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Threat Simulation in Virtual Limbo: An Evolutionary Approach to Horror Video Games

Keywords: horror, Limbo, game studies, evolution, simulation, evolutionary psychology

Abstract

Why would anyone want to play a game designed to scare them? We argue that an alliance between evolutionary theory and game studies can shed light on the forms and psychological functions of horror video games. Horror games invite players to simulate prototypical fear scenarios of uncertainty and danger. These scenarios challenge players to adaptively assess and negotiate their dangers. While horror games thereby instil negative emotion, they also entice players with stimulating challenges of fearful coping. Players who brave these challenges expand their emotional and behavioural repertoire and experience a sense of mastery, explaining the genre's paradoxical appeal. We end by illustrating our evolutionary approach through an in-depth analysis of Playdead's puzzle-horror game *Limbo*.

Introduction

Imagine this: You are a little boy, lost somewhere deep in the woods at night. You do not know how you got there or how to get out. All you know is that your sister is out there, somewhere, possibly in great danger. You have to find her.

The ambiance is alive with animal calls, the flutter of branches and bushes and a welter of noises that you cannot quite make out. Flailing about to make some sort of headway, you rush past foot-high mounds of decomposing meat - once living things, now organic breeding grounds for the flies. Somewhere in the distance you see skulking silhouettes that look human. They see you - see you see them - and quickly scatter among the trees. You move on, scouring for any trace of the woods' furtive inhabitants. Clearing a hill, you fix your gaze on a large tree trunk with three heavy boughs that seem to be *hanging* from the tree rather than projecting out of it. As you move closer, the boughs lift over your head as if from a powerful gust of wind. Instead of falling again, however, they steady themselves, like snakes making ready to strike. But they are not snakes, much less branches. They are the multi-jointed, spiked legs of a colossal spider whose body completely enfolds the tree's copious trunk. Suddenly, the monster thrusts one of its readied members forward to skewer you alive. Whether you will manage to dodge it and survive the encounter is now entirely on your focus and reflexes.

As a real experience, this scenario would be positively terrifying. No sane person would want to be in the boy's shoes. As an imaginative exercise, however, the scenario is harmless but intensely stimulating. People pay good money to experience virtual danger of this kind when they watch a horror film or play a horror video game, such as *Limbo* (Playdead 2010), from which the scenario is taken. Why would they do that? The philosopher Noël Carroll (1990)

labelled this difficult question *the paradox of horror* and distinguished it from the so-called paradox of tragedy with which aestheticians have grappled for centuries (Smuts 2009). Carroll proposed that the genre's appeal comes from its presenting the audience with impossible monsters (like the giant spider) and deep mysteries (how did it, and *I*, get here?) that grab and hold our attention. We are inquisitive beings, and horror serves up intriguing mysteries for us to solve.

In this article, we develop an alternative but abutting solution to the paradox of horror, one grounded in the evolutionary and cognitive psychology of fear (e.g., Clasen 2017). This line of research has shed light on horror in literature and film by showing it to be crucially dependent on the evolved human psychology of fear that shapes our fears and phobias. We dread reptiles and reptile-like monsters, in real life or on the big screen, because they have preyed upon us throughout our mammalian evolutionary history; we fear the dark, whether real or fictional, because it limits our access to information about our surroundings, thereby allowing predators and hostile conspecifics to creep up on us unnoticed; and we recoil at the sight of a zombie because this lumbering horror staple is simultaneously a rabid predator and an oozing vector of disease (Clasen 2012). These phobic pressure points make sense as a function of what mammalian, defanged and disease-prone hominids have ancestrally had good reasons to avoid (Öhman and Mineka 2001). They find their way into so many of our scary stories because they reliably and cross-culturally elicit fear - they do what the genre needs them to do (Clasen 2017; Davis and Javor, 2004). We aim to extend these insights to horror in video games, using the popular puzzle-horror game *Limbo* to illustrate our points. We argue that horror games, including *Limbo*, represent a virtual repository of evolutionarily rooted scares. These scares combine and

interact to produce imaginatively compelling experiences of being alone in the dark, surrounded and hunted by dangerous agents.

Ours is not the first attempt to investigate video games from an evolutionary perspective. Evolutionary social scientists have for some time advanced functional accounts of video-game genres ranging from the high-profile, controversial first-person shooter games to ‘casual’ mobile games (e.g., Ferguson 2010; Mendenhall, Saad and Nepomuceno, 2010). Like these theorists, we are convinced that evolutionary theory can shed light on the forms and functions of video games, including horror games. However, we believe that these previous efforts have erred in neglecting pertinent insights of contemporary game studies, and that they therefore represent a missed opportunity for scholarly cross-pollination. Of course, the feeling may be mutual. Mendenhall, Saad and Nepomuceno (2010: 306) observe that evolutionary theory is ‘conspicuously absent’ in game studies. They overstate their case (see, e.g., Dillon 2010; Grodal 2003), but we agree that the explanatory potential of evolutionary theory represents an underused resource for game studies.

