

Enabling and recognizing strategic play in strategy games: Lessons from Sun Tzu

Andrew S. Gordon (gordon@ict.usc.edu)

The Institute for Creative Technologies, University of Southern California
13274 Fiji Way, Marina del Rey, CA 90292-7008

Abstract

The interactive entertainment genre of the strategy game entertains users by allowing them to engage in strategic play, which should encourage game designers to devote development efforts toward facilitating users that wish to employ commonsense strategies, and to recognize and react to specific user strategies during game play. This paper attempts to facilitate these development efforts by identifying and analyzing 43 strategies from Sun Tzu's *The Art of War*, which are broadly applicable across games in the strategy game genre. For each strategy, a set of specific actions are identified that should be provided to users to enable their execution, along with generalized recognition rules that can facilitate the design of entertaining responses to users' strategic behavior. Consideration of how the enabling actions could be incorporated into an existing strategy game is provided.

1. Strategy-enabled interactive entertainment

In a previous paper (Gordon, 2001a), we argued that there were three distinct levels in which an interactive computer game could be considered to be strategy-enabled. First, a game could be *strategy facilitating*, in that the breadth of actions that were available to its users included those that were part of known strategies in the corresponding real-world domain. Second, a game could be *strategy aware*, where these real-world strategies would be explicitly represented internally as patterns to be matched against user behavior – and where the recognition of a user's strategy would cause some entertaining response by the game. Third, a game could be *strategy capable*, where the computer uses these real-world strategies to plot their offensive and defensive actions against the user in a dynamic manner.

This previous paper also described a design methodology that was based on the collection and pre-formal representation of specific real-world strategies (from Gordon, 2001b). 60 pre-formal representations of political strategies collected from Niccolo Machiavelli's *The Prince* were considered, identifying a set of 46 abstract actions that enabled users to execute these strategies and 66 abstract environmental features that played a role in the recognition of these strategies. It was argued that to create a game that was strategy-enabled at the first two levels (facilitation & awareness), it would be necessary to offer the users specific

instances of these abstract actions, and explicitly represent and manage these environmental features.

In many ways, these recommendations are too impractical to be used by game developers. First, they require that developers identify the ways that abstract actions are instantiated in their game environment, which is a non-trivial task (e.g. the action *Execute a partial plan*). Second, they require game developers to collect and represent these strategies themselves – a task that cannot easily be worked into typical development budgets.

In this current paper, we attempt to address the shortcomings of this previous work in two ways. First, we focus our analysis on a set of strategies that are specifically relevant to an entire gaming genre: the strategy game. Second, for each of the strategies that we examine, we identify the specific user commands that must be supported by the software (through a menu of commands, mouse clicks, keyboard hotkeys, or otherwise) to enable user to execute these strategies, along with generalized recognition rules that will allow the software to notice when a strategy is being used. This approach aims toward a development process that requires only the instantiation of these recognition rules by game developers in their specific strategy game environment.

2. Strategy Games and Sun Tzu

An important genre of interactive entertainment is that of the strategy game, where one or more users lead their forces into conflict with their opponents, which may be controlled by the computer or by other players. Within two general frameworks, turn-based and real time, the strategy game genre has explored an enormous number of contexts, from the growth and defense of emerging civilizations, the command of modern mechanized military offenses, to intergalactic struggles for species survival. Despite their differences, instances of this genre are almost always based on the theme of military conflict, and indeed the moniker of *strategy game* is largely in reference to the notion of military strategy. The entertainment value of these games is closely tied to the notion of strategy as well, as the fun seems to stem from constructing an offensive or defensive strategy for your military forces, and then attempting to execute it successfully. From a design perspective, it is critical that specific attention be directed to understanding the sorts of common strategies that users

can be expected to want to employ, and to ensure that the game facilitates strategic play by providing an appropriately rich palette of possible user actions.

In contrast to other genres of interactive entertainment, the command interfaces of strategy games make it relatively simple to enable strategic play. Throughout decades of strategy game development, the persistent mode of user control has been the assignment of high-level instructions to individual units under the player's control. That is, during a single turn or over a period of time, a unit can be instructed to attack, defend, retreat, construct buildings, produce materials, hide, or any number of other behaviors – all through the assignment of a single primitive command from a palette of options. A complex action such as *launching a siege on an enemy stronghold*, which may require a whole suite of user behaviors in a first-person shooting game or a role-playing adventure game, can be provided as a simple menu option or keyboard command in a strategy game environment. From a design standpoint, a strategy game can be considered to be strategy-facilitating if this palette of options includes all of the actions that are part of the particular set of strategies that users will want to employ.

