

1 Basics

We begin our survey of game characteristics with three so basic that they influence all the others. The first two, length of playtime and number of players, are familiar to everyone. Anyone, when asking a friend about a game, might well ask how long it takes to play and how many players it requires. Most boardgames give this information on the back of the box. But even though this information is basic and seemingly simple, there is actually quite a bit of complexity hidden here, and we try to unpack some of it.

Our third basic characteristic, heuristics, may seem more esoteric. But by "heuristics" we simply mean the rules of thumb by which players play games ("develop your pieces" in chess or "never draw to an inside straight" in poker). When players discuss among themselves a game they know, it is these heuristics that they talk about. Given our goal of analyzing games from the point of view of thoughtful players, it's only natural that game heuristics should be a basic characteristic for us.

1.1 Characteristic: Length of Playtime

It is easy for hardcore players (including most game reviewers and game designers) to underestimate the importance of game length and the cost a long playtime imposes on players, especially more casual ones. But game length is probably one of the most important characteristics people use when deciding whether to play a game: picture someone saying to a friend "want to come over and play a game?" The answer is very likely to depend on how long that game takes to play. And if the game is going to be played in some specific time slot-over lunch, say-the players will want to pick a game that can be played comfortably in that amount of time.

Note that the amount of time a game takes to play is not just a property of the game itself, but of the community that plays it—that is, length of play is agential. The African game of mancala (actually a family of related games, such as kalah and oware) is played with great rapidity in Africa, although Europeans and Americans who play it are liable [to do so at a slower speed.](#) Chess in the West is often played relatively slowly, with games that last over an hour not being uncommon, but Eastern versions of chess, no less complex in terms of their rules, are generally played at the speed of casual checkers in the West (perhaps because the game go has taken up the "serious" gaming niche in the East that chess occupies in the West). The advent of the chess clock has meant that chess has to some extent become two different games: "normal" chess, where the total clock time is around two hours per player, and speed chess, where the total clock time can be five minutes per player. These two games have (slightly) different rules, different rating systems, and somewhat different player bases. This splitting of the audience is merely a more formal version of a phenomenon common in many turn-based games: casual players like to play quickly, more serious players prefer to spend more time on their moves, and thus informal conventions arise within different play groups as to how long a game is "supposed" to take to complete.



Figure 1.1

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As the length of time to play a game changes, it can affect many other characteristics of the game: skill, randomness, costs and rewards for playing, how pleasing the game is to watch, and so on.

Units of Gameplay Length

To discuss length of playtime in more detail, it is useful to break down units of play into various pieces of (usually) increasing length:

Atom The smallest complete unit of play, in the sense that the players feel they've "really played" some of the game (e.g., two possessions in football, or one level in Donkey Kong)

Game What is conventionally thought of as the length of the game—a "standard" full round of play (most typically starting from a standard beginning state and ending with the determination of a winner)

Session A single continuous period of play (e.g., an evening of play)

Campaign A series of games or sessions that are all linked in some way (the weekly poker game at Randy's place, a match, or an ongoing paper role-playing game)

Match A series of individual games commonly agreed on as the correct amount of play in order to arrive at a satisfactory determination of the victor. For many games this is merely "best two out of three" or similar grouping.

Depending on the game, some of these categories will make more or less sense. The categories are also sometimes subjective (especially the atom).

For example, take poker. Here, the atom is probably a single hand. The game may last until a player cashes out or gets knocked out. A session would be an evening of play, and a campaign would be an ongoing game featuring the same players. For tennis, an atom might be a couple of games or even a set, a game would be a standard tennis match, and a session might be several matches in a row, or perhaps a tournament. A campaign might be a professional tennis season, or an ongoing series of games between two friends who compare their progress. With Donkey Kong, an atom might be a single level, a game would begin when you put in your token and end when you ran out of lives, and a session would be the amount of time you spent in the arcade playing Donkey Kong that day. There might be no campaign involved, but if you went to the same arcade regularly, trying to improve your position on the high-score board, then there would be.

Note that the campaign ties in very much with the "metagame"; see section 7.1 on that topic.

Typically the game is the most clearly defined unit of play, but there are exceptions even to that. Poker was already mentioned; World of Warcraft is another example. Some playgroups might play bridge hand after hand, without necessarily keeping game score. If a game has separate stages, like bridge, a game probably needs to include each of the stages to be considered a game: you could argue that bidding to a contract is an atom, and playing the hand is an atom, but either one alone can hardly be a game. You would need to bid and then play a contract at the very least to call it a game, even informally. Of course, to have an official game of bridge you'll need to play several hands so as to reach the required point total.

Not all games have matches, but many do. The most common form is simply to play a fixed number of games, with the winner of the majority being the winner of the match (extra games that won't affect the match outcome typically are not played, so for example a best three out of five match will end as soon as one player wins three [games](#)). [Often matches are used as a sort of "extended game": if the game length is short, playing best three out of five is a way to play a longer game. Playing more games makes it more likely that the better player wins the overall match, and when determining the best player is an important goal, matches can become very long-championship chess and go matches, for example, can consist of many games played over a period of weeks or even months.'](#)

So a match can be shorter or longer than a session. Multiple matches may take place inside a session, for example when playing a trading card game, or a match may be longer than a session as in the playoffs in many sports. The length of a match often varies with a particular subset

of its player base. The interaction between players' skill and the game's inherent randomness sets the tone for what feels like a satisfying amount of play in terms of deciding a winner. Sometimes this lines up with a single game, but it often requires more play at higher levels of competition.

Note that although a game is generally shorter than a session, that is often not the case. A particularly long game (a complex hex wargame might be a paper example) could be broken up into several sessions. This is very common, even standard, with single-player computer games, due to the ability to save games in midstream. Even paper-based RPGs are rarely completed in a session.

