# What Makes Gameplay Creative?

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**Abstract**

We consider the question of where the threshold is for the play of a game to be creative. The question of creativity is connected to, but not the same as, the complexity of finding optimal play; in particular, just because a game is *hard* to play well, that does not inherently make it a *creative* game to play. To clarify that difference, we introduce a set of desiderata for determining whether playing a given game is a creative task. Inspired by a recent paper, we examine the word game Codenames as an example of how these desiderata can be applied to analyze whether a game admits creativity. Our overall goal is to explore the relationship between creativity, algorithmic gameplay and fun in games that are clearly ones in which a computer could be a player.

## Introduction

What properties make the play of a game a creative task? Some games seem clearly creative to play: for example, playing Charades or Pictionary requires pantomime or drawing; other games involve competitive storytelling or coming up with songs or other creative artifacts. Other games likely are not creative: games of pure chance certainly are not, but neither are games in which the optimal choice of action for a player is clearly defined by a simple algorithm, such as Blackjack or Connect Four. In general, the process a player must engage with in developing either turn-by-turn tactics, or the overall strategy that they are implementing, must have properties consistent with creativity for gameplay to be a creative task.

Humans are not the only game players, of course; pets play games with their human companions, and non-human primates play games together (Kaufman and Kaufman 2015). When animals play games, they also sometimes discover novel, successful strategies, and in doing so, they also can be creative participants in a game. Similarly, agents like computers can also be game players, and the strategies and approaches they discover in their gameplay can also be novel and successful, and hence creative. Gameplay is thus one entertaining route into the overall field of creativity studies in general, and computational creativity in particular.

Our key idea is that creativity is a facet of a rule set: a game either does or does not admit creative play by its nature, and modifying a game's rules may change the game's creativity status. We identify a set of desiderata that we believe are necessary for games to be creative.

### Gameplay and creativity

It is easy to categorize games at the extreme ends of the spectrum of possible creativity they allow. Famous chess and Go players are often characterized by gameplay that is universally praised as creative, and it is difficult to imagine arguments in favor of tic-tac-toe allowing for creativity. But is there space for creativity in, for example, checkers? This potential uncertainty leads to two questions. First, what qualities of a given game lead us to categorize it as allowing creativity or not? And second, how can those qualities be applied to games whose status as creative is less clear? Answering these questions can also help to clarify relative differences between creativity in games. Checkers is strategically deeper than tic-tac-toe, but is it deep enough to allow for creativity? A robust framework for categorizing creativity should be able to account for the difference between strategy and creativity.

### Natural language games

It is instructive to consider the case of natural language games. The richness of language is and has been a constant source of joy in human life. Wordplay, rhyming, jokes, songs, and poetry all draw on the depth, emotion, and shared understanding afforded by language. Language is powerful; it must be to describe the complexity of our reality, both internal and external. And within that power and complexity is an inexhaustible combinatorial space of words, forms, and ideas. The clever navigation of that space to find novel and meaningful expressions is a prime example of creativity.

The rules of a word game, like the forms of poetry or song lyrics, establish a shared portion of the language space for the players to explore together. And while artistic expressions may be difficult to evaluate, a game's rules provide a common metric to compare and judge plays. These traits are desirable from a computational creativity perspective. Word games can be creative domains with a constrained combinatorial space and clear evaluation criteria, which serve as useful footholds for designing, improving, and sharing creative computer systems that play them.

Such games clearly allow for (or even require) creativity to play, and we can examine their properties in terms that can be applied to non-language games to usefully reason about the creativity they permit.

## Characterizing Creative Games

We propose that the degree to which a game admits creative play can be characterized by examining the space of possible moves in the game, how that space changes as the game develops, and the algorithm that decides the winner of the game. Specifically, we say that a game admits creative play—i.e. playing the game is a creative act—if it has a sufficiently large space of possible moves that changes meaningfully as the game progresses. We also consider whether the game's outcomes can be decided by a highly compressible algorithm. This last criterion does not affect the creativity admitted by a game, but a game that satisfies it falls into a category of creative games that is particularly interesting to computational creativity.

