Introduction

STEREO FRONT AND CENTER

> At the present moment, the talking picture—comprised of filmed images and recorded sounds (the later either placed on the same filmstrip or played synchronously)—is limited to representations of noise, music, and speech that refer to the projected image (such as dialogue uttered or heard by a character on screen, or the sound of an explosion depicted on screen). Aesthetically speaking, this mode of representation is monotonous.[1]
>
> —Abel Gance, Patent Application 280,255, August 13, 1929

Abel Gance hoped to improve talking pictures. Indeed, many people did. It was 1929 and film sound was still a rudimentary technology. Synchronous dialogue, while an impressive feat, was regularly masked by hisses and hums. Music and effects were similarly marred by electrical distortion. And for sound-conscious audiences, these noisy reproductions paled in comparison to the richness and excitement of live accompaniments.[2] Such sentiments were shared by studio technicians, who spent the next several years fixing various flaws inherent to the new equipment, as well as by engineers from the radio and telephone industries, who soon developed noise-reduction processes to address these acoustical issues.[3] But Gance's concerns were of a different nature. He had little interest in technical matters like distortion and noise levels. After all, he was not an engineer but a filmmaker, and an eccentric one at that. He had just produced the nine-hour *Napoléon* (1927), for which he employed multiple projectors to triple the size of the image. And now, fresh off his biopic's success,

the famed French director looked to expand the size of another cinematic element: the soundtrack.

From Gance's perspective, talking pictures failed to exploit the full potential of theatrical space. Every sound—from orchestral cues to canon fire—played exclusively through horns located by the screen, and this led him to wonder if there was a better way of structuring cinematic listening. What if he placed speakers all over the theater (on the ceiling, along the walls, even under the seats)?[4] And what if he then situated sounds around the audience much like a set designer places objects around the actors? Church bells could ring from above the heads of filmgoers. A vehicle could zig-zag between each side of an auditorium. In effect, Gance wanted movies to offer immersive simulations of real-world acoustical phenomena, the types of filmgoing experiences that theorist André Bazin would famously call "total cinema."[5]

Gance nevertheless struggled to generate these effects. As it turns out, he was merely a novice when it came to audio engineering, and his descriptions of his proposed apparatus were beset by vague and imprecise language. For instance, though he wanted loudspeakers ("haut-parleurs") placed under the seats of patrons, he mistakenly instructed theaters to install "un série de microphones" under their seats, thereby insinuating that he wished to record each filmgoer's caboose for hours on end.[6] The French patent office subsequently rejected his initial application.[7] Gance would succeed in patenting his invention a few years later, though to do so he removed any mention of speakers (or microphones) under the seats.[8] Presumably, he deemed these add-ons too controversial for an industry still acclimating itself to the possibilities of talking pictures.

We can imagine an alternate universe where Gance never abandoned his original idea, and where speakers under the seats became common attractions in French theaters, if not also in Hollywood's largest movie palaces. Ginger Rogers could have tapped her toes right next to our feet. The snakes that hissed at Indiana Jones could have slithered below us as well. Scholars may have even deemed Mel Brooks a sound auteur for exploiting these speakers during the beans scene in *Blazing Saddles* (1974). But sadly, such practices are not to be found in the history of cinema. Since the advent of talking pictures, the film industry has remained conspicuously conservative in its spatialization of audio. Even today, most theaters offer

some form of surround sound (those equipped with Dolby Atmos even boast ceiling speakers), but rarely do they produce the kinds of acoustical thrills Gance proposed. Instead, dialogue plays primarily from the front of the theater, as do other narratively important sounds. The atmospheres and echoes sent to the rear of the theater, in contrast, seldom grab our attention.

These spatial practices constitute the industry's norms of stereo design. Their aim is to keep audiences focused on the story, not the sound system. Like three-point lighting and the 180-degree line, craft workers adopted these conventions in the studio era to bolster narrative clarity and expedite production schedules. But over time, practitioners have come to treat these stereo guidelines as absolute laws of cinema that must be followed at all costs. Films rarely explore alternative modes of representation, and the ones that do receive considerable pushback.