An atom practically has to be shorter than a session: since the atom is the shortest satisfying unit of play, and a session is the amount of time you actually play, an atom longer than a session is not a pleasing experience. In fact, you really need the session length to be a multiple of the atomic length-that is, you want to end the session by completing an atom (if not an entire game). The shorter the atomic length, the easier it is to achieve that, and incidentally to be tempted into playing just a bit more ("let's play one more hand" in a card game is a lot more common than "let's go on one more raid" in an MMO). Computer games with save points that you can't reach before your session ends are one example of failure in this regard. Even if you can save anywhere, though, players will prefer to save at a point where they have reached a "logical stopping point" (finished a turn, killed a boss, completed a quest)-that is, finished an atom. In general, "good" atoms are ones that are fairly short, and fairly distinct, so that players can stop when they like and still feel they have had a satisfying experience.'

There are many pressures keeping atom length long, however. Players may tend to feel a greater sense of accomplishment in longer tasks.

Very often there is something like a downtime between atoms, whether that is shuffling, switching offense and defense in certain sports, or merely waiting for a computer game to save or a level to load. In each of these cases, more atoms inside a given session length leads to more downtime for the player. Also of note is that in simulation games a short atom may simply be unacceptable for appropriate suspension of disbelief.

With all of these issues, the agential nature of session length should be kept in mind. An atom length longer than the session length for a certain group of players is very likely to result in having those players cease playing the game. Thus large raids in the average MMO taking longer than an hour effectively exclude players who can only play on their lunch break. MMOs with long raids must then provide shorter atomic lengths in other areas of content to keep those customers, such as quests or grinding.

The different levels of atom, game, match, session, and campaign are of course interrelated. Longer atoms means longer games, or else fewer atoms per game. Long games make it harder to have multiple games per session. Tournaments (which can be thought of as extra-long sessions having some elements of a campaign) can be held in a day if the game length is short, but will be much harder to run if the game length is longer. If tournaments take too long to run effectively, they may not exist and instead something like a sports season-which is essentially a tournament spread out over many months-will become the standard campaign for that game.⁴

Some Examples

Let's go through a number of game genres with these concepts in mind.

Party Games

Games like Pictionary or charades tend to have very short atomic lengths. In the case of charades, the atom is probably more important than the game: it is very natural for people to play for however long they would like to play. Arguably there is no "game" as such, but really just atoms and sessions (in this sense, charades is similar to poker). If there is an identifiable game, it may be as simple as an agreement among the players to play a certain number of atoms (or for a certain number of minutes) and then declare a winner.

With for-purchase games, there's usually some well-defined game that comes built in (in the case of Pictionary, reaching the end of the board's track), but it often feels somewhat artificially imposed on top of a charades-like fundamental layer.

Campaigns do not tend to be part of party games except in a very informal way. This informal sense of campaign (memories of who did well in past games among a given group, for example) can be very important to the players, but every game that's played repeatedly among a given group of players shares this feature, so it is not a feature of any particular game.

Complex Paper Wargames (e.g., Third Reich)

When the game is long enough, it goes over several sessions. The atomic unit (a turn for each player is a reasonable choice of atom) is already as long as many other games. There is no real need for a campaign, because the game itself fulfills many of the needs players might have for a campaign in a game of less epic scope.

Paper RPGs (e.g., Dungeons & Dragons)

Here the atoms are less clear, due to the variety of gameplay; a round of combat or an encounter might be reasonable choices. The game (as a

unit of length of play) hardly exists at all, since there's no winner or loser declared and no specified ending condition.' The focus is on the session and on the campaign.

Single-Player Computer RPGs (e.g., Diablo II)

The total number of hours a player might spend could be similar to those spent in a complete paper RPG campaign, but because there's an ending condition we think of Diablo II as having a very long game length, not as a campaign with no real game like Dungeons & Dragons. Due to the save-game feature, the atoms are more flexible (and thus sessions easier to end at an appropriate time). However, a natural atomic ending is finding a new teleporter, as any Diablo player who has stayed up later than planned looking for the next teleport pad knows. For some players, Diablo doesn't really have a campaign, for reasons similar to that of Third Reich: just the game itself is long enough. For others, experimentation with different characters might be considered a kind of campaign.

MMRPGs (e.g., World of Warcraft)

A game like WoW is an interesting hybrid of the previous two cases. The atoms are varied in length. Longer atoms, like going on a raid, are reminiscent of paper RPGs. Shorter atoms, like checking the auction house or gathering some herbs, might be closer to Diablo. (Also, in Diablo, it's possible to interrupt an atom by saving in the middle of it, whereas in WoW, like a paper RPG, it is not possible to do so without the agreement of the other players.) In that it has no game but only a campaign, WoW is much more like a paper RPG than like a single-player computer RPG.

Classic Card Games

To take just two examples, recall that in poker an atom was a hand. The short length means you can play quite a few atoms in a session. What might otherwise be an informal campaign (like those of party games) is made more formal by means of a long-term tracking tool: money. It's quite natural for people to think about whether they are up or down over the course of several sessions, if they don't track it explicitly.

For rubber bridge, there's an atom-the hand-but also an explicit game made up of around two to five hands. Some playgroups ignore the explicit game and just play a series of hands in each play session. Most playgroups just have informal campaigns, but there are also leagues, and the recording of masterpoints gives an explicit campaign structure (here, the length of the campaign is one's entire bridge-playing career). Note that in duplicate bridge, a single hand may be considered a more satisfying atom than in rubber bridge, because a team's quality of achievement is more measurable on a single hand, and because each hand is more independent.

