

INTRODUCTION

Hi there. I'm Mike Selinker, and I'm a puzzlemaker. If you go into my line of work, the question you'll get asked most often is in the long entries of the puzzle on the facing page. You'll learn to hate that question. You'll imagine the questioner trapped under an array of black and white squares, being poked with a pencil and eventually erased. That thought will make you feel good inside.

The question you'll get asked second-most often is, "How on earth do you think of those?" That will also make you feel good inside. It may be coupled with a sentence like, "You must be some sort of genius!" Sorry, but being a puzzlemaker doesn't make you a genius. I, for example, have no idea how to fix my dishwasher. I barely know how to run it. You would think a genius would know things like that.

But I can say that being a puzzlemaker makes your brain go places you'd never imagine it would. You learn to think in three dimensions at once, to catalog long lists of trivia in your head, to bend words in all sorts of directions. You understand logic and word construction better than anyone you know. Your mind deconstructs the universe in fascinating and completely meaningless ways.

I've been doing that for a while. In the three decades I've been making puzzles for publication, I've figured out how to construct hundreds of puzzle types. I've made some up along the way, when I couldn't find a puzzle type that did what I wanted. Through trial and error, I began to master the science of making puzzles into art. My coauthor, Thomas Snyder, and I have spent years explaining that combination of science and art in the pages of *Games* magazine, and now here.

We both have our specialties. I'm primarily a word guy, having made crosswords and similar puzzles for *Games*, *Wired*, the *Chicago Tribune*, *The New York Times*, and so on. Thomas is primarily a logic guy. "Dr. Sudoku," as he dubbed himself, has won the World Sudoku Championship three times and the U.S. Puzzle Championship seven times, and runs Grandmaster Puzzles (gmpuzzles.com), a publisher of hand-crafted logic puzzles. Through research and guesswork and handed-down wisdom of the ancients, we figured out how to make these puzzle types elegant.

It's that accumulated knowledge that you'll find in this book. The subtitle's a lie, of course. We can't fit descriptions of how to make *every* type of puzzle into one book. But we've done our best to cram as much in as we can. Whether you're making puzzles to publish online or befuddle your family or educate your students, you should find what you need in here. If you master everything we talk about, you'll be on your way to being a puzzlemaker.

Let's start with some straw-man questions.

WHAT IS A PUZZLE?

As someone who designs both puzzles and games professionally, I often get asked to define the difference between a game and a puzzle. There are many possible answers to this question, but the one I've settled upon is this:

A game is an activity where, if fairly constructed, two sides given the same advantages will have a roughly equal chance to win. A puzzle is an activity where, if fairly constructed, one side will have all the advantages, except that the disadvantaged side is expected to win.

That may not make sense the first few times you read it, so I'll deconstruct it. In a game (say, chess or basketball or Hungry Hungry Hippos), both sides face each other on a more or less even playing field. They may or may not have the same tools, and they may or may not be able to access them at the same time (such as the eleven players on either side of an American football play having very different roles). But fundamentally, if both sides show up with equal knowledge, skill, and preparation, there should be a reasonable question as to which will win.

This is not the case in puzzles. The field of play is horribly imbalanced. The puzzlemaker has as much time as desired to prepare, a totally different set of skills,¹ and knowledge of the answer. The puzzle solver has none of these things. She is expected to solve on the spot with no understanding of how the puzzle came together or what its solution is. The puzzlemaker would, in a game situation, be favored to triumph every single time.

But it doesn't work that way. The puzzlemaker isn't looking to beat the solver. That's like taking candy from a baby. Instead, the puzzlemaker gives the solver all the tools to beat him. The puzzle's clues and hints are designed to be fair and accessible at the solver's level of ability. If the solver attacks the puzzle in the right way, she will defeat the challenge at a satisfying progress rate. That's not the same as defeating the puzzlemaker, although she may see it that way. If you are a puzzlemaker, you must be comfortable with losing every single time.