For strategy games, there is perhaps no greater catalog of commonsense user strategies than the classic Chinese text, *The Art of War*, written by military strategist Sun Tzu around the fifth century BC. Importantly, the strategies presented in this text make little reference to the specific nature of Chinese warfare technology of this period. Indeed, part of the reason for the continued popularity of this text is that it seems to contain advice that remains relevant despite changes in how military campaigns are conducted. While this text may have been influential in its time, the contemporary reader will find little in it that is surprising or innovative, as the strategies that it discusses have largely been integrated into our common culture. Accordingly, it serves as an appropriately general starting point for the investigation of commonsense strategies in traditional mechanized warfare games, civilization development games, intergalactic battle games, and any other game where forces under the control of the user are in opposition to the forces of others.

In our previous work (Gordon, 2001b), 43 warfare strategies were collected from this text, and a pre-formal representation was authored for each to inform the design of future AI planning systems. In this paper, we use this collection to identify the palette of user actions that should be provided to strategy game users to enable the use (and recognition) of Sun Tzu's warfare strategies.

3. Enabling & recognizing the strategies of Sun Tzu

In this section, the titles of each of 43 warfare strategies of Sun Tzu that were analyzed are listed. Accompanying each strategy reference is the set of enabling actions that must be provided by game developers to allow users the opportunity to execute the strategy within the context of the game. Following the enabling actions are generalizations of the recognition rules that must be employed by game developers to recognize specific user strategies. Each of the actions and enabling rules has been distilled from the pre-formal representations of these strategies that were authored in our previous work. To simplify the use of this information in game design, actions are listed as single commands to be included among all of the menu choices, mouse clicks, or keyboard hotkeys available to the user. The recognition rules each include the execution of these actions by the user, accompanied by various other constraints having to do with the order of execution, the location of the user's forces, a duration of time, or specific game statistics, among others.

1. Support your armies with supplies that are gained in conquest

Enabling actions: Capture resources; Attack

Recognition rule: The user's forces have just defeated an opponent's forces by attacking them, followed by the capturing opponent resources near the location of the battle.

2. Deceive your enemy by feigning inaction, preparation, and disorder of your army

Enabling actions: Pretend preparation; Pretend disorder

Recognition rule: The user's forces are adjacent to opponent forces, but not yet in battle. The user then pretends preparation or pretends disorder.

3. Bait your enemy into advancing by providing a false opportunity

Enabling actions: Provide false information

Recognition rule: The user's forces are near an opponent's forces, but not yet in battle. The user then provides false information to the opponent.

4. Cause an enemy to attack at an inopportune time by irritating them

Enabling actions: Taunt opponent

Recognition rule: The user's forces are adjacent to an opponent's forces, but not yet in battle. The user then taunts the opponent's forces.

5. Reduce the readiness of your enemy by occupying their time with distractions

Enabling actions: Distract enemy

Recognition rule: The user's forces are near an opponent's forces, but not yet in battle. The user then distracts the enemy.

6. Reduce the risk of draining the state's wealth by conducting only short campaigns

Enabling actions: Attack, Move forces to location

Recognition rule: The user moves forces from the user's base, executes an attack, and returns the forces to the user's base within a threshold period of time.

7. Reduce the costs of war by striking vital targets of the enemy first

Enabling actions: Destroy/disable enemy resources

Recognition rule: The user's forces destroy/disable enemy resources of high value without attacking closer targets.

8. Conquer your enemy as a whole to avoid the problems of partial victory

Enabling actions: Accept surrender

Recognition rule: The user accepts the surrender of the central leadership of an opponent without accepting the surrender of an opponent's provincial or territorial leadership.

9. Surround your enemy when your forces greatly outnumber them

Enabling action: Move forces to location

Recognition rule: The user's forces are adjacent to an opponent's forces, which are of significantly smaller size. The user moves their forces such that the opponent's forces are positioned in their center.