Chess

Here the game can be fairly long, but there is no atom shorter than the game (one could argue a turn for each player is an atom, but this would be extremely unsatisfying). This makes chess less satisfying as a game to squeeze into a few empty moments. The game length is close to a good session length. Thus sessions are less flexible (there's no short atom to let you end when you want, so you need to complete the game) but satisfying if you can find the time (you get to complete a game, and you've played a decent length of time when you've finished that game). Campaigns are broadly similar to bridge (none/informal, leagues or clubs, and lifetime ratings).

Monopoly

This game shares with chess a somewhat long playtime with no reasonable subset of the game being satisfying as an atom. Socially Monopoly has more in common with party games, so its campaign structure tends like theirs to be informal.

Sports

Football, baseball, and basketball are all broadly similar in terms of game length and in terms of campaign structure (leagues, often informal, at the very casual level, with seasons at the level of school or professional sports). The interesting difference is in terms of atoms: for basketball, the atom is very short, perhaps a possession or two for each side. The football atom is probably a possession for each side, which is a lot longer. In baseball, it is at least an inning for each side and very likely multiple innings so each player has a guaranteed chance to bat.

Hockey and soccer are similar to basketball in having short atoms, but the atoms are less sharply defined. The fluidity of these games means they are closer to continuous than atomic, compared with a game like basketball where there are more distinct drives in which the teams alternate possession. Football's atoms are a bit more distinct than basketball's, and baseball's much more so.

Injury time in soccer (where the referee adds a certain amount of time to the game to make up for missed time due to injuries, substitutions, and the like) can be thought of as a way of ensuring the game ends on an atom. Injury time means the game ends at the sole discretion of the referee, who is likely to end it when an action has been completed, rather than, say, at the moment a shot is headed toward the goal. A similar aim is achieved by the basketball rule allowing a shot to count if the buzzer sounds while it is in midair.

First-Person Shooters (e.g., Quake)

In an FPS, the typical atom might be the time it takes for a kill (either you are killed and then respawn, or you kill someone and then go look for another target). All the advantages of short atomic length, such as quick satisfying play experiences and the ability to fit play into your real-life schedule easily, exist for an FPS. Like poker, an FPS is often played as a session of atoms strung together, with no actual game per se. Formal campaigns are possible but rare. In fact, the game length structure of an FPS-at the atomic, game, session, and campaign levels-is very similar to that of poker, something that might be hard to notice if one were not looking at this characteristic specifically.

From Stickball to Basketball

In the early twentieth century, children played stickball. Now the street game of choice is probably basketball. Basketball's success as a game of street culture has often been attributed to its lighter requirements in terms of space (versus baseball) and equipment (versus football). But another possible factor is basketball's shorter atomic length. Given a limited period of time, such as a lunch break or recess, it is possible to play a satisfactory amount of basketball but harder to play a satisfactory amount of football or baseball. Even a longer period of time, if it is of uncertain length (as is often the case in pickup games), benefits from having a short atomic length. Basketball's shorter atomic length may not be the main reason for its relative increase in popularity, but it does seem like a prerequisite given the modern pressures on children's leisure time.

Real-Time Strategy Games (e.g., Starcraft)

Because RTS games, like chess, progress through an early game, middle game, and endgame, their atomic structure is less distinct. One could declare an atom to be a few minutes of play, or a single battle (or round of base building), but there's no really clear atom. Probably it's

better to just think of the atomic length as being equal to the game length. A session maybe a single game over lunch, but it's often an afternoon or evening of several games.

Campaigns come in two different forms: in its single-player mode, an RTS usually has an actual series of linked scenarios that form a campaign. That campaign usually comes with a storyline or with a metagame of some sort (e.g., a conquer-the-world Risk-type map).

A multiplayer campaign (in our sense of the word campaign) is occasionally a "season" along the lines of a sports season, but more commonly it is centered around a leaderboard or a ratings system.

Platformers (e.g., Super Mario Bros.)

The original arcade platformers (e.g., Donkey Kong) had single screens as atoms. This evolved into "worlds" or "levels" as atoms in console platformers. As these atoms became longer, it became more annoying to replay them every time one wanted to play the game again, so save points were introduced: one could save the game at the end of a level and then resume play from that point. As game length continued to increase, at some point a level seemed more like a game than an atom, and a game seemed more like a campaign. Arguably, a complex modern console platformer has atoms something like "a few minutes of play," a game is completion of one level, and a campaign is the completion of the entire (purchased) game.

This trend is fairly common with deliberately designed games: a game may begin with a short game length and short atoms, but over time designers attempt to satisfy their more serious fans by adding content, which tends to make the atoms and the games longer.' Note that as the games get longer, they essentially become campaigns, which may not always be a good thing-it may make short satisfying play

experiences less available to the players, and it can drive out the possibility of other campaign structures. Since many players like shorter games, the longer games may appeal to a narrower audience, opening up a space for newer shorter games: think of the relatively broad appeal of the old NES games, the often longer and more complex games on the Playstation 3 or Xbox 360, and then again of casual web games or Wii games. (Of course, complexity is a factor as well as play length, but the two are correlated, and more or less the same remarks apply.)

Atoms and Points

Many games with "good" atoms (short atoms with clear and satisfying boundaries) are point-based. At the end of each atom, points are recorded, and the winner of the game is the one with the most points at the end. Such a structure allows players to play a more or less complete minigame in each atom, so that atoms are satisfying. Games that benefit from this kind of structure include poker and most sports games. Games like chess or an RTS, which have a binary victory condition (kill or be killed), tend not to have such satisfying atoms shorter than the game itself. Note that if the atom is short enough and the game long enough, so that many atoms will be played in a single game, it's common for binary victory conditions to become points-for example, kills in an FPS. There are exceptions, of course, to the rule that points make for good atoms: the game go is point-based, but because points can only be calculated effectively at the end of the game, they don't serve as a basis for an atomic structure, and go winds up being more or less like chess in terms of its atomic structure.