For their part, the evolutionary theorists of video games have largely failed to consider the actual experience of playing through the games they investigate, reducing them to themes that appear in the game, such as shooting or family life, before explaining how these themes relate to human evolution. But if video games manage to do anything to us, they do so through the structured, embodied and temporally extended experience of gameplay, not through creating abstract thematic alignment between what goes into the game and what went into human evolution. The concept of a zombie is not very scary, but a simulated encounter with its in-the-flesh instantiation certainly is – especially, perhaps, if that encounter is prefigured with anxiety-provoking cues to danger and suffered from a phenomenally verisimilitudinous first-person perspective, as in many

modern horror games (Pinchbeck 2009). These are hypotheses that can only be explored through careful attention to the kinds of prestructured experience that games afford players. In this article, therefore, we want to bring the two fields into closer dialogue. Importantly, our discussion will move beyond the semantics of horror video games, beyond the beasts, revenants and (oversize) creepy-crawlies that inhabit the genre. Horror video games allow for kinds of enactive and embodied experience that traditional narrative media do not (Perron 2005), and we will attempt to explain these defining features in evolutionary terms.

Our formal-functional thesis breaks into two substantial claims: horror video games (1) rely on ancestral threats to fulfil their affective promise, and (2) present virtual environments in which players are challenged to cope with such threats. Horror video games are thus danger-simulation devices in a very real sense: they feature psychologically deep-seated scares and instil methods for dealing with them, including behavioural coping strategies and emotional self-regulation. This adaptive quality explains the genre's paradoxical appeal.

In the next two sections, we will build this conception of the genre by arguing that horror games adaptively simulate what Panksepp and Biven, in their seminal work, *Neuroevolutionary Origins of Human Emotions* (2012), term *prototypical fear scenarios*: ancestrally prevalent situations of physical danger and uncertainty. We will then flesh out and illustrate our points in an evolutionary analysis of *Limbo*.

Video Games, Horror and Evolution

Popular video Games typically invite a simulative experience (Aarseth 2004). They challenge players to reach goals in a virtual environment phenomenally marked off by its rules and narrative horizon (Juul 2005). This interactive mode of engagement represents a substantial

breach with traditional narrative media in offering players ego-centred experiences (Gaut 2010). Of course, that is also true of horror video games.

Narrative horror media rely on third-person and often empathy-mediated ‘witness emotions’ of fearful concern for central characters (Tan and Frijda 1999). By contrast, videoludic horror, because it is simulative in nature, prototypically evokes the first-person experiences of surviving in a dangerous world (Perron 2005). It confronts resource-starved players with immediate physical threats, such as a ravenous predator, and challenges them to cope. Panksepp and Biven (2012: 177) label this a prototypical fear scenario: the kind of scenario to which the human fear system originally evolved to respond adaptively and to which it is therefore most sensitive. Prototypical fear scenarios involve agents *assessing* and *negotiating* physical threats in the form of hostile agents. These two basic classes of experience, we propose, correspond to two dominant modes of horror gameplay. How do horror video games simulate threat assessment and threat negotiation?

Threat assessment. Humans who feel threatened are motivated to assess those threats in order to either avoid them completely or prepare for them optimally (Barrett 2005; Woody and Szechtman 2011). They do so by vigilantly scanning their environment for cues to danger: ill-intentioned conspecifics may chatter loudly enough among themselves to be heard, for example, and a feline predator may give away its location by scaring nearby wildlife into uproarious flight. False positives are likely because the anxious organism is in a state of heightened psychophysiological responsivity, enabling it to quickly identify, but also to misidentify, a potential threat. Despite this potential for error, we do well to expect the worst because, on the off-chance that the worst is indeed the case, the result of inaction could be fatal (Barrett 2005; Haselton and Buss 200). *Better safe than sorry.*

The problem of threat assessment clearly looms large in the horror video-game genre, including the popular survival-horror games such as *Amnesia: The Dark Descent* (Frictional Games, 2010) and *Silent Hill 2* (Konami, 2001). The player of these games explores a dangerous setting to discover what menacing forces occupy it and what kinds of threat these forces represent. Some games focus sharply on this aspect of the prototypical horror scenario. In the point-and-click adventure-horror game *Tormentum - Dark Sorrow* (OhNoo Studio, 2015), for instance, the player navigates a Gigeresque environment of great uncertainty and manifest danger. The game features lots of discovery and puzzle-solving in its elaborate fictional world, putting a premium on sensory acuity, but it does not require players to contend dynamically with the hostile agents that the world surely contains through either fight or flight. (The point-and-click gameplay, of course, would not lend itself well to that kind of scenario, once again emphasizing that the form and experience of horror games cannot be understood in analytic isolation.)

