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## DOOM

Dan Pinchbeck

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## DOOM by Numbers

*DOOM* is a game of wonderful simplicity in many dimensions, not just story and gameplay. The entire first episode, *Knee Deep in the Dead*, contains just six monsters, one of which only appears in the very final level, in a kind of boss battle. All of *DOOM*'s monsters are defined by a number of parameters, although the artificial intelligence is, by modern terms, very simple.<sup>1</sup> Defining parameters include height and width (to establish bounding boxes so they act as obstacles), speed, reaction time, pain delay on being hit, a series of links to audiovisual files for audio and animation, and, of course, hit points and damage.

All damage is randomly calculated within a given spread, as is the likelihood of the monster hitting its target (which is adjusted by range to target). For example, the Trooper has 20 hit points, causes 3–15 damage per successful shot, moves at 70 map units per second (MUS), and so on. The Imp, in comparison, is considerably tougher. He has 60 hit points, moves at 93 MUS, and has two attacks: a melee, causing 3–24 damage, and a slow-moving projectile, whose speed is calculated at 350 MUS and also causes 3–24 damage. It should be noted that unlike the Trooper's bullets, the Imp's fireball attack is slow enough to be dodged. The artificial intelligence exhibits basic pathfinding and target acquisition, but there is no tactical behavior as we understand it in more contemporary games. Players had to wait until *Half-Life* for the uneasy realization that they had just been flanked. Interesting, though, is how simple tricks helped bootstrap the sense of intelligence of the agents upward. For example, *DOOM*'s monsters will happily attack one another. If a Trooper happens to be in the line of fire between an Imp and the player, the Trooper will get hit by the Imp's fireball, and provided

this doesn't prove fatal, the Trooper is likely to forget all about the player and attack back. This is really very basic in AI terms, but it creates a sense of interrelationship that is comparatively powerful, and it perfectly fitted the frenzied chaos that Romero wanted to create.

That was never seen in a game before, . . . that they are so possessed, they are so out of their minds that they kill each other. They don't care what they kill, they just want to kill everything, even each other. (JR)

As an aside, the process of monster creation fell mostly to Adrian Carmack, with Kevin Cloud focusing mainly on weapons (textures and details were shared). Concept sketches were passed onto Gregor Puntchaz, who turned them into latex models that were manipulated to create the basis for sprite animation. As we've seen, many of the basic sprites and animations existed very early on in development, and according to Cloud, there was never a particularly formal process of creation, test, and iteration.

Sandy and John [Romero] would have an idea of something that they wanted in the game, like a cool weapon or a character, there'd be some brief discussions, and then we'd just turn each other loose and do something about it. It wasn't as if ideas couldn't come from everywhere, but generally they came from Sandy and John and then Adrian and I focused on the art. But for the most part, even though there was some pretty different style and skill differences, people pretty much let each other do their thing. Sandy and John weren't like "We want it to look like this," more "We want a shotgun," so we'd go off and make a shotgun and just get it into the game. There's wasn't a lot of reworking. It was more like "Hey, I've got this cool idea, let's put it in the game." (KC)

The idea of a small team running around more or less freely is like a utopian dream, and we do need to remember the context the members of the id team were operating in (and, arguably, the old adage that very talented people have a sickening ability to make stuff look really easy). But once again, we can see the links to the current indie boom, as the experimental approach is very appealing, in terms of a group of like-minded experts experimenting sometimes wildly with each others' output. Cloud also tellingly notes that at this point in the history of game development, the lack of a drive toward transferable intellectual property and the requirement of

extendable franchises was liberating and also served to simply make a better game.

We would create the textures, and sometimes a wall would end up on the floor and a floor would end up on the ceiling. . . . I mean, the environments were such an abstraction. It was just crazy. There were candelabras on a space station. It made no sense. The design direction kind of ebbed and moved and changed over time, and we riffed on new ideas as we were moving along. . . . You went with the flow of it. It was a great way of working at that point, because there was really no expectation of anything, and games weren't—well, no one was trying to make a movie. And it allowed you to focus on what works, not what doesn't work, which is a nice frame of mind to be in—OK, that works, let's do more of that, not "That doesn't work and we've GOT to have that in, so let's fix it." We'd be more like "That doesn't work, so screw it. We won't do that. We'll do more of this." (KC)

On the flip side of things, the player has access to a range of weapons and objects as well as their 100 hit points and good ol' fists. Armor is expressed as a percentage, with green armor absorbing one-third of all damage taken. The blue mega-armor raises the percentage to 200 percent and absorbs half of the damage. Armor bonuses raise the current armor's percentage by 1 percent, up to a maximum of 200 percent. Health vials (+1 percent), stimpacks (+10 percent), and medikits (+25 percent) allow the player to regain lost health. There are a range of super power-ups. Some of these give temporary benefits: partial invisibility, invincibility, radiation suits to prevent damage from nukage, light amplification goggles. Others, like the soul sphere or automap, give a one-off boost, and the backpack permanently increases ammo capacity. Then there are, of course, the guns.