To summarize, game length has a great influence on how players interact with a game and, indeed, on whether they choose to interact with it at all. When looking at game length, it helps to look at the

length of the game's atoms, the game itself, the session, and the campaign.

In general, players will be happiest to end their session by completing an atom, if not a full game. This makes games with short and satisfying atoms easier for players to fit into their lives. Sometimes keeping the atom or game length short can conflict with other goals the game might have, such as complexity or development through the course of a game. Very often, though, a game designer can support those other goals and still support short atom and game lengths (save-game features are a very simple example of this).

In particular, there's nothing wrong with having a very short game. If players want a longer game experience with a short game, they can simply play again. If players want a short experience in a long game, it's much harder for them to find a satisfactory solution. Games with short play lengths or short atoms, such as poker and basketball, do not seem to suffer for it.

Exercise 1.1: Name some computer games whose atom length is longer than their session length. Name a sport whose game length is longer than its session length.

Exercise 1.2: What are some potential drawbacks of short atoms?

Exercise 1.3: Different sessions of the same MMO can have quite different lengths. What are some common session lengths for MMO play? What real-world circumstances cause them? How do MMOs satisfy these different desired session lengths in terms of their atomic lengths (i.e., what about MMO atoms makes them fit, or fail to fit, in various session lengths)?

1.2 Characteristic: Number of Players

How many players a game has seems like a simple enough question, but there is a bit to untangle. In many ways, the number of sides is even more important than the number of players: football, for example, is a two-sided game and thus takes on many aspects of a two-player game, even though it has many players. In particular, there are some issues (such as politics and kingmaking) that only arise in games with three or more sides.

When we speak of a "multiplayer" game, we mean a game that has at least three sides (and hence at least three players) unless we say otherwise. In particular, we don't use the term multiplayer for two-player games; this is standard usage for all games other than computer games (where multiplayer is sometimes taken to mean three or more players, but sometimes taken to mean two or more, in contrast to single-player games).



Figure 1.2

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In this section, we'll categorize the number of players a game can have, and discuss a few examples. Later chapters will discuss issues arising from the number of players in more detail.

Categorization by Number of Players

[Zeroplayer](#) Some "games" can be observed, but there are no players who influence the outcome. These are games only by common parlance. John Conway's game of Life is one example. Another is Progress Quest, a parody computer RPG in which the player does nothing but observe his character leveling up and gathering treasure by

fighting monsters automatically. Closer to a "real" game, but still not very close, is "raindrop races": a bored person on a rainy day chooses two raindrops on a windowpane and sees which one makes it to the bottom first. The anthropomorphization of the raindrop contestants makes this very much like a real game from the spectator's point of view, but there are no (conscious) players.'

One-player It is useful to break one-player games into two categories, namely,

"Pure" oneplayer Games where the player plays more against "the system" than against an imaginary opponent. Crossword puzzles, Tetris, card solitaire, Zork or Myst, and Asteroids all fall into this category. Arguably even going out for a run (especially if you are timing yourself) would fit. In addition to having only one human player, these games have no playerlike elements in the game that behave like the player (e.g., when you play Tetris, there is no computer player arranging blocks in the same way you are).

One human, simulated opponents ("one and a half player") This category exists almost exclusively in the computer world.' A human plays one side of the game; the computer AI plays other simulated opponents. The simulated opponents may follow essentially the same rules a human would (e.g., playing Starcraft against the AI) or may have their own rules (e.g., playing Diablo against the AI-controlled monsters). Almost any computer game that has a multiplayer version falls into this category in its single-player version. Other examples include Civilization, any first-person shooter, and Mortal Kombat. Platformers fall somewhere between this category and the pure one-player category, depending on how active the enemies are (trying to jump onto a certain platform is a one-player experience; fighting a boss is a simulated twoplayer experience).

One may think of such games as a kind of Turing test-if you can write a good AI, you've passed a Turing test in a limited domain, in that the (human) player experience [maybe quite similar to the experience that player would have against another human, at least in terms of gameplay.](#)⁹ With poker bots, this is literally true: go online, and you don't always know if you're playing against humans or bots.

To some extent, any one-player game can be thought of as a one and a half player game depending on how much you wish to anthropomorphize your opponent. Thinking of the computer as resembling a human opponent seems quite natural in a oneversus-one RTS battle against a computer AI, fairly natural with a computer RPG, but a bit strange when playing Tetris or (card) solitaire. There is in effect something of a continuum from one-player games to one and a half player games to two-player games where the gap is bridged by computer AIs who may or may not play by the same rules as humans and whose existence may or may not even be known to their human opponent.

[Twooplayer This is the core category in the sense that two-player games feel like the "best" examples of games \(in the same way that the sparrow feels like a particularly good example of a bird\).](#)¹⁰ There are countless examples, such as chess, gin, Battleship, Scrabble, tennis, most trading card games, most miniatures games and wargames, and Starcraft. Note that many of these examples have multiplayer variants. Some games that are commonly multiplayer can also be played two-player, such as basketball or Quake.

Two-sided team games These are games where there are two sides or teams. Each side plays (or tries to play) as a single entity, and each side wins or loses as a unit. Examples include football, team shooters (e.g., Counterstrike), bridge, Mafia/werewolf, and Axis & Allies.