Threat negotiation. Not all threats can be preempted with adequate information and foresight. Some must be escaped or overcome - fled or fought - in a real-time encounter. The human fear system is prepared for this contingency, too, and rapidly prepares the organism to cope:

The heart rate goes up and glucose is released into the bloodstream for an instant energy fix... Blood is diverted from the digestive system - irrelevant when you're facing a predator or an oncoming boulder - to the large muscle groups... Pupils dilate to take in as much visual information as possible... Attention is sharply focused on the threat. (Clasen 2017: 26)

This autonomic cascade primes the organism for situations of immediate, physical danger that motivate either evasive or aggressive *action*, or, in rare circumstances, tonic immobility in response to a concrete and immediate threat. In horror games, dynamic threat negotiation describes the player's experience of dealing with simulated threats of a comparable urgency. An example would be the player's experience of the adrenaline-pumped chase sequences in *Outlast* (Red Barrels, 2015), where homicidal maniacs must be outrun in a secluded asylum.

In *Outlast*, the entire gameplay experience is divided rather cleanly into sections of paradigmatic threat assessment (stealthy exploration) and threat negotiation (chase sequences). Shifts between these two modes are marked at several levels in the game's design space. Musically, the sudden shift from anxious threat assessment to fearful, dynamic threat negotiation is signalled by musical stingers (sharp, loud notes) whose intensity convey the prudence of a mad dash to safety. The mode of gameplay challenge shifts in chase sequences, too, in accordance with the heightened dramatic circumstances players find themselves in. Instead of the deliberate button presses that mediate the player's movement during stealthy exploration, the chase sequences call for frantically coordinated controls to implement the player's split-second decisions about how best to escape.

The vital adaptive pursuits of threat assessment and negotiation are what fear is essentially about, what it motivates and is motivated by. Hence, it is not surprising that horror video games should facilitate these experiences (Clasen 2017). As many theorists of the genre have noted, horror video games can be roughly divided into two modes, or intensities, of gameplay, to which individual games assign different weightings (e.g., Nacke et al. 2016; Perron 2005; Toprac and Abdel-Meguid 2011). Survival-horror games accentuate threat assessment: These games are about traversing dangerous environments while evading their dangers, and about building an

atmosphere of vulnerability and anxious tension that prompts the player to stay vigilant. By contrast, the typical *action-horror* game, such as *Dead Space* (EA Redwood Shores, 2008), accentuates threat negotiation. These games stage dynamic confrontations with dangerous antagonists, such as in fight and chase sequences. Of course, the two modes may coexist within a single medium, as they do in *Outlast*. They may also shade into one another at the conceptual fringe. The point is only that the two modes are assigned different weightings in individual games according to the kind of coping experience that the game aims to foster. Games that focus on threat assessment will promote an affective climate characterized by restless tension, whereas games that focus on threat negotiation are more likely to generate a dynamic experience of actionable fear. (See Perron's (2005) discussion on 'horror' vs 'terror' for a somewhat similar argument.)

The signatures of these two basic modes, we propose, emerge at different levels of analysis of the horror genre. For example, they instantiate in a specifically horrific frame what Grodal (2003) terms the fundamental gameplay activities of *explorative* and *dynamic coping*. The former, signified by the player's flashlight and monster-sensitive radio in *Silent Hill 2*, is about slow-paced and careful exploration of the gameworld. The latter, signified by the advanced weaponry available to the player in *Dead Space*, is about overcoming an immediate challenge. Also, and as already mentioned, the twin poles are respectively typified in the broad genre configurations of survival- and action-horror, as well as in the affective categories of anxiety and fear. They even emerge at the level of production geography. Threat assessment, as embodied in the experience of survival-horror, is frequently associated with Eastern horror game developers. Threat negotiation, as it embodied in the experience of action-horror, is associated with Western developers.

Horror video games, then, are organized around the quintessentially adaptive pursuits of threat assessment and threat negotiation. From the first-person perspective of the player, these pursuits involve appraising and fighting/fleeing threats to one's (avatar's) life. (Of course, horror games can be organized around other themes as well, but that would normally warrant an additional genre tag, such as with a *puzzle*-horror game.)

Recognition of the fact that horror video games stage evolutionarily resonant, prototypical fear scenarios for their players almost forces the question of the genre's paradoxical appeal upon the analyst. The dubious selling proposition of finding oneself *Alone in the Dark* or *Left 4 Dead* is if anything more puzzling than the appeal of witnessing others so afflicted.