Consider *Roma* (2018), a Mexican melodrama about the day-to-day struggles of a Mixteco housekeeper (Marina de Taviro). Critics praised its cinematography and acting, but its surround sound was less beloved. Particularly controversial was a shot/reverse-shot sequence between Cleo, the housekeeper, and her boyfriend Fermin (Jorge Antonio Guerrero). Throughout the scene, Cleo's voice plays from the front of the theater, while Fermin's offscreen voice emanates from the rear speakers, a startling effect that creatively accentuates the emotional distance between the two lovers. Nevertheless, prominent figures in the industry questioned its appropriateness. Randy Thom, head of sound design at Skywalker Sound, wrote on his website, "It tended to take me out of the film, reminded me that I was watching a film, which is usually considered a no-no in moviemaking." He continued, "Am I simply an old codger who is conservative about the use of surrounds, and am I unnecessarily resistant to the idea that a different aesthetic could be equally valid? . . . At this point I have to say that I doubt it."[9] Renowned sound designer Walter Murch concurred: "My personal feeling is that it's artificial, and it just reminds the audience that they are in a theatre rather than with the characters in their own space."[10] For Thom and Murch, as well as for many others, there exists a right and wrong way to deploy sounds in theatrical space. Films that keep dialogue in the front and center speakers illustrate the right way. *Roma*, by flaunting this convention, represents the wrong way.

Such criticisms demonstrate the extent to which the industry's norms of representation and conceptions of proper stereo design are internalized by practitioners and, at times, even used to police the creative decisions of other filmmakers. Rather than welcoming the stylistic flourishes found throughout *Roma*, Hollywood's sound community has established, codified, and enforced a set of rules for creating three-dimensional sound designs, rules based on unique understandings of acoustical beauty and narrative immersion. This book defines what these rules are, where they came from, and how they governed Hollywood's craft practices and storytelling conventions from the transition to talking pictures through the adoption of Dolby technologies.

SOUNDS IN THREE DIMENSIONS

Today, the term *stereophonic* (or *stereo*) is ubiquitous. It refers to theater systems, recording techniques, even ways of listening. The prefix "stereo" derives from the Greek word for "solid" (στερεός), while "phonic" stems from the Greek term for "voice" (φωνή). Stereophonic thus literally means a "solid voice," though in everyday parlance it refers to the representation of sounds in three-dimensional space, much as stereoscopes refer to three-dimensional images. And like stereoscopic illusions, stereophonic experiences typically require the juxtaposition of multiple sound perspectives. A stereo reproduction of a live concert, for instance, might involve two microphones to record the performance from different angles as well as two loudspeakers to reproduce those two perspectives simultaneously in an entirely new environment. Whereas traditional sound technologies are often designed to transmit acoustical information as clearly as possible, stereo technologies are designed to convey the physical presence of a given sound, often by enhancing its atmospheric details—such as reverb and decay—and reproducing them from different locations around the listener.

Such spatial practices, of course, are far from new. As Emily Thompson chronicles, eighteenth-century concert halls were designed not only to exaggerate a venue's opulence but also to harness music's three-dimensional elements. Without the luxury of electrical amplification,

architects designed venues that controlled the reverberation times of soundwaves so that a performance's musical details could remain audible in the furthest reaches of the auditorium.[11] In this context, we might think of concert hall architecture as a primitive form of stereo design. The reproduction of sound through multiple speakers is also not a new phenomenon. Both Gascia Ouzounian and Jonathan Sterne document that by the mid-nineteenth century stethoscopes, headphones, and similar two-channel devices were common in laboratories and world's fairs.[12] But instead of stereo, they were called *binaural* ("two-eared") technologies, a reference to the physiological process enabling three-dimensional audition. In contrast, single-speaker technologies were known as *monoaural* ("one-eared"), or simply *mono*.

Stereophonic did not enter the vernacular until the end of the nineteenth century. Its first known use was by Alexander Graham Bell, who in 1880 theorized that telephones might soon reproduce "the stereophonic phenomena of binaural audition."[13] The coinage became one of many neologisms that highlighted modern technology's power to transform our perception of the world through what Carolyn Marvin and James Lastra call "annihilations" of space and time.[14] Telegraphs, unlike traditional forms of in-person communication, enabled messages to be transmitted over long distances and at impressive speeds. Telephones did the same for sounds. Stereophony involved even more jarring annihilations; its transmissions compressed geographic space while its reproductions simultaneously expanded the size and shape of each sound.

That said, the term was seldom uttered during the early twentieth century. Helen Hanson notes its first prominent appearance was in a 1927 article for *Wireless World* that detailed a method of adding stereophonic effects to standard phonographs.[15] Indeed, when inventor Alan Blumlein unveiled his now-famous film stereo system in 1931, he dubbed it "Binaural Sound," demonstrating the continued popularity of the two-eared metaphor. It was only in the mid-1930s that these discursive practices changed. During that time, Bell Telephone Laboratories (BTL) and its affiliates developed a series of multi-speaker theater systems and marketed them to the film industry in three-dimensional terms. When they installed an array of speakers at the Hollywood Bowl in 1936, they called it stereophonic sound. When their Hollywood office unveiled two-track

film the next year, they called it stereophonic sound as well. And when they premiered their famous four-track format at Carnegie Hall in 1940, they branded it the Stereophonic Sound-Film System. By the mid-1940s, thanks largely to the promotional work of BTL, Alexander Graham Bell's portmanteau would become Hollywood's preferred term for describing three-dimensional sound and its associated technologies.