In general, two-sided team games have more in common with two-player games than they do with true multiplayer games. In particular, the political issues unique to multiplayer games, such as kingmaking, do not appear. If one imagines a team as a kind of complex player, two-sided games just reduce to two-player ones. The one difference is in the interteam dynamics—that is, how a single player interacts with her teammates and contributes to the team effort.

One-sided team games A game can have a single side playing against an AI (or against the rules of the game); this is simply the team analog of a single-player game, in the same way two-sided team games are similar to two-player games. One-sided team games are commonly referred to as "cooperative games." Examples include Gauntlet, Knizia's Lord of the Rings boardgame, fighting a raid boss in World of Warcraft, or playing Starcraft as a group against the AI. Although it may vary based on a particular group's style of play, this is the most common way to think of paper role-playing games like Dungeons & Dragons as well. The distinction between "one-player" and "one and a half player" applies here as well.

Multiplayer This category includes games where there are several players or sides (at least three), each pursuing his or her objectives." Examples are golf, a marathon, poker, Trivial Pursuit, Scrabble (again), first-person shooters, (free-for-all) Starcraft, Candyland, Risk, and Clue.

Note very few high-interaction sports or high-interaction classic games fall into this category." Traditionally, these genres have only achieved a true multiplayer state at the cost of very low player interactivity. We'll discuss this more in the next chapter, but for now we'll just note that high interactivity and the ability to have multiple players (both desirable things in and of themselves) are very difficult to

combine well.

Massively Multiplayer This category encompasses games where the number of people a given player interacts with is much smaller than the number of people playing. World of Warcraft, Everquest, Killer and other live-action assassin games, and parimutuel betting are examples. The stock market or war might count as examples, but the stakes are high enough that people generally do not classify them as games.

Given these categories, it's not hard to come up with other possibilities. An RTS game might have three humans and three AI opponents, either as teams or in a freefor-all. There are multisided team games, such as Dark Age of Camelot PvP or a team bicycle race.

Games that allow a varying number of players often have a "sweet spot"-the number of players where the game is best. For example, hearts is probably best with four players. Pari-mutuel betting just needs to be "large enough," but there's no upper limit: ten thousand players or a million players both look the same to an individual player. Most people would consider the sweet spot for Texas Hold 'Em to be eight or nine players. With World of Warcraft, the sweet spot is probably in the 1,500-2,500 range; fewer than that and the server seems empty, more than that and not only is lag an issue, but the crowding limits comfortable access to mobs, questgivers, vendors, and so on.

Sweet spots are usually agential. Scrabble provides an excellent example where for a certain competitive section of the audience the two-player game is the clear sweet spot. A more social or casual group of Scrabble players will often prefer a full game of four.

Single-Player Games

Before computers, single-player games were relatively uncommon.

When people think of traditional games, they tend to think of two-player games like chess, or games for even more players like hearts. There are some exceptions to this rule. Certain sports such as racing or weightlifting can be done alone as well as in groups, although doing so may be considered practicing or training rather than "really" doing the activity. Puzzles of various kinds (crossword puzzles, jigsaw puzzles, sliding block puzzles) are meant for one person. Interestingly, though, the noun game and the verb play aren't generally used for these activities-you don't call weightlifting a game, or play a crossword puzzle-perhaps indicating these activities feel less like "normal" games to most people. Other notable examples of single-player games include card solitaire (typically considered a game, perhaps because the platform, a deck of cards, is so strongly associated with other activities labeled games) and slot machines (in fact, many gambling games are single-player, with slots being perhaps the most extreme example). Overall, though, the activities earlier generations imagined on hearing the word game involved two or more players.

Exercise 1.4: Why do you think we use the verb play and the term game with blackjack, the slots, or other gambling games, when we don't use it with things like crossword puzzles?

Perhaps one reason for the historical scarcity of single-player games is simply that nonelectronic single-player games are hard to make. Uncertainty in outcome¹³ is at the heart of games, and a human opponent provides much uncertainty. In fact, if the game is fair and the opponent is equally skilled, then one's chances of winning (in a two-player game) are 50/50-maximal uncertainty.

Without a human opponent, uncertainty needs to come from somewhere else. Sometimes, as in card solitaire, the game rules plus a built-in randomizing mechanism provide enough uncertainty.

Sometimes, as in crossword puzzles, the uncertainty comes from hidden information or human ignorance, although in that case the game's content may be exhausted-having done the crossword puzzle once, you won't want to do it again. To keep playing, you'll need fresh content. (And indeed, one can think of the rules for some layout-heavy card solitaire games as a sort of automatic randomized puzzle generator.) Thus single-player games are more prone to exhaustion (i.e., have less replayability) than multiplayer games. This is not to say that individual single-player games can't be very replayable, just that on average multiplayer games tend to be better for repeat play-and indeed many electronic games are designed with a single-player core meant to be played by all, and a multiplayer mode meant to give a high degree of replayability for those who want more.

However, computer games are very often played alone. Indeed, before computer networking was common, PC games were almost always single-player. Even arcade games, which tend to be played in social spaces, almost always have a single-player mode, and many have only that mode, with social play consisting simply of score comparison.

Some computer games (e.g., *Myst*) take the same approach as crossword puzzles. Some (e.g., *Minesweeper* or *Tetris*) are like card solitaire-generating a randomized puzzle. However, computer games have a third option: create a simulated opponent. Doing this in a paper game is awkward at best (a few wargames do it, with exact instructions for playing the other side). But in a computer game the level of complexity a simulated opponent requires can be hidden from the player, and highly complex opponents can be created. Even fairly simple opponents, like the ghosts in *Pac-Man*, can provide a lot of uncertainty (although good players will eventually learn the patterns involved if there's no randomness in the system-in a sense, *Pac-Man* changes from a game to a puzzle as you get better at it). Even if a

computer game opts for the handcrafted content-providing ("puzzle") approach, or the randomized scenario-generating approach, the computer's ability to store information and execute algorithms helps to provide more complex content with a lower burden on the player. (The occasional downside is that hiding the details of how the system works from the player can make it harder for the player to understand what's going on and how she should play the game-that is, it makes it harder for her to climb the heuristic tree.)