The Appeal of Virtual Danger

Building on Clasen's (2017) adaptationist perspective on horror, we argue that the appeal of horror video games rests on their capacity to provide safe experience with prototypical fear scenarios. Our roaming, social, omnivorous species has faced many and varied dangers over evolutionary time, and it is adaptive (and therefore enjoyable) for us to obtain information about which threats are out there and how best to negotiate them. Humans have exchanged such information for many millennia through the telling of scary stories (Clasen 2017; Sugiyama 2001). Such stories grab our attention and stick in memory for obvious adaptive reasons (Nairne and Pandeirada 2016). It seems that we are drawn to the abyss, even if only to mark it off for future travels. The modern medium of the horror video game, however, offers a more involved experience than its narrative counterparts that, like prototypical fear scenarios, centres on the self. The medium affords players the opportunity to simulate danger - not the abstract slow burn

of a carcinogenic cigarette, but the blazing fear of being preyed upon - and to practice effective coping.

This argument derives its functional logic with what the play theorist Brian Sutton-Smith, in his influential *The Ambiguity of Play* (1997), termed the pervasive *progression rhetoric* of play.

Sutton-Smith noted that many play theorists made much of the putative adaptive benefits of play, to the extent that it was 'the most popular play explanation among many animal theorists' (30).

Though not entirely dismissive of this perspective, he identified problems with the literature and concluded that the broad functional claims that had been made about play lacked sufficient empirical evidence. The years following the publication of *The Ambiguity of Play*, however, saw continued interest in the topic of the adaptive benefits of play across, especially, the mammalian species. These inquiries produced a wealth of evidence for the adaptive functions of human and animal play (Burghardt 2014; Spinka, Newberry and Bekoff 2011; Steen and Owens 2001), including simulative play in humans (Vorderer, Steen and Chan 2006). Across different animal taxa, play behaviours recapitulate aspects of adaptive adult behaviors. It is no coincidence that humans, with our vast behavioural repertoire, exhibit the most varied and creative forms of play of any species (Vorderer, Steen and Chan 2006). As for horror video games specifically, the limited available evidence indicates that, indeed, players may learn to cope with fear - whether induced by a game or stimuli in the real world - through playing horror video games: repeated exposure makes the experience more enjoyable and whets the appetite for more extreme forms of horrific experience against which to test one's resolve (Andrade and Cohen 2006; Vachiratamporn et al. 2015). Players seem to continually transcend their fears by graduating the experience so as to be scary without being horrifying to the point of forcing the player's disengagement.

As already noted, horror games are not frightening because they feature ancestral dangers. Instead, the games are scary because they afford players *experiences* of ancestral danger. The same type of argument goes for the motivation of horrific gameplay. Horror games are not engaging merely because they feature scary scenarios (who would buy a game that offered nothing but a series of thematically unrelated startles?) but because they make such scares the core of a complete simulative system that promises a sustained, ego-focused challenge of threat assessment and threat negotiation. Thus, Jesper Juul (2013) points out that something like the paradox of horror applies to most challenging games. Players may fail time and time again and thus come to experience abiding negative emotion. However, these games always hold out the promise of a final resolution, or at least of the attainment of desirable goal-states, such as a public top score or an in-game unlock. You are supposed to be able to do well at a game, to *beat it*, and players know that. The implicit promise of a surmountable challenge motivates players to power through negative emotion such as frustration (Malone and Lepper 1987). They come to construe diverse gameplay obstacles and antagonists as stimulating challenges to overcome.

This implicit promise structures all aspects of horror gameplay and helps explain why the notion of a fear-based entertainment simulator is not a contraction in terms. Within mere minutes of gameplay, players will normally know what they are supposed to do because the game telegraphs its goals as well as their moments of completion. This teleological inscription can often be simply read off at the level of framing narrative ('escape the haunted mansion'), but, as Gee (2003: 109) points out, it may also be gleaned at different levels of game design. In a 2D horror game like *Limbo*, for example, the perspective frames the player's sustained effort to move the avatar rightward. Based simply on the perspective and the avatar's orientation within it, the player knows that he or she is being challenged to reach some as yet unseen goal to the far right,

and to contend effectively with the dangers and challenges that lurk between the avatar's starting position and the implied desired end state. To a seasoned player, one fully versed in the unforgiving 2D-platformers of the early 1990s, for instance, this implicit ludic signifier reads like an open challenge: 'can you do it, despite the perils ahead?' Many an adventurous individual will know the real-life counterpart of this challenge, as well as its motivating force. It aptly begins: 'I dare you ...'