10. Schedule attacks when the defenses of your enemy are down or reduced

Enabling actions: Attack

Recognition rule: The user's forces attack adjacent opponent forces at a moment when the defensive strength of the opponent is lower than average.

11. Divide your army when you are several times stronger than your enemy

Enabling actions: Move forces to location; Attack

Recognition rule: The user's forces are adjacent to an opponent's forces that are significantly smaller, the user moves a portion of their forces to a different location and attacks the opponent with the remaining forces.

12. Attack an enemy if you believe your forces are equal in strength to the enemy

Enabling actions: Attack

Recognition rule: The user's forces are adjacent to an opponent's forces that are of nearly equal size. The user executes an attack on the opponent.

13. Avoid attacking an enemy if you believe the enemy overpowers your forces

Enabling actions: Defend

Recognition rule: The user's forces are adjacent to an opponent's forces that are of greater size. The user does not execute an attack on this force for a period of time that is greater than some threshold.

14. Flee when your forces are greatly overpowered by those of an enemy

Enabling actions: Flee/retreat

Recognition rule: The user's forces are adjacent to an opponent's forces that are many times greater. The user flees or retreats to a different location.

15. Have a strong defense in place and wait for an opportunity to attack

Enabling actions: Defend; Attack

Recognition rule: The user's forces are adjacent to an enemy's forces, which are attacking the user. The user repeatedly executes a defense over a period of time, and then executes an attack when variable conditions for success are met.

16. Gain the support of the nearby civilians when fighting an enemy army

Enabling actions: Befriend civilians

Recognition rule: The user executes an attack on an opponent after attempting to befriend civilians in locations near the location of the battle.

17. Overcome the defenses of an enemy by conducting a sustained siege

Enabling actions: Siege stronghold; Supply forces

Recognition rule: The user repeatedly executes a siege on an opponent's stronghold while delivering supplies to the forces conducting the siege.

18. Use long-distance signaling to coordinate the actions of large armies

Enabling actions: Signal own forces; Wait for signal

Recognition rule: The user causes part of their forces to do some other action after waiting for a signal, which is delivered by a different part of the user's forces, who also do some action after signaling.

19. Be more prepared than your enemy by reaching the battlefield first

Enabling actions: Move forces to location; Attack

Recognition rule: The user executes an attack on opponent forces after occupying the location of the battle for a greater period of time than the target of the attack.

20. Move your troops only through neutral or uncontested territory

Enabling actions: Move forces to location

Recognition rule: The user moves their forces outside of the territory they defend where the location of the troops is never in an area that is defended by an opponent's forces.

21. Position your troops in locations that are unassailable

Enabling actions: Move forces to location

Recognition rule: The user moves their forces to a location where it is not possible that an opponent can attack the user while they are there from any other location.

22. Ensure that your forces are faster than the enemy to keep the option of retreat

Enabling actions: Flee/retreat; Attack

Recognition rule: The user attacks the opponent forces when the speed of the user's forces is greater, and does not attack the opponent forces when it is less, over a period of time greater than some threshold.

23. Force an entrenched enemy to move by attacking somewhere else

Enabling action: Attack; Move forces to location

Recognition rule: The user's forces are adjacent to an opponent's forces that hold an unassailable position. The user moves their forces to a different location to attack other forces of the opponent.

24. Prevent attacks by displaying unexplainable behavior to the enemy

Enabling action: Pretend disorder; Pretend preparation

Recognition rule: The user's forces are adjacent to opponent forces, but before attacks have been initiated. The user begins to pretend disorder or pretend preparation.

25. Cause an enemy to spread their defenses by enabling many points of attack

Enabling action: Move forces to location

Recognition rule: The user moves their forces to multiple locations adjacent to opponent units and resources and has not yet initiated an attack.

26. Rouse an enemy with false starts in order to reveal their intended counterplans

Enabling actions: Pretend to attack

Recognition rule: The user's forces are adjacent to an opponent's forces, but have not yet attacked. The user executes a command to pretend to attack.

27. Send light troops when speed is more important than force

Enabling action: Move forces to location

Recognition rule: The user separates their forces in two such that one portion has a speed that is significantly faster than the other, then moves the faster force to some location.