### Large set of possible moves

We first draw a distinction between the game-theoretic complexity of a game and the space of possible moves the player may make in the game, the latter of which pertains to the current discussion. Game complexity can be reasoned about by metrics pertaining to search strategies and computational complexity. One such measure is the total number of possible games for that set of rules. Tic-tac-toe is an example of a game with a very small number of possible games that are trivial to exhaustively explore by a computer or adult human. It is not widely considered to admit creativity. Conversely, chess is a game with approximately $10^{40}$ sensible games[1] and has been demonstrated to admit creativity.

Reasoning about the number of possible games is not sufficient to determine whether a game admits creativity, however. We can construct pathological examples of nonsense games that technically have a large number of possible games. For example, consider a "googol guessing game" where a random number between 1 and $10^{100}$ is generated and the player has one chance to guess it. There are a very large number of such games, but they are not interesting and playing them is not creative. Therefore, in addition to the size of the game space, we also consider the (potentially) creative task that faces the player at each ply.

Our first desideratum is that the space of possible moves at any given ply is large enough to admit creativity. When framing a game ply as a creative task, we can reason about how many possible actions the player could take. We may count the full space, restrict it to sensible moves, or include hidden information in the formulation of the creative artifact.

### Meaningful difference between possible moves

The combinatorial size of a game alone is not sufficient for a game to admit creativity—recall the googol guessing game. Thus, our second desideratum is that the game rules give rise to meaningfully different sets of choices at each ply. We say that difference is meaningful if either the best strategy for selecting a move, the goal of the current move, or the space of moves itself differ from ply to ply. In other words, the space must accommodate artifacts that are recognizably different from one another and are of varying levels of quality. We discuss artifact novelty and quality further in a later section.

This desideratum rules out the googol guessing game as one that admits creativity because the strategy is only ever to guess a random number. Playing that game is not creative because each outcome is functionally identical. Modifying the game to allow for an unlimited number of guesses is similarly uninteresting. If we further modify the game to say whether a guess was higher or lower than the target number, the strategy to search the space is an obvious binary search. To admit creativity, the task of playing the game must present a meaningful creative task at every ply.

Chess, again, is an example of a game that admits creativity. There are many possible games of chess, but crucially the way the game plays out is almost guaranteed to result in a game that has never been played before. Thus, at each ply, the player is likely to face a completely novel set of options, each with the potential to produce further novel game states. In this way, the game rules give rise to effectively limitless creative tasks with different spaces of possible moves. This is also an example of a common way to inject variety into a game: by pitting opponents against one another. When two players are changing the game state to achieve opposing goals, the game can give rise to many different problems for players to solve.

### Deterministically decidable games

What separates games from other creative tasks is that games have concrete win and lose states. One player wins, and the other(s) lose. Even if a game is not zero-sum, there is still a rule-defined goal and some method for determining which player has a higher score or equivalent measure.

As we are computational creativity researchers, one key goal for us is to describe creative games that computers can themselves play, and where the winner of the game is easily determined. As such, we seek rule sets for which there exists a straightforward description of the current state of a game and an easy-to-describe algorithm that, given the state of the game, can identify the winner.

We can divide games into two categories: games whose outcomes are determined by a deterministic, low-complexity algorithm and those that are not[2]. Examples of the former are myriad and include chess and checkers as well as complex war games. Matches of even the largest of such games can be easily represented as a list of moves taken, and the algorithm to decide the outcome of the game consisting of those moves is trivial.

Even real-time video games ranging from Super Mario Bros. to modern first-person shooters are deterministic over a set of inputs and starting game state and have relatively simple game state representations (that may be embellished

[1]This is a modification of the well-known Shannon number—$10^{120}$—which assumes there are 30 legal moves at each ply over a game of 80 plies (Shannon 1950). Grime (2015) instead substitutes 3 as the approximate number of "sensible" moves at each ply.