The risk of low replayability may be their natural disadvantage, but single-player games have some big natural advantages as well. The greatest of these is the ease of getting a game started-if you want to play, a single-player game lets you start right away without having to find anyone else. Also, people like winning (although they may get bored if you let them win all the time), and with a single-player game a player can win more than half the time, something impossible on average with a two-player game. If a designer thinks people would be happiest winning about 70 percent of the time, she can make a game where that's what happens (or make a game with multiple difficulty levels, which amounts to making several games, with players choosing how often they'd like to win by choosing among them). Single-player games also benefit from having player performance that is more comparable: if we each play games of [chess or Quake, and I win mine but you lose yours, it doesn't mean much](#)¹⁴ about our relative skills-too much depends on the quality of our opponents. But we can compare our scores in Tetris, or you can boast that your guild has defeated Onyxia (a boss monster in World of Warcraft) before mine, and the comparison means something.

Note that all the pros and cons of single-player games are really about single-sided games: games where there is only one side, one team, trying to achieve victory. If that team has a single player, the game is a

single-player game; if that team has multiple players, then it's a cooperative game. The one exception to this generalization (of single-player attributes applying to single-sided games) is, of course, that the ease of getting a game together really does stem from there being exactly one player of the game.

It is also perhaps worth repeating that many single-player (or single-sided) games, especially digital games, have an opponent that is simulated in enough detail that much of the logic and analysis from two-player games still applies-what we've been calling one and a half player games. In other words, a game that technically has just a single human player might best be analyzed as a two-player game: playing chess against a computer is much like playing chess against another person, at least from the point of view of game mechanics (less so psychologically).

Changing Categories

Many games can be played in different forms (e.g., two-player or multiplayer) or have variants that allow you to play with a different number of players. Such flexibility is very powerful, but the game dynamics often change so much that it's arguable whether it's even the same game.

The power of changing the number of players comes in part because it allows players who like the game to play in different circumstances. Whether there are one, two, or a larger number of people together who'd like to play a game, the game that can support varying numbers of players is more likely to get chosen. Also, since the different options do vary so widely, fans of the game have the chance to have very different experiences with their favorite game.

[When the number of players in a game changes,15](#) the game

dynamics can become very different. Even a game like Scrabble, which on the surface seems fairly similar as a two-player game and as a four-player game, can change a great deal. In particular, the ability to restrict your opponent's play, and to modify the board in hopes of [improving your next play, both change significantly.](#)¹⁶ Other games, like team basketball versus one-on-one, change so much that one might not even consider them the same game. Above all, taking a two-player (or one and a half player) game and turning it into a game with three or more players can result in a great many unintended consequences; we'll have much more to say about this topic when we further discuss multiplayer games below.

[Sometimes it's easier to create variants involving different numbers of players from games that have a large number of complex parts, like Magic: The Gathering or World of Warcraft.](#)¹⁷ With such games, a designer has so many pieces to work from that there are many ways of [creating variants.](#)" Games with complex emergent behavior coming from simple rules, like chess or go, often fare less well under this treatment, but there are plenty of exceptions like basketball or first-person shooters.

[Some variants are easy to create: two-player games can often be converted into two-sided team games by allowing multiple players to share a side. A two-sided team game such as Werewolf or World of Warcraft battlegrounds can be made into a multiplayer nonteam game by assigning one point to each person on the winning team, randomizing the teams every round, and declaring the person with the highest point total at the end of the session the overall winner.](#)¹⁹

Two common ways of creating multiplayer games are by having several players simultaneously play one-player games more or less independently, or by adding more players to a two-player game. We

term these races and brawls respectively, and discuss them at length in the next chapter.

For games that do allow varying numbers of players, which variant is preferred is necessarily (being a player preference) agential, but systemic influences are important.

In face-to-face play, two-player variants (or one-player variants, if they exist) often have the edge over multiplayer variants simply because of the ease of assembling a smaller number of players. With computer games, even those for which the 2+ player versions are considered the "standard," the majority of play may occur in the singleplayer campaign; this is common for RTS games. It's much easier to assemble one player (yourself) for a computer game than it is to go online to play. Once you do go online, though, getting several players together isn't that much harder than finding a single opponent, so multiplayer variants are quite common. But hardcore players, if the multiplayer variants are highly political, may wind up preferring the two-player version (see section 2.3, on politics).

Exercise 1.5: What is the minimum number of players in a game of werewolf? (Hint: How low can you go before the game is predetermined?) Maximum? Sweet spot? Why is this the sweet spot? What is the number of sides in werewolf?

Exercise 1.6: Name some games you've played with a variable number of players. Name some two-sided games you've played with a variable number of players.

Exercise 1.7: Can you name a party game with a fixed number of players?

1.3 Characteristic: Heuristics

Many games, in order to satisfy players, need to allow players to gain mastery in the game over time.²⁰ Players typically gain skill by developing heuristics: rules of thumb that help them play the game.²¹ Some of these rules might be quite concrete ("never draw to an inside straight" in poker) and some might be fairly vague ("develop your pieces" in chess).

Discussions among players after a game are often about heuristics—what moves were most effective, what decisions could have been made differently, what the correct winning strategies are. "Monday morning quarterbacking" and other postgame analysis from spectators also tend to be about heuristics. And if someone asks "how do you play that game?" and they already know something about the rules, chances are they are looking, not for even more detailed rules, but for some basic heuristics. So although they may not use the term heuristics, players of games are very much concerned about heuristics, and discuss them all the time.