Horror games, then, infuse the imaginative lure of prototypical fear scenarios with progression structures that make for a ludically rewarding experience. The other side of such deep gamification is the removal or omission of disincentives inherent in unmediated experiences of horror. One such disincentive is immediately obvious: Real predators can hurt you, whereas their digital counterparts cannot. Reasonably enough, the risk of death or serious injury limits the enjoyment most of us get out of engaging in highly dangerous activities. More subtly, horror games, like other genres, offer a customizable gameplay experience that allows the player to set the intensity of different facets of the experience. The player may do this by lowering the game's difficulty, which may give the player access to more measures for coping, or by increasing or decreasing their own sensory immersion by manipulating the sound volume, for example, or by opting in or out of a Virtual Reality experience, such as is on offer for *Resident Evil 7* (Capcom, 2017). In addition, players can choose to quit whenever they want, thus segmenting gameplay into 'bounded experiences of fear' (Perron 2005) that are manageable for audiences of diverse temperaments. These choices find counterparts in domains of real-life play, such as play fighting, where the ebullient contestants can signal when things get too rough or too exhausting. All of this is to point out ways in which the experience of playing horror video games is basically *dissimilar* to that of suffering a prototypical horror scenario in real life. These dissimilarities

converge in an incentive structure that motivates the player's ludic engagement in activities that, *sans* deep gamification, would put almost anyone off.

Those who set out for the simulated abyss of horror video games will get to experience 'extremity of circumstance in perfect safety,' thereby 'deepening and widening [their] emotional experience,' to quote horror author Peter Straub (Clasen 2009). They will learn to pay close attention to their environment to progress, as in *Silent Hill 2* (Konami, 1999). They will need vigilance and fast reflexes to escape the frenzied axe-murderer Jason Vorhees in *Friday the 13th: The Game* (IllFonic, 2017). And they will have to control their fear to focus on the life-and-death decisions at hand, as in *Five Nights at Freddy's* (Cawthon, 2014). In short, they will have to practice and master challenges of threat assessment and threat negotiation. As we shall now argue, the same kinds of challenge abound in Playdead's *Limbo*. While *Limbo's* platforming gameplay may not represent a prototypical horror-game experience, such as has been defined by high-profile series including *Resident Evil*, *Silent Hill* and *Alone in the Dark*, its liminal nature will serve to bring out discriminant features of the genre.

Limbo

Limbo is a 2D side-scrolling puzzle-horror game with platforming elements. It was first released as an Xbox Live Arcade exclusive for the Xbox 360 in 2010. The game's success prompted later releases on a range of platforms, including PC, PlayStation 4 and Xbox One.

The game's entire premise is contained within its tagline: *Unsure of his sister's fate, a boy enters Limbo*. The player assumes the role of the unnamed boy who must traverse a series of achromatic, Stygian environments to find his lost sister. These environments include a dark

forest, an abandoned factory and a desolate city. When at the end of the game the boy finally reunites with his sister, her strangely ambiguous reaction is eclipsed by the end credits.

Basic though it is, the one-sentence narrative premise of *Limbo* carries motivating significance. This is easily demonstrated with the flat bathos of a modified tagline: *Unsure of a girl's fate, a boy enters Limbo*. The motif of one's family being in peril has an obvious evolutionary underpinning that accounts for its ubiquity in all sorts of fiction (Boyd, Carroll and Gottschall 2010). In video games as in traditional narrative media, a helpless child of or related to the protagonist is often introduced and then brought in danger to motivate a protective or restorative effort in the player (Eichner 2016). *Limbo* uses this simple and conventionalized premise to build a meaningful incentive structure with minimal disclosure of narrative contents; it tells the player just enough to make the gameplay effort seem meaningful. This sets an important precedent for the game as a whole. *Limbo*'s minimalist setup invites the player to enter the gameplay experience with minimal expectations. We know exactly as little about the diegetic world as the name- and faceless avatar, and this pushes the player into an ego-focused mode of engagement often adopted by the genre whereby, as Perron (2009: 125) explains, we are 'urged to act and feel through' the neutral intermediacy of the generic avatar ('a boy'). The game invites the player's virtual and extended embodiment in presenting no psychologically realized substitute for it (see, e.g., Grodal 2003; Nørgård 2011 for a similar arguments).



Figure 1. In the opening chapter of *Limbo*, the avatar awakens in a gloomy forest. The player is given no indication as to what lies in wait.