28. Get advice from local guides when traveling through foreign territory

Enabling actions: Befriend civilians; Ask for directions; Move forces to location

Recognition rule: The user moves forces into a territory that they do not control, then befriends civilians in this territory, then asks for directions through the territory.

29. Leave an enemy a means of retreat to prevent desperate defensive action.

Enabling actions: Move forces to location; Attack

Recognition rule: The user moves their forces to locations adjacent to an opponent and executes an attack, where it is never the case that the opponent cannot execute a flee/retreat action.

30. Schedule your attacks when an enemy is half mired in bad terrain

Enabling actions: Attack

Recognition rule: The user's forces have a position adjacent to an opponent's forces, which are moving across terrain that is difficult to pass. The user initiates an attack at a moment when half of the opponent's troops are in the difficult terrain.

31. Delay the movement of your troops across terrain that will improve.

Enabling actions: Move forces to location

Recognition rule: The user moves forces to a position adjacent to terrain that varies in difficulty over time. The user then moves these forces into the terrain at a moment when the condition of the terrain is better than when the forces first arrived.

32. Position your enemy between your troops and terrain that is difficult to cross

Enabling actions: Move forces to location

Recognition rule: The user moves forces to a location adjacent to an opponent's forces, such that the opponent is adjacent to bad terrain on the opposite side.

33. Guard the territory that contains the supply lines of your forces

Enabling actions: Patrol territory, Supply forces

Recognition rule: The user is sending supplies to forces, where the supplies are traveling over terrain that is being patrolled by a portion of the user's forces.

34. Overtake a greater enemy by capturing something that they value highly

Enabling actions: Capture resources

Recognition rule: The user captures a resource of an opponent with a much greater force, where the resource is among those that are ranked highest in value.

35. Put your forces at risk to strengthen their determination to succeed

Enabling actions: Move forces to location; Disable own resources

Recognition rule: The user disables resources used in an attack or moves forces to a disadvantageous location when others positions are available, and then attacks an opponent's forces.

36. Mystify your troops with false reports and appearances to ensure plan secrecy

Enabling actions: Pretend disorder; Pretend preparation; Act bizarre

Recognition rule: The user causes their leadership units to pretend disorder or preparation, or disseminate false information to their own subordinate troops.

37. Attack an enemy over and over again to progressively weaken their defenses

Enabling actions: Attack

Recognition rule: The user unsuccessfully executes an attack on an opponent's force repeatedly over a period of time in the same manner.

38. Destroy any records that would allow your enemy to learn your plans

Enabling actions: Destroy planning records

Recognition rule: The user causes the leadership units to destroy planning records.

39. Close frontier passes and stop the passage of emissaries to block information flow

Enabling actions: Block pathway; Prohibit emissary movement

Recognition rule: The user blocks all pathways that enable units other than their forces to enter or exit the user's territory, and then prohibits emissary movement.

40. Use spies that hold positions high in the chain of command of enemy forces

Enabling actions: Enlist spy

Recognition rule: The user attempts to enlist a spy that is a leadership unit in an opponent's force.

41. Use the spies of your enemy as double agents

Enabling actions: Enlist spy

Recognition rule: The user attempts to enlist a spy that is a revealed spy of an opponent.

42. Provide false information to enemy spies when you know who they are

Enabling actions: Provide false information

Recognition rule: The user provides false information to a unit that is a spy for an opponent.

43. Gather information about enemy tactics from soldiers that survive lost battles

Enabling actions: Gather war stories

Recognition rule: The user causes leadership units to gather war stories from user forces that have executed a retreat or fleeing action from a battle.

4. Facilitating strategic play: Age of Empires II

To better understand how enabling actions can be realized within the current framework of existing strategy games, the 26 enabling actions identified in the previous section are considered within the context Microsoft's *Age of Empires II: The Age of Kings*. Roughly half of the enabling actions are already supported in the game. In the following list, the methods of invoking these supported actions are described. For those actions that are unsupported, a new method is suggested.

Accept surrender (supported): Enemies can become allies using during the game through various diplomacy mechanisms.

Ask for directions (unsupported): A new command could ask neutral, newly aligned, or converted units to reveal portions of the map that they have seen.