Note that the "solver" doesn't need to be only one person. Sometimes it's the *best* solver (or team) in a large group of solvers. A puzzle released on the internet, with a prize for the first solver, won't be solved by the lowest common denominator. Somebody is going to ace that test first, and be crowned champion. But if nobody solves it fairly, that's a disaster. If your puzzle involves burying a bejeweled rabbit by a cross-shaped monument to Catherine of Aragon in England's Ampthill Park, you don't want it found by someone who gets the answer from the ex-girlfriend you told where you buried it.²

¹People have asked why, given my skill in making such things, I don't compete in crossword tournaments or game shows much. I ask whether they would expect a highly talented arsonist to be good at putting out fires.

²This happened. In 1979, artist Kit Williams released the groundbreaking puzzle book *Masquerade*, whose paintings secretly revealed the location of a

Ideally, then, you want to make a puzzle that matches your solver step for step, yet ultimately falls into a heap at her feet. This is an intricate balance, but you have many techniques at your disposal to make sure that happens.

WHAT MAKES A PUZZLE SOLVABLE?

The central skill of a puzzlemaker is not the mastery of wordplay or logic or math. The puzzlemaker's most important skill is the mastery of *frustration*.

I've had many puzzle event staffers work for me over the years, and I look for a certain balance of emotions in them. The ones that don't get invited back are those that cannot bear to see a solver in pain. The solver will come up, eraser worn to a nub, and say, "I can't solve this!" The puzzle staffer who says "Here, I'll show you the answer" is failing in her job. Because the solver *doesn't want to know the answer*. People solve puzzles because they like pain, and they like being released from pain, and they like most of all that they find within themselves the power to release themselves from their own pain.

What the solver wants from you is acknowledgment that she is not wasting her time. Progress begets desire for more progress, but lack of progress begets abandonment. So the frustration a solver feels while not getting the answer is tolerable if there appears to be a direction toward which the solver can apply that frustration. For that to work, the puzzle itself has to be amenable to checkpointing.

Checkpointing is the process of breaking a puzzle into hierarchical, self-confirming steps. Think of an average jigsaw puzzle. Most pieces are nubby-edged, but some pieces have straight edges on one or two sides. Step one of solving is making the frame out of this self-contained group of parts. Now you have a color scheme for the next few layers of your image; the dark red ones go over in this corner, while the light yellow ones go along that wall. Once those are done, now you're down to the third set of pieces, the ones that go in the middle. You couldn't solve those when the entire puzzle was broken apart, but now, with only those to link up, it's more manageable. Those three checkpoints—outer frame, inner buffer, center—make it possible for you to tackle a task that, without those checkpoints, might be beyond you.

Most puzzle types have checkpoints. A sudoku has a few easily placed numbers, and a process to get the rest. A word search allows discovery of some long words, and a message that isolates the letters in the short ones. A mystery has some suspects whose alibis you can nail down, and then, once you've eliminated the impossible, all that remains must be the truth.

The key is that the solver must know when she's reached a checkpoint. This can come one of two ways:

first, the puzzle can tell her, and second, you can. If the solver gets to submit a partial answer, you can say, "I think you're on the right track." Nothing spurs progress like being told you're making progress.

You can also give hints. A hint is not the same as a clue, though those are synonyms in real life. A hint is a clue you provide your solver after you give her the puzzle, for when she is good and truly stuck. You should prepare these hints in advance. Usually, you're looking to get the solver to the next checkpoint, so if she doesn't know that list of 1- and 2-letter strings are all element symbols, you could say, "Why, the solution is elementary, my dear solver."

A solvable puzzle also needs a way to tell the solver she's done. Sometimes it's filling in the last space in a grid, other times it's finding a match for each of the unmatched parts. This is why many puzzles with very complex processes eventually reduce to a single word. You can't do much with a single word except report it as a conclusion.

Ideally, it will be clear to the solver that she has found the only possible solution, without asking the constructor or checking the answers at the back. It is possible to have a good puzzle with more than one unique solution, but it certainly shouldn't be your goal. Aim for uniqueness, and your puzzles will be thought of as unique.

WHAT MAKES A PUZZLE DIFFICULT?

I have been described in many complimentary ways in my day. "Satanic," for example. And "cruel" and "demonic" and "savage." Those, in a puzzle sense, are high praise.