Like its exposition, *Limbo*'s interface and controls are rudimentary. The game features no Heads-Up Display (HUD) during actual gameplay, and hence minimizes the semiotic distance between the gamer and the gameworld (Pinchbeck 2009). The player does not need to interpret symbols such as health gauges or life counters, which telegraph the artificial nature of the game and may therefore break immersion (Saunders & Novak 2007). The aim of cognitive fluidity appears also to have guided the design of the game's controls. They are simple and fully graspable mere seconds into the first play session. In the PC version of the game, the player moves left, right, up (jump, climb up), and down (climb down) by pressing the corresponding arrow keys on the keyboard. The only additional input open to the player is a context-sensitive action key whose functions include grabbing and pushing. Imprecision in operating this control scheme will typically result in the death of the avatar, who may be torn, dismembered, pierced, torched,

crushed, electrocuted, flung and drowned over the course of a single play session. Faced with these odds, the player must pay close attention to the gameworld to negotiate its threats, apprehend its affordances, solve its puzzles and ultimately find the lost sister.

The minimalist setup and simple gameplay of *Limbo* work to underscore its nightmarish themes. As noted, players quickly master the game mechanics, and this allows them to absorb the game's shadowy ambiance. Unidentifiable noises signal danger. The hint of an agent in the distance puts the player on edge. As H. P. Lovecraft saw and exploited in a narrative mode, 'The oldest and strongest kind of fear is fear of the unknown' (1927/1971: 12). *Limbo* conveys a looming sense of uncertainty and peril without revealing its object, and consequently the player's imagination runs laps to supply it. As already discussed, the phenomenon is well understood by evolutionary psychologists: Evolved cognitive heuristics make us hyper-vigilant in the face of ambiguous cues. *Limbo* plays to this adaptive bias by presenting objects hard to identify in the game's two-dimensional, fog-ridden darkness. Yet it also nudges sinister interpretations. A nondescript bundle on the ground, for example, becomes more salient because of the flies buzzing about it. *Could that be a dead body?*

Fictional worlds may be necessarily incomplete (Pavel 1986), but *Limbo*'s ubiquitous sense of doubt and ambiguity is integral to its overall design. The game's director, Arnt Jensen, has been at pains to stress ambiguity and uncertainty as central to all aspects of *Limbo*, from individual sound bites to overarching narrative: 'The whole concept of the visuals, the horizon is always blurred so you can project your own things into the spaces. I tried to do the same with the sound with noise and textures - you start to hear things that aren't there' (Thomsen 2010: 2). The game does feature sequences of frantic threat negotiation, as we shall discuss shortly, but the game's overall affective mood is one of anxious threat assessment.



Figure 2. *Limbo*'s atmosphere is deeply unsettling and intensely suggestive.

The hostile denizens of *Limbo*'s netherworld fall within a constrained possibility space of ancestral dangers. A particularly nasty example is the aforementioned giant spider that stalks the avatar throughout the early game. Poisonous spiders and snakes have exerted significant selection pressures on our mammalian fear system, and this explains why they crowd the imaginary landscapes of horror fiction across different media, cultures and historical periods (Clasen 2017). In support of this thesis, researchers have found that humans, like other mammals, come to fear some things, and especially some living things, much more easily than others. Evidence converges from the ubiquity of spider and snake phobias (Öhman and Mineka 2001), asymmetrically rapid - or 'prepared' - fear conditioning to such natural predators (Öhman 2007) and their enhanced salience in visual identification tasks (LoBue and DeLoache 2008). *Limbo*'s giant spider, moreover, is even more frightening than earthly arachnids because of its

absurdly enlarged morphology. As such, it instantiates a basic psychological principle: human reactions tend to scale with their elicitors (D. Barrett 2010). This is because the magnitude of the elicitor tends to correlate with its positive or negative fitness value: a big meal nourishes more than its less satiating counterpart. *Limbo*'s spider is especially threatening, then, because it is a *supernormal* stimulus - an artificially hypertrophied predator-antagonist. If one were to search through abstract morphological design space for something sure to scare genus *Homo*, this would be it.



Figure 3. A giant, arachnoid creature stalks the avatar.

Another predictable threat in *Limbo* is strangers. The first half of the game features groups of psychotic children who are out to kill the player with weapons and traps of various kinds. These murderous silhouettes trigger continuous anxiety and vigilance in the player for good adaptive

reasons. Conspecifics from competing coalitions, like spiders, have exerted a substantial selection pressure on the hominin lineage (Gat 2006). Humans, in turn, have evolved to respond to strangers with vigilant apprehension (Navarrete et al. 2009). Following the first encounters with the hostiles of *Limbo*, players interpret environmental hazards as traps set specifically for them, whether or not that is indeed the case. Humanoid agents, of course, are especially suitable to hint at this disconcerting connection because we intuitively assume them to be deeply intentionalistic - to want specific outcomes and to proactively organize their environments to bring about those outcomes. Similarly, strange noises come to signal the machinations of hostile agents because, again, it generally pays to assume the worst (Garner and Grimshaw 2011).