As an extreme example of the lack of heuristics, consider a game we'll call "Guess the Digit." Each round, we have a computer pick a random number between a million and a billion. We then each try to guess that digit of π ; whoever comes closest wins. This is a deterministic game (once the computer has picked the digit), but there are no apparent heuristics, so the game is essentially random for its players. Most people would have little interest in playing this game—anyone who wanted to play a purely random game would probably prefer rolling dice or flipping coins. Perhaps if one knew enough about the distribution of the digits of π , there might be some useful heuristics, and the game might become more interesting. But as it is, it's not much of a game, due to its lack of heuristics of any kind.



Figure 1.3

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It's useful to distinguish two kinds of heuristics:

Positional heuristics These are heuristics that evaluate the state of the game—that is, tell you who's winning. Examples include seeing how many people are ahead of you (and by what distance) in a race, or counting the point values of the pieces on each side in chess.

Directional heuristics These are heuristics that tell you what strategy" you should follow. Examples include rules like "run as fast as you can once you see the finish line" or "try to control the center squares."

For those familiar with boardgame-playing AIs, these can be thought of as board evaluation algorithms and move generation algorithms respectively.

Playing well in a game involves using these two kinds of heuristics in conjunction. The two kinds of heuristics are of course related-for example, one simple directional heuristic is "make moves that, when I apply my positional heuristics, look good."²³ Note in particular that if you have no useful positional heuristics (i.e., you can't tell which game states are good for you and which are bad), it's hard to develop any directional heuristics at all. On the flip side, "I'm winning if I've achieved a lot of my directional heuristic goals" is a possible state heuristic.

Although in general positional and directional heuristics support each other, exceptions are possible. Consider the following two games, "Money in the Bag" and "Money on the Table." In Money in the Bag, each player has access to two buttons, a red one and a blue one. Pressing the red button gives a player one dollar 80 percent of the time; blue gives one dollar only 20 percent of the time. Any money a player receives goes into a bag, and the contents of the bag are only revealed at the end of the game. Each player receives ten presses. This game has powerful directional heuristics "always press the red button!" is a perfect guide to play. But there are no state heuristics: which player is ahead is an utter mystery until the end of the game.

In Money on the Table, there is no bag; any money gained is placed on the table in front of the respective players. However, one button gives a dollar 51 percent of the time, the other only 50 percent of the time, and players don't know which is which. This game has very clear state heuristics (the amount of money on the table), but essentially no directional heuristics (players won't be able to deduce which button is

which).24

Besides heuristics, depending on the game, a greater or lesser amount of specific physical skills (running fast, aiming at onscreen targets using a mouse) may also be involved, as may a certain amount of reading out moves (if he goes there, and I go there, and then he goes there, what do I do then?).zs

Our focus, though, is not on how to win games. Why, then, are we concerned with heuristics? The answer is that for players to have fun, they need to have (not necessarily conscious) heuristics. Human beings playing games need to know if they are winning or losing, and they need to know what they want to do next. We say a game has "good heuristics" if there are heuristics available to the players that let them do these things. Note this is very much dependent on the player base as well as the structure of the game itself.

The phrase "good heuristics" is quite general, and it's important to ask "good in what sense?" Heuristics can be:

Clear vs. muddy How easy is it to understand and use the heuristics?

Rich vs. sparse How many heuristics does the game have? Do they cover most of the situations that arise in actual play?

Satisfying vs. unsatisfying Do players find the heuristics enjoyable to execute, or do they seem more like work than fun (highly agential, of course)?

Powerful vs. weak Do the heuristics provide a great deal of help in winning, or do they just nudge the heuristic user's chances up a bit?

In general, when we use the phrase "good heuristics" we mean good for

the game, in the sense that their presence makes the game more enjoyable. That includes being clear, rich, and satisfying, but it doesn't necessarily mean being powerful. Players who want to win will naturally seek out the most powerful heuristics they can, and in that sense they might think of powerful heuristics as "a good thing," but having extremely powerful heuristics may not be good for a game. Indeed, if the heuristics are too powerful (as in Nim or tic-tac-toe, where the heuristics tell you everything you need to win), they will be bad for players' enjoyment of the game. We discuss this topic further below.

Climbing the Heuristics Tree

[A great deal of enjoyment in a game,26](#) especially for more serious players, comes from the process of "climbing the heuristics tree": learning successively better and more sophisticated heuristics for a given game. For a more "serious" game, say chess, this process of learning is arguably the main appeal of the game. Of course, this learning and skill-gaining process is inextricably intertwined with the process of winning more often, at least against an imaginary fixed opponent. In practice, one often tends to find opponents of one's own level, and thus win roughly the same ratio of games, so the improvement may come from being able to beat better and better opponents.

For sports, and for computer games that rely heavily on reflexes, the heuristics are only part of the process of improvement, and specific physical skills are a large part of one's ability at the game. In a sprint, say, it's almost entirely physical skill, but of course there are many sports where heuristics play a larger part. Sometimes the heuristics are not so much at the individual-player level, but at the level of the coach or team manager. Even if the heuristic operates at an individual level, it

often must be thought of in advance, trained repeatedly, and then performed automatically during an actual match (think, say, of fencing).

But for games without physical skill, which includes many computer games and almost all boardgames and card games, one's improvement at the game is based on one's improvement in heuristics.