Some of those compliments come from certain puzzles of mine being difficult. Simply requiring more effort or inspiration—more stress, if you will—makes a puzzle a workout. When the solver is done, there's a metaphorical bead of sweat on her brow. If there's a timer, maybe not so metaphorical.

Difficulty is relative from solver to solver, and from puzzle to puzzle. This is why puzzles often come with difficulty ratings. I know from experience not to waste my time with a one-star word search, and I know from repeated defeats not to tackle the highest-difficulty abstract logic puzzles. I know what my solving skills are, and how much effort I can expect to expend before I either destroy the puzzle or give up from utter bewilderment.³

The *New York Times* crossword uses a very interesting scale, in that it rates difficulty by day of the week. A Monday puzzle is expected to be easier than a Wednesday puzzle, which is expected to be easier than a Saturday puzzle. When this turns out not to be the case—say,

³The Seattle-area company Puzzazz has experimented with something intriguing. In some of their puzzle ebooks, the solver could select a desired difficulty and puzzles populated with the clues needed to make them as easy or hard as selected. For example, in crossword puzzles, each crossword clue would have two versions, one hard and one easy. If this catches on, you'll never throw out a 1-star puzzle again.

if the editor has put a Thursday difficulty puzzle into the Tuesday slot—solvers get cranky. They would be hard-pressed to articulate why, of course. Certainly a Thursday-difficulty puzzle on Thursday is fine. But not on Tuesday. It's about management of expectations.

Trickiness is another important aspect to difficulty. Unless it is entirely procedural, a puzzle must have something tricky going on. In some sense, that's what the customer is paying for. A flat roller coaster is no fun. You need some ups and downs to call it a thrill ride.

A tricky puzzle uses misdirection, obfuscation, and disguise to lead its solver down wrong roads. It never flat-out lies, though. At the end of the puzzle, the solver must say, "Okay, you told me everything I needed to know. I just didn't know that you had done so."

A tricky puzzle likely has traps. A trap is an obvious-looking path to success which turns out not to pay off. A maze path that appears to beeline to the finish line probably isn't going to make it there. But it's hard not to check it out, right?

A popular place to trick the solver is in the instructions. A puzzle's instructions can contain flavor text—that is, text which does not appear to be conveying rules. Sometimes you can sneak a critical clue into the flavor text, but have this fact not be obvious on first glance. If your subject is cars, but you don't want to say your subject is cars, putting the words "drive," "shift," and "gear" into your instructions might tip the solver off on a reread. That's cool. It's the task of pre-hinting the puzzle, without saying that you've done so. Like I said, tricky.

WHAT MAKES A PUZZLE ELEGANT?

Obviously, a puzzle is good if it is accurate, free of errors, and approachable. To make sure it fits that description, you'll need to get it test-solved. A test-solver takes your puzzle, without any help from you, and does the best she can with it. You note her triumphs and struggles, and revise it from there. After that process, you'll have a solid puzzle.

But having a solid puzzle is not your goal. That's like praising Ford for their slogan "Quality is Job 1," or Delta for their "Delta gets you there." Sure, I want a car made of stable parts, and I sure as heck want my plane to land safely in the city I expected. But I want more than that. I want a car that feels like it was conceived from a point of cleverness, like the one-shot SR-71 Mustang being made to resemble the Blackbird spy plane. I want an airline that takes care of me from start to finish, such as the now-defunct Virgin America understanding that

providing the entire catalog of Virgin Music was far superior to three channels of Top 40 vapidness.⁴ I want the creator to care.

One way to tell that the puzzlemaker cares is if a puzzle demands a healthy balance of effort and inspiration. Too much effort, and the puzzle is busywork. Too much inspiration, and the puzzle is a guessing game. Right in the middle, and the puzzle is worth my time.

Effort is often a function of puzzle size. A Sunday *New York Times* crossword may be no harder than a Thursday crossword, but the fact that it's 21×21 rather than 15×15—twice its size—makes it take more effort.

Inspiration is a bit harder to quantify, naturally. But you can know when you've achieved inspiration by monitoring your solver's progress along the way. When the solver is working through the checkpoints of the puzzle, she is looking to achieve a singular moment. That moment is called the "aha" moment. It's the second when the puzzle cracks open, and all that remains is to finish it out. The aha may be implicit, as when the sudoku solver says "Okay, I know where the rest must go," or it may be explicit, as when the trivia solver says "Oh wait, those are all the names of kings of England!" Then the finish line is in sight.