[2]The authors of this paper are not aware of any popular games with a deterministic outcome but a highly computationally complex decision algorithm.

by entertaining graphical representations). This is evidenced by the efficiency of multiplayer network code and the existence of shareable sequences of inputs for recreating gameplay on another computer, e.g. tool-assisted speedruns or Doom demos (Lowood 2008).

The other class of games is those that are not deterministically decidable by an algorithm, either because of a game state that is not tractably representable or a subjective scoring system. Examples of such games include artistic competitions, sports, and some board games such as Apples to Apples (Kirby and Osterhaus 2007). Due to their complexity, these games often fulfill the desiderata for games that admit creativity. However, we propose that algorithmically decidable games that admit creativity are especially interesting to computational creativity research.

Such games provide unique opportunities to study creative tasks that have outcomes of deterministically decidable quality, i.e. their contribution toward winning or losing the game. Evaluating the quality of a creative artifact is a central challenge in computational creativity and is often very difficult. Free-form creative domains in the arts often have no agreed-upon subjective evaluation criteria among human critics, let alone computationally tractable ones.

If a game satisfies the two desiderata presented herein, we argue that playing the game qualifies as a creative task. The creative agent fulfilling the task is working within a large space of possible artifacts that compare meaningfully with each other, the agent's creative responsibilities inform how the artifact space is searched, and both the agent and their audience can evaluate the quality of an artifact.

## Connection to Creativity Theory

In this section, we explore how the desiderata for creativity-admitting games that we have presented relate to existing theories of creativity. We will demonstrate that they reflect important considerations for reasoning about creativity.

Ritchie (2007) introduces three necessary qualities of an artifact that is to be considered creative: novelty, quality, and typicality. If an artifact exhibits these properties, then it follows that the agent responsible for the artifact's creation behaved creatively. As we are evaluating game rulesets instead of single artifacts, we instead interrogate whether the game's task can produce artifacts with these qualities. In other words, we say that the space of possible moves at a given ply admits creativity if the artifacts in that space can be meaningfully novel, high-quality, and typical.

The relationship that deterministically decidable creative games have to these qualities makes such games notable and interesting for computational creativity research. Under this theory, creativity requires novel, high-quality, and typical artifacts. Games enforce typicality through the rules and social contract the players enter into when playing the game. We have discussed how deterministically decidable games represent a uniquely tractable means of evaluating quality. Our desiderata of a large space of meaningfully different possible moves reflect whether the task of playing the game allows for novelty and quality in its output artifacts.

For a counterexample, consider the googol guessing game. Of all the guess artifacts that comprise the space, one is correct and the others are incorrect. Artifacts in the space do have different quality measures, but the space admits neither the richness nor nuance of differences between the quality of two given artifacts that characterize creative domains. Worse still, all artifacts in the space have the same novelty: they are all equivalently uninteresting guesses. No matter how many artifacts the game player generates, none of them are novel, and therefore the act is not creative (Colton, Pease, and Ritchie 2001).

Instead of focusing on qualities of creative artifacts, the creativity tripod described in Colton (2012) describes three capabilities that an agent must necessarily display to be judged as creative: skill, appreciation, and imagination. Through this lens, we can reason about whether a given game task requires these capabilities and allows an agent to express them. Appreciation is the agent's skill that allows them to evaluate the quality of an artifact. Thus, just as a quality measure is implicit in the rules of a deterministically decidable game, that same decision algorithm can be run by the agents playing the game. Thus the game requires and exercises the agent's appreciation.

Skill is a requirement for playing all but the most simple of games, whether they admit creativity or not. The more difficult or complex the game, the more skill is required. Many games that do not admit creativity still require skill, such as agility- or precision-based competitions. Even executing a known strategy in a solved game such as checkers (Schaeffer et al. 2007) can be considered skillful if that strategy is complex enough. Successfully navigating a space of possible actions large enough to admit creativity is certainly a skillful endeavor. Highly strategic games that are not open or complex enough to admit creativity—which are not the focus of this work—fall somewhere in the middle of a spectrum of games that require low skill, to games that require high skill, to games that admit creativity.