- Attack** (supported): Clicking on a target when a unit is selected causes it to attack.
- Befriend civilian** (supported): Unaligned units at the beginning of a game become allied when a unit approaches them.
- Block pathway** (supported): Villagers can construct walls to block the travel of units.
- Capture resources** (supported): Monks can convert enemy units including some buildings.
- Defend** (supported): Military units can be commanded to adopt a defensive stance.
- Destroy planning records** (unsupported): A new technology of town centers or castles should disable an opponent's spy technology.
- Destroy/disable enemy resources** (supported): Enemy buildings and special units can be attacked and destroyed.
- Destroy/disable own resources** (supported): A player's units and buildings can be deleted.
- Distract enemy** (unsupported): A new command for a military unit should cause enemy units in a defensive stance to move toward a specified location.
- Enlist spy** (supported): Spies is a technology that reveals explored enemy territory. A more strategic implementation would create special spy units that could pass unnoticed in enemy territory, and could be enlisted as double agents.
- Flee/retreat** (unsupported): A new combat stance should cause units to quickly move away from any enemy unit, perhaps at the cost of defensive strength.
- Gather war stories** (unsupported): A new command should allow military units that have returned from battle to improve defensive technologies, or improve the ability of military units that they are grouped with.
- Move forces to location** (supported): Clicking on a destination moves individual or groups of units.
- Patrol territory** (supported): Military units can be commanded to patrol a specified territory.
- Pretend disorder** (unsupported): A new combat stance should cause military units to move in unpredictable ways, possibly increasing their defensive strength.
- Pretend preparation** (unsupported): A new combat stance should cause military units to appear to be preparing an attack, possibly increasing their defensive strength.
- Pretend to attack** (unsupported): A new combat stance should cause military units to appear as if they are attacking, possibly increasing their defensive strength.
- Prohibit emissary movement** (supported): Gates can be ordered locked and trade carts & ships can be commanded not to travel.
- Provide false information** (unsupported): A new technology for town centers or castles should cause opponents with spy technology to report incorrect map information.
- Siege stronghold** (supported): Siege weapons (and other military units) can attack enemy buildings.
- Signal own forces** (unsupported): While the game allows signaling of allied forces in multiplayer games, it should also allow the triggering of units waiting for a signal (see Wait for signal, below).
- Supply forces** (unsupported): A new command for trade carts should cause them to move between town centers and distant military units or siege weapons, replenishing their strength upon each arrival.
- Taunt opponent** (supported): Preset taunts can be sent to other teammates & opponents using the chat interface, although it is unclear if computer players react to these taunts.
- Wait for signal** (unsupported): A new command for a military unit should delay a specified command until a signal is received (see Signal own forces, above).

5. Conclusions

If we treat the specific strategy game discussed in the previous section as representative of the genre, then some generalizations can be made concerning the sorts of game functionality that should be further explored to facilitate strategic play. Among the actions that are unsupported in this game, many of them seem to deal specifically with the flow of information between units and the use of deception, specifically Ask for directions, Destroy planning records, Distract enemy, Gather war stories, Pretend disorder, Pretend preparation, Pretend to attack, Provide false information, and Signal own forces. In the previous section, we suggested a number of simple mechanisms by which these actions can be enabled. However, we believe that more satisfying and entertaining solutions are possible if developers are willing to invest a significant amount of additional effort. Specifically, we propose that game AI should begin to incorporate factors that concern the intentions of users – their goals and plans, as evidenced by their actions. By incorporating these factors into the logic of computer-controlled opponents, the delivery of misinformation and other deceptive user behavior can have a more direct effect on their opponents.

This direction for future development work also opens the door for additional sorts of collaboration between AI researchers, specifically those interested in modeling and recognizing intentional behavior, and their counterparts in the computer game industry. It is through continued collaboration in this area that will one day result in interactive entertainment that is fully strategy-enabled, where users and computer players alike plan their behavior in truly strategic ways.

References

- Gordon, Andrew S. (2001a) Playing Chess with Machivelli: Improving Interactive Entertainment with Explicit Strategies. *The 2001 Spring Symposium on Artificial Intelligence and Interactive Entertainment*, Stanford University, March 26-28, 2001.
- Gordon, Andrew S. (2001b) The Representational Requirements of Strategic Planning. *Fifth Symposium on Logical Formalizations of Commonsense Reasoning*, New York University, May 20-22, 2001.