Heuristics at Different Skill Levels

Like most game characteristics, the heuristics of a game will be perceived differently by players of different levels of skill. In go, the heuristics are very unclear to a beginning player: they cannot tell who is winning, and they are often at a loss for what to do. In fact, beginners often have difficulty telling if the game is over or not!²⁷ Chess has excellent heuristics for absolute beginners (checkmate the other player's king, or failing that take his better pieces) and for advanced beginners (make advantageous trades according to the point value system, develop your pieces, control the center). But intermediate players may reach a state where they feel they are simply avoiding moves that are obviously bad, waiting for their opponent to err-the intermediatelevel heuristics for chess are not as friendly. Indeed, chess is sometimes described as the game where the winner is the person who makes the second-to-last mistake. Intermediate go players have a much easier time finding profitable moves, since many moves will increase one's score at least somewhat.²⁸

In some games, there are heuristics of sufficient quality that, once known, players can play perfectly (the game is "solved"). Tic-tac-toe is one such game (although arguably this is more a matter of reading out the game tree than heuristics per se). A better example is Nim. Note that for Nim, there are not many good heuristics for levels of skill

below the complete solution. Thus Nim isn't really a very fun game-it has an excellent one-time metagame for the mathematically inclined (figure out how to solve Nim), but it is hard to play an interesting game of Nim before you figure out the solution, and impossible to play an interesting game once both players know it. In particular, it is basically impossible to know anything at all about the state of a multiple Nim game until you have entirely solved Nim.

As an aside, note that the possibility of a game having heuristics so powerful that the game is "solved" does not depend on the game being deterministic. One could construct a game "rando-Nim" where two players played Nim, and then a die was rolled to see who won (say 1-4 the winner of the Nim game, 5-6 the loser). Once the players understand Nim heuristics, this becomes a purely random game, but its strategy and its heuristics are the same as those of Nim.

What Makes for Good Heuristics?

There are a number of different axes on which one can measure the quality of a game's heuristics.²⁹ Ideally:

- Heuristics exist at all levels, from beginner to advanced. Players should be able to improve at the game by acquiring increasingly sophisticated heuristics.
- Some heuristics should be easy for players to discover on their own; others need to be more difficult (if they are all easy, eventually they will all be discovered and the game will be exhausted) and will typically be learned from other players.
- The set of heuristics should be powerful enough to cover most situations (so that the player is never without guidance) but not so powerful as to completely cover more than a few situations (lest those

situations, or worse yet all situations and thus the game itself, be "solved")."

- The heuristics are "satisfying" in the sense that the player feels she is exercising judgment using rules of thumb, rather than executing a computer program. The Nim heuristic or a memorized chess opening is not satisfying in this sense; "develop your pieces" or "bluff occasionally, so that other players will call you when you do have the best hand" is. One common way for a heuristic to be unsatisfying is for it to be completely deterministic, eliminating judgment; another is for it to involve a great deal of calculation (see the discussion in section 6.5 on reward/effort ratio).

Beginner heuristics, also called "zero-level heuristics," are particularly important. Players who first learn the game need to have some idea of what they are trying to do and how they might go about it. Even heuristics that look quite ineffective from an advanced player's point of view may serve, since beginners can use them against other beginners and hope over time to improve their heuristics. But with no good zero-level heuristics, the game may be so unenjoyable the beginner simply gives up. Games with good zero-level heuristics include Uno (even out your suits) or even bridge (win a trick with the lowest card you can, bid what you can make³¹). Games with bad zero-level heuristics include go and some European boardgames, where there are often a plethora of options with no one obviously better than any other ("silk costs more, but gives me more victory points, compared to wheat... which should I pick?"). In general, any game with a large number of options, carefully balanced to preserve gameplay variety for advanced players, runs the risk of damaging its zero-level heuristics. This risk is one reason one might want bad cards in a trading card game or bad items in an RPG: they provide zero-level heuristics, choices that even beginning players can make and improve their game.

If a game does have weak beginner heuristics, more advanced players can often help beginners get started by giving them some heuristics that are not too difficult to apply but that would be difficult or impossible for the beginners to discover on their own. Chess openings are an example of this kind of transmission at a somewhat more advanced level. At a more basic level, the relative values of the pieces in chess provide a simple and powerful heuristic for beginners. Too many of these transmitted heuristics, however, can create a burden on the memory.

Heuristics and the Player Base

As players gain skill at a game, the heuristics can change. Tic-tac-toe has decent heuristics if the player base is small children, but the heuristics are not good for the adult player base. Games like chess or go evolve over time as players learn more and develop better heuristics.³²

An interesting extreme example of heuristic dependence on the player base and development of heuristics over time is Dots and Boxes. Commonly played by schoolchildren, Dots and Boxes has slightly weak zero-level heuristics—for example, "move randomly except don't complete the third side of a box." But it has some good, reasonably easy to discover, intermediate-level heuristics that apply to its endgame (in particular, the trick of not taking the last two boxes in a long chain, thereby forcing your opponent to begin a new chain). The beginning stages of the game seem impossible to analyze—that is, there are no obvious positional heuristics, and play tends to proceed essentially at random. However, relatively recently, advanced techniques in theoretical mathematics (namely combinatorial game theory) have allowed one to play the earlier stages in a productive way.³³ In other words, Dots and Boxes now has very interesting and powerful heuristics for a certain small player base, namely combinatorial game

theorists. Schoolchildren, presumably, have chosen to continue as before.

Exercise 1.8: What are some first-order heuristics in werewolf? What gives werewolf so many basic heuristics?

Exercise 1.9: What are some heuristics that Risk and RTS games share? Name some other games that share these heuristics.

Exercise 1.10: What are some heuristics that bridge and hearts share?

Exercise 1.11: Name some games (besides go) with poor first-order heuristics. Why are they so poor?