Limbo's atmosphere changes quite suddenly about midway through the game, when the player enters the deserted city. The gameworld's malicious agents cease appearing, and the number of scripted chills is reduced. In their place, the game predominantly loads on puzzles. Jensen has commented on this shift, admitting that he views it as a genuine design flaw, a 'big wound' in his own words (Thomsen 2010). The shift does counterbalance *Limbo*'s unsettling mood, as the player's attention shifts from the game's oppressive ambiance and occasional horrific spectacle to the abstracted mechanics of puzzle solving. For the purposes of this analysis, the change is mostly interesting in a negative sense; it is the reason why the first half of *Limbo* is especially thick with anxious tension. The human psychology of fear is especially attuned to agency, to things that act on their own accord (Arrindell et al. 1991). When *Limbo* subtracts (the suggestion of) threatening agency, it also largely subtracts what otherwise qualifies it as a puzzle-horror game. As a *GameSpot* reviewer of *Limbo* put this point, '[t]he later puzzles are complex and clever, but they don't haunt the heart' (VanOrd 2014). The gameplay experience becomes less about absorption into the anxiety-inducing fictional world - an evocative setting for simulative

engagement - and more about the gameplay emotions that attend mechanical challenge, such as pride and frustration (Lazzaro 2004; Perron 2005).

Especially in its early and most frightening parts, *Limbo* uses a variety of technical emphases to chilling effect, with the game's dynamic sound design being especially impactful. The sounds of on-screen and oncoming dangerous agents and obstacles are consistently accentuated relative to the ambient underscore. Take, for example, the first encounter with the game's giant spider: Partially occluded by vegetation in the foreground parallax, the eldritch monster suddenly thrusts an enormous, spiked leg toward the player avatar, and the kinesonic experience of virtual impalement is suitably piercing. Likewise, the gameworld's many traps, including bear traps, automated machine guns and falling rocks, trigger scripted sound sequences of discrepantly high volume. Such auditory spikes induce strong reactions in the player, partly due to the inherently frightening nature of loud noises, partly to potentiation by antecedent cues to danger (Grillon and Davis 1997; Garner and Grimshaw 2011). As in *Outlast*, these spikes signal a shift from explorative coping to dynamic coping, from deliberate threat assessment to fervent threat negotiation.

These devices, moreover, never work in isolation. When the player blunders, a frequent result is the death of the avatar followed by the retrieval of the last save state. Such negative feedback, combined with the game's implicit promise of its own surmountability, encourages vigilance and practice: coping, in a word. Its morbid expression in *Limbo* is genre-consistent and thematically addresses the evolved human psychology of fear, whose function is exactly the instigation of adaptive coping in response to environmental threat (Öhman and Mineka 2001). Such priming sharpens player focus and accords apperceptive primacy to the stimulated senses - a fact that, coming full circle, is exploited in the game's densely acousmatic sound design, which always

suggests at unknown agentic forces operating beyond the confines of the mise-en-scène. *Limbo*, like other competent horror games, approximates the structural invariants of real danger across its modalities, and this integration makes it powerfully engrossing (Anderson 1996; Toprac and Abdel-Meguid 2011).

The sense of careful integration of all aspects of *Limbo* extends upwards even to the game's evocative art direction, which draws inspiration from German expressionism and film noir. These stylistic frames are not just aesthetically appealing in *Limbo*. They guide the player's expectations to its bleak and dilapidated gameworld. Notably, the theme of insanity, a leitmotif of the expressionist tradition, looms large about one-third into the game, when the player begins to encounter parasitic 'brain worms.' These slugs descend from ledges and latch onto the boy's head, boring into his brain to take control of his body. Players experience reduced control, as they can only retard the slugs' overriding will by pressing the arrow keys in the direction opposite to its pull. *Limbo* represents the boy's loss of sanity and agency by warping and twisting the player's semi-subjective visual field, and by manipulating the loudness and timbre of the diegetic sounds to make them appear distant. This crossmodal cinematic convention draws inspiration from such classic works as *The Cabinet of Dr Caligari* (Wiene 1920), in which twisted and impossible angles convey the main character's mental breakdown. But the convention also pivots on a naturalistic basis: Insanity really does have something to do with perceiving one's environment in an altered way. *Limbo* uses a conventional phenomenal construction of insanity to construct a metaludic frame, allowing it to evoke themes of perceptual unreliability. In addition, the game's stark minimalism allows it to represent concrete threats with minimal conceptual texture. The two-dimensional gameworld is replete with black contours that are inherently difficult to classify. This is a felicitous setting for suspenseful engagement -

‘is that just a bough or something living and dangerous?’ - and it fractionates seamlessly from a higher-level design choice. The point, once more, is design-dimensional synergy. *Limbo*’s stylistic makeup harmonizes with its inherently frightening subject matter. It is a dark and unsettling game through-and-through.