Along similar lines, we may consider imagination as a factor that distinguishes between strategic play and creative play. Although it may take skill to execute a complex strategy, it by definition does not require imagination. Inventing new approaches to problems or finding especially clever lines of play are only possible in a game that satisfies our desiderata and admits creativity. An agent must have imagination to successfully play such a game.

## Example: Codenames

We can apply our desiderata to games to examine the degree to which they admit creativity. We will use Codenames (Chvátil 2015) as an example of this analysis.

Spendlove and Ventura (2022) presented Codenames as an example of a creative language game and claimed that playing the spymaster role in the game was a creative task. Codenames is a game of communicating secret information via one-word clues. The game is played with two teams using a grid of 25 word cards dealt from a large deck. One member of each team is the spymaster, who can see a secret key that shows which of the word cards belong to their team, the other team, or neither team. Teams take turns with the spymaster giving a one-word clue related to the team's word cards and a number that signifies how many such cards the spymaster intends the clue to relate to. The rest of their team then guesses one word card at a time, and its secret role is revealed. Any incorrect guess ending the team's turn. The goal is for each team to identify all of their cards before the opponents identify theirs.

The spymaster's task is to come up with a clue word that relates to some subset of their team's word cards while *not* relating to any of the other cards. This can be represented as a graphlet with connections between a potential clue word and any word cards it relates to, positively or negatively. Because the clue word can be any English word, there is a very large number of such graphlets the spymaster must consider. Furthermore, as the game progresses and some word cards are guessed, they are removed from the set under the spymaster's consideration, changing the creative task from ply to play. Codenames, therefore, fulfills our desiderata for admitting creativity. Many different sets of targeted word cards and clues can be selected at any given ply, and clues can be obvious (likely relating to only one word card) or surprising. High-quality clues will lead the spymaster's teammates to correctly guess the intended word cards, while low-quality clues will result in fewer or no correct guesses.

Additionally, Codenames is decidable by a very simple algorithm. Regardless of the complexity of the task of selecting a clue, a team's turn consists of a clue and a number of guesses that update the game state, both of which are simple to represent. Given a starting state and a history of guesses, it is trivial to determine both who wins the game and the useful intermediate measure of how many of each team's cards remain. Thus, Codenames also fulfills the additional decidability criteria. By this analysis, Codenames is indeed a creative task with a tractable evaluation metric that merits further computational creativity research.

## Future Work

Our desiderata for determining creative gameplay can serve as tools to interrogate a spectrum of games and rulesets. Most notably, we see potential in examining how the creativity admitted by a game changes as its rules are changed. Identifying a cross-over point in a series of game tasks that share similar rules could provide more specific insights into how rules shape play spaces.

Similarly, there is potential for more granular analysis of games as they naturally evolve over the course of play. For example, chess openings and endgames can be memorized and solved to some extent, but the middlegame still represents a space of possible moves large and complex enough to admit creativity.

Finally, this work could serve as a useful tool for game designers. A legitimate goal for a game designer is to design a game that admits creative play. Having a framework for reasoning about the creativity admitted by a game could aid game designers in analyzing and improving such games.

## Conclusion

Games may represent a fruitful vein for computational creativity research; their concrete win and lose states could serve as a unique foothold for evaluating creative artifacts. However, because games differ from more traditional creative domains, it may be unclear whether playing a given game is truly a creative task.

In this paper, we have described considerations for how creativity in games can be analyzed. We introduce the desiderata that a game have a large enough space of possible moves and that those possibilities differ enough to allow for a range of novelty and quality. Through this lens, we may identify the hallmarks of a creative domain in gameplay.

With confidence that a given game admits creative play, computational creativity researchers can take advantage of the uniquely tractable aspects of gameplay as we pursue a greater understanding of creativity and more successful computer agents that execute creative responsibilities.


## Acknowledgments

None.


## Author contributions

Both authors contributed equally.

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