*DOOM's* weapons break down into two types: hitscans and projectiles. The latter have a speed, meaning they can be avoided by a fast player, but also meaning monsters' speeds and positions must be accounted for when they are being used. A hitscan is calculated at the moment of firing and cannot be avoided. Of the weapons in Episode 1, the fist, chainsaw, pistol, shotgun, and chaingun are all hitscans. The fist and chainsaw are both unlimited melee weapons with a range of 64 units that do 2–20 damage per hit. The chainsaw increases the number of hits per minute from roughly 123 to 525, so it's similar to the chaingun, which uses the same ammo and does

the same damage as the pistol (5–15 units) but increases the fire rate from 150 shots per minute to 525. Unlike melee weapons, hitscan distance weapons include shot dispersal when the fire key is held down, so subsequent shots have a greater chance of going wide (introducing a sense of recoil). The shotgun is slightly different, as it includes a spreading set of seven bullets (each sticking to the 5–15 hitscan damage of the pistol). This means that depending on range to the target, multiple enemies can be hit with a single shot. At close range, the majority of the bullets will hit the same target, increasing the damage toward a massive potential of 105. Balancing this, however, is a much slower rate of fire—around 57 shots per minute. Finally, Episode 1 also includes a single projectile weapon, the rocket launcher. Its rockets are twice the speed of an Imp's and include a splash damage feature. Each rocket causes 20–160 damage on impact but also triggers an area blast, which starts at 128 damage at the epicenter and decreases outward to 128 units (so a monster standing 100 units away would take 28 damage). Balancing against this massive damage to a directly hit target is the fact that the player can also be caught in the blast, and there is a slow rate of fire (105 shots per minute). While explaining all this weapon detail here might seem like nerding out somewhat, it's actually really important to consider how *DOOM* manages its arsenal of weapons, items, and monsters, because it's this subtle balance, not just a great concept and good design, that makes a game really work. The process of getting this balance right occupied the *DOOM* team for some time, and for Cloud, it's inherently tied to how immersive *DOOM* is. A comment of his really brings home how complex reactions can emerge from the carefully managed interplay of integers:

A lot of time was spent thinking about the weapons and how they played off against the creatures, the weapon switch speeds, the weapon damage, enemy placement, in terms of trying to get those types of emotional reactions that are not just cognitive but emotional. (KC)

Equally, managing the sense of development across a game's duration is critical, and getting either the pacing of new features or the balance between increasing difficulty and increasing player capabilities wrong can seriously unbalance a game, destroying any sense of atmosphere, challenge, or fun. For example, *Prey* (Humanhead Studios 2006) really suffered from this, although it's hard to exactly put your finger on why. On paper, *Prey* does things right, it adds new weapons just before it introduces new aliens, so

you get the rush of power as a reward before the difficulty ramps up, it keeps back old friends even while adding new foes, and the weapons have a qualitatively different feel and flavor and clear tactical uses in various situations. But it just doesn't quite hang together, and in the face of an almost total lack of serious academic analysis of the minutiae of mechanic balancing, we'll have to settle with the folk understanding and intuiting that most designers and players have about getting the balance right and how important it is.

One of the things *DOOM* does that has not, interestingly, become a standardized FPS design tactic is "leaking" weapons forward in secret areas, essentially rewarding players for exploration at the risk of throwing off game balance. Especially given what I've just argued, the idea of allowing a rocket launcher to be discovered by players in E1M3, some four levels before other players are certain to find it in E1M7, is a high-risk strategy and arguably demonstrates how effective the game is at balance on a general level.<sup>2</sup> Certainly, more modern games that have a set number of weapons and use these as a reward system, such as *Quake 4* (Raven Software 2004) or *Half-Life 2*, are designed to make sure that when the player obtains the weapon is carefully orchestrated, even if they subsequently allow a degree of tactical choice in terms of how combat is approached. *DOOM* doesn't bother with any of that. The rocket launcher appears as a secret in E1M3–6 and is officially found in E1M7; the shotgun is a secret in E1M1 and official in the subsequent level; the chaingun is a secret in E1M2–3 and official in E1M4; and the chainsaw is a secret in E1M2, 3, and 5 and official in E1M6. So for nonexploring players, there is a staggering of new weapons—shotgun on 2, chaingun on 4, chainsaw on 6, and rocket launcher on 7—but the rewards of exploration deliver these much, much earlier. Equally, the limited number of monsters in Episode 1 are staggered on lower difficulty settings, but this changes as one hits the Ultra Violence or Nightmare levels. Shotgun Troopers or Sergeants normally appear in E1M3, but in the higher settings, they are right there from the outset. Demons, or Pinkys (as they are more commonly known), pop up in E1M3, but their invisible counterparts, Spectres, appear in E1M6 for lowest difficulty, E1M5 for midrange, and E1M3 for supertough. The final monster in Episode 1, the Baron of Hell, appears as a boss for all difficulty settings in E1M8. For the sake of consistency, we should note that Pinkys have 150 hit points and are fast movers (at 175 MUS), with a single melee attack dealing 4–40 damage (Spectres are exactly the same). Sergeants come in slightly tougher than standard Troopers, with 30 hit points and a shotgun attack similar to the player's, dealing 3–15 dam-

age per bullet, with a potential total of 9–45. Barons have a whopping 1,000 hit points, move at the same speed as an Imp, and also have both melee and missile attacks. The former deals 10–80 damage; the latter is a projectile with a speed of 525 MUS, doing 8–64 damage on impact.

Remember all that now, as we descend into Hell. There will be tests later. Seriously though, it is important to bear these kinds of details in mind, as they do inform design considerably. From the geographic placement of monsters within a level to the dynamics of multiple and especially mixed multiple monster groups, not to mention the golden threads pulling players around the game space, the details may exist under the hood, but their influence on game design and gameplay is total. In games, the integer is king.