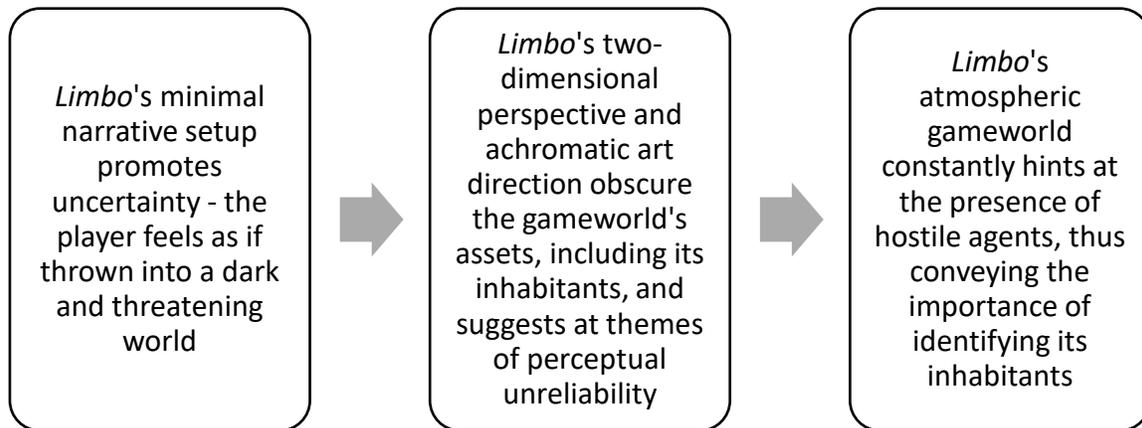


Figure 4. *Limbo*’s design comes together to minimize what players know about their situation while simultaneously motivating their survival-based need-to-know - their threat assessment.



Figure 5. A brain worm has wrested bodily control from the avatar.

The core experience of playing *Limbo* can be accurately characterized as a survival gauntlet - a series of life-threatening events and encounters endured under conditions of profound uncertainty. This conception is mirrored in the developers' characterization of the gameplay experience as one of 'trial and death' (Hatfield 2010). This experience could only prove attractive when ludically transformed. Such transformation is signalled by the very nature of the medium, as discussed in the last section, but it is also evident in the flow and progression of *Limbo's* gameplay specifically. When players first face a novel threat, such as the giant spider or the murderous children, the threat is presented distally and only in glimpses. These fleeting encounters warn players that a serious threat is out there and eminently worthy of their attention. They encourage coping measures that centre on threat assessment. After some such fleeting encounters, the threat suddenly intrudes fully into the frame. Players must now engage dynamically with the threat in attempting to evade or mitigate its attacks. This happens, for

instance, when the murderous children send a flaming tire rolling toward the player, who must dash forward to avoid a fatal collision.

Finally, players find themselves in situations that allow them to overcome the threat through problem-focused coping. For example, coming upon a large boulder while being chased by the spider, and having themselves been squashed by a boulder at an earlier point in the game, players immediately perceive the boulder as a weapon to use against the spider. And after having earlier been repeatedly flattened by pressure-activated hydraulic crushers, players realize that they can bait the murderous kids onto the crushers to pay the lesson forward. These learning sequences conform to the distinctly survival-themed progression structure of threat assessment and negotiation. They give the player a palatable sense of progression and mastery within a dangerous virtual world designed to test them.

Limbo is intimately structured to induce anxiety, uncertainty and, at times, hair-raising fear in the player. The game invites players to experience their primeval fear circuits blasted from within - through cuing the player's nervous projections of hostile agents into the gameworld - and without - through few but impactful confrontations with such fearsome agents as the player might imagine. The appeal of this experience is that of daunting but ultimately risk-free challenge, of venturing into the virtual darkness with its heartening promise of a safe return.

Conclusion

An evolutionary analysis explains the paradox of virtual horror by linking the genre's forms and functions. Horror games do not just motivate players by frightening them. That truly would be paradoxical. Instead, they challenge players to *overcome* fear and danger, an aim that is entirely comprehensible in evolutionary terms. To reliably provoke fear, horror games let players

experience ancestral fear scenarios. To reliably motivate gameplay, horror games ludically stage these scenarios as obstacles to be overcome - as adaptive challenges of fearful coping.

We hope that the evolutionary approach to horror video games outlined in this article will prove fruitful to both humanist and social scientific researchers of horror video games. Even more so, we hope that it may point a way toward collaborative empirical and interpretative efforts to understand this rich genre.

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