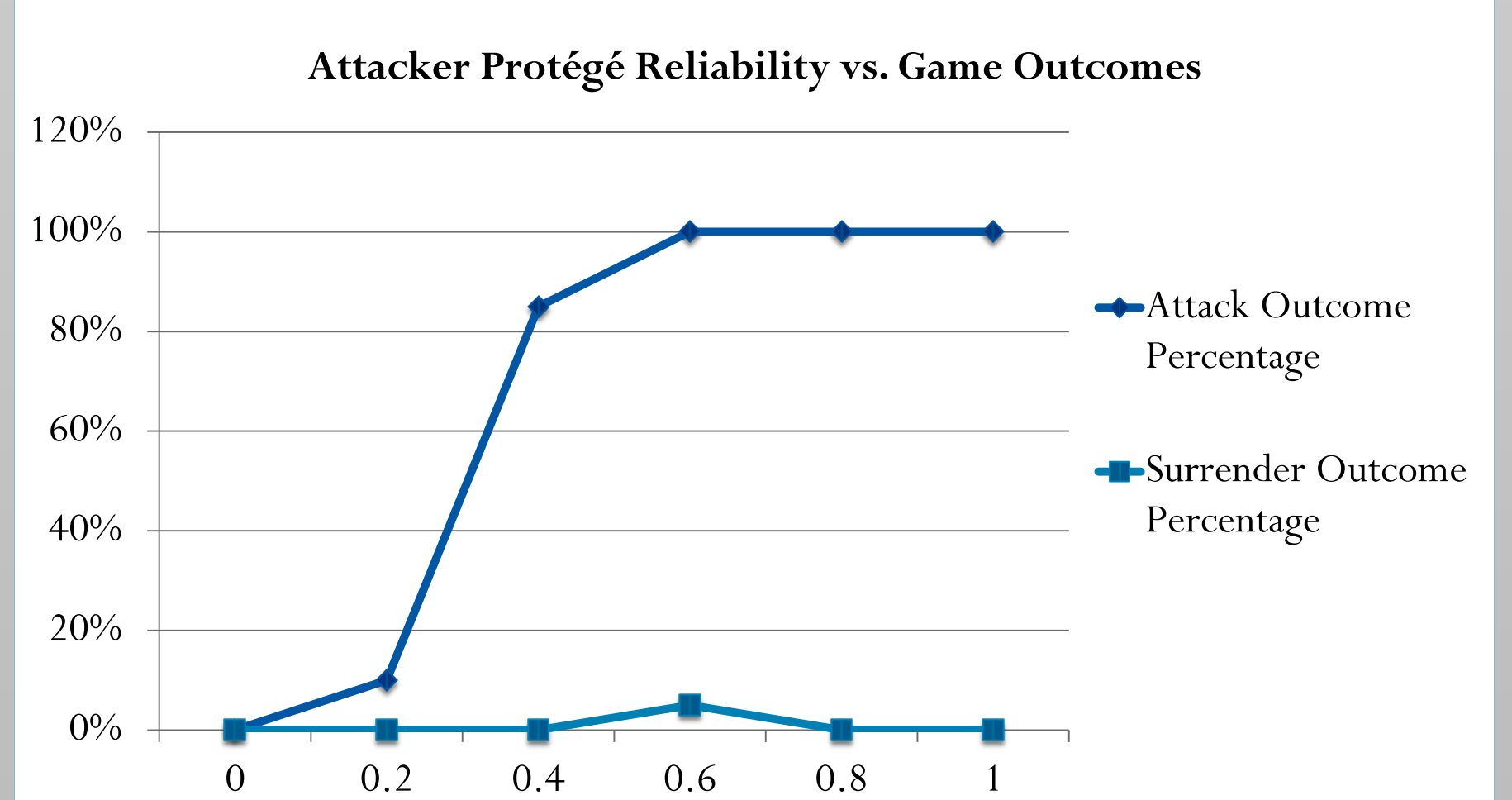
Results



Sample Game



Results Cont.



Discussion

All of the hypotheses were confirmed except for the relationship between the number of protégé with security commitments to both the defender and attacker and the frequency of attack and surrender outcomes.

The results indicate that the relationships between the independent variables and dependent variables may not be linear.

The use of an agent based model was successful, and perhaps revealed qualities of the relationships between variables that would not otherwise be noticed. However, further examination of the dependent variables' sensitivity to the game's parameters in different configurations and payoffs is merited.