The aha moment is crucial for the solver. It is this moment that justifies the opportunity cost of solving the puzzle, as opposed to doing the dishes or finishing her master's thesis. She gets to say, "And then I noticed that the bridge cards formed a bridges puzzle!"⁵ and everyone slaps her on the back for her brilliance, and congratulates the puzzlemaker for his brilliance. That's the moment everyone wants, every day of their lives.

WHAT MAKES A PUZZLE FIT?

The hardest task a puzzlemaker faces is the first one: figuring out what puzzle is for what purpose. Certain puzzles occur in natural places. If you're designing a kids' placemat, the word search and crisscross will call out to be on it. If you're putting a puzzle into a newspaper, the crossword and sudoku may fit better. If you're constructing a map of enemy encampments for your country's armed forces to assault, codes and ciphers may be the logical choice.

Solvers start with different types of knowledge. For example, everyone understands, seemingly from the point of mastering the crayon, how to solve a connect the dots puzzle. Not very many Americans can be counted upon to differentiate a masayu from a nurikabe on sight. You might be looking to teach them, though. One of my

⁴Virgin also got props for hosting "Day in the Cloud," a 2009 puzzle battle *between two planes*. On that day, Virgin cared about a lot more than getting us there.

⁵As solvers did in the 2010 MIT Mystery Hunt's "1710" metapuzzle by Mark Halpin. Teams solved five puzzles with 13-letter answers, each of which matched a set of 13 bridge cards. The answers' first letters spelled HASHI, the shortened name of the Japanese puzzle type known to Americans as bridges. The numbers on the non-face cards indicated the numbers of bridges connecting out from each card, and solving the hashi allowed following a path along the bridges to spell the answer. Bridge to bridges: That's what I mean by inspiration.

test-solvers noted that if she had learned shikaku before she took her high school math classes, factoring would have come easier to her. She kept taking math classes, so she still can benefit from that knowledge. Maybe everyone could.

Not everyone is looking for self-improvement classes, of course. Some people just want to pass the time on an airplane. For them, the Jumble is comfort food, like macaroni and cheese. Don't mock them. They're solving something, not staring into space.

The key is knowing who you want your solver to be, both before and after they encounter your puzzle. You want to understand their mindset going in and perhaps change their mindset going out. Let them say, "I never knew that!" or "I don't know how you made that." Or, even better, spur them to tell everyone "You'll never believe what I just learned." Make a puzzle that will urge them to spread the virus.

Your puzzle will fit if you've correctly assessed the solver and their situation. If it takes time to figure out, take that time. Your solver has plenty to do before they attempt your puzzle. They'll be thrilled you crafted it just for them, even if you didn't.

WHAT DO I DO TO MAKE ONE?

Start by committing to the idea that you're going to make an awesome puzzle, even if you fail a few times before it's truly awesome. Choose a puzzle type that reflects your personality. It doesn't have to be a puzzle type in which you have expertise. Immerse yourself in something new. When constructing your first tetromino minesweeper or hedgehogs & worms, you'll stumble about a bit. That's okay. We did too.

It helps to have a step-by-step guide, and that's what we've done our best to provide. The rest of the book will

focus on how to make individual puzzle types. We've broken the book up into sections—perception puzzles, word puzzles, logic puzzles, puzzles within puzzles—with examples of each, and a deconstruction of how we put them together. I lead the discussion in most chapters, while Thomas takes the lead in Chapter 3, but we sometimes step in for a subsection of each other's chapters—so, to help keep track of who is speaking, every time one of us takes over for the other, a small cartoon portrait will show who's just taken over. This is me, Mike:



And this is Thomas:



You will also see Gaby Weidling, the book's developer; Francis Heaney, our editor; and Peter Sagal, whose excellent foreword you already read.



I recommend you try solving a puzzle first, and then read the text on how we made it. As you solve, keep mental notes on what you did and where you got stuck. The neighboring essay should explain what you learned along the way, and how you can make it work in your own puzzle design.

First, we open the doors of perception.