DIRECTION AND PROPORTION

Yet despite the term's ubiquity, stereophonic remains a rather perplexing concept. Sounds, after all, are not material objects. They are the invisible vibrations of air molecules that our ears and brains translate into information. By definition, they are always three-dimensional. A crash of thunder that erupts from one speaker will invariably radiate throughout the space of a theater, reverberating off the walls and reaching filmgoers from every direction. In this regard, words like stereophonic or three-dimensional sound might seem redundant, if not meaningless.

The concept nevertheless carries a great deal of meaning in Hollywood. For filmmakers and technicians, stereo refers to the use of multiple loudspeakers to spatialize sound according to two parameters: direction and proportion. Take for instance a film about an adorable but kvetchy cat. In mono, he can only cry out for catnip through a single speaker behind the screen, and when he does, his meows appear to originate from a nonspecific location within the film's setting. But in stereo, a filmmaker can direct these meows to the back of an auditorium, giving them unique coordinates that may suggest the cat has wandered into the theater. A stereo system can also alter the cat's proportions. If he cries out from one speaker, he can sound like a small, ordinary cat, whereas if he meows from every speaker simultaneously, he can sound enormous.

Hollywood movies feature a combination of directional and proportional effects. In most situations, the localization of sound can accentuate offscreen noises, like the footsteps of a thief. Such effects can also elicit affective responses from audiences. In *The Matrix* (1999), for instance, bullets regularly ricochet in the rear speakers, potentially amplifying the audience's anxieties and emotional allegiances to the characters.

Proportional effects, in contrast, are generally less noticeable, though no less potent. Consider, for instance, the Dolby Stereo release of *Crossing Delancey* (1988). Toward the end, Sam (Peter Riegert) surprises Isabelle (Amy Irving) at her grandmother's apartment, and Isabelle—who has concealed her true feelings for Sam—finally leans in to kiss him. As they embrace, Paul Chihara's orchestral score slowly crescendos in the rear speakers, accenting Isabelle's emotional release and inviting audiences to experience similar affects. Yet because the surrounds contain only background music, filmgoers presumably pay more attention to the onscreen romance between Isabelle and Sam. In this sense, the stereo effect parallels what scholar Claudia Gorbman calls the "inaudibility" of nondiegetic music.[16] It creates meaning and shapes our emotional responses to a movie. And much like an orchestral cue, it does so behind our backs, sometimes quite literally.

In general, proportional effects are believed to work best when used in moderation, as *Apocalypse Now* (1979) famously demonstrates. According to Walter Murch, the film's editor and sound designer, much of the film was intended to play through only the center loudspeaker, save for select sequences, such as when Willard (Martin Sheen) guides his river boat toward a USO concert stage.[17] The scene begins in mono, but as Willard becomes aware of the stage, the soundtrack gradually opens into the side speakers to heighten the strangeness of this new environment. The acoustical space continues to expand when helicopters fly through the surrounds. Then, once the sequence ends, the soundtrack collapses back into the center channel.

Such manipulations of auditory spaces are remarkably effective. As Jay Beck documents, *Apocalypse Now* is often seen as one of the finest stereo designs of all time—an achievement attributable both to the ingenuity of its sound team as well as its employment of popular ideals pertaining to stereophony.[18] Like other tenets of classical narration, its surround sound effects structure our attention and shape our emotions without making us conscious of the film's highly constructed nature. As such, the war epic demonstrates the validity of the industry's long-held principles for how and when to use surrounds. That *Apocalypse Now* was universally praised for its stereo design suggests that these aesthetic ideals were codified and championed by the time of its release. That it continues to be extolled as

the pinnacle of surround sound artistry indicates that these classical proclivities have remained firmly in place well into the twenty-first century.

MONOCENTRISM DEFINED

I refer to these enduring stereophonic ideals as *the principles of monocentrism*. Much like continuity editing or nondiegetic music, monocentrism defines a set of stylistic practices that are ubiquitous in Hollywood, but that remain insufficiently articulated in both trade and scholarly literature. The concept builds on the theory of *vococentrism* outlined by Michael Chion and expanded upon by David Neumeyer.[19] According to this theory, Hollywood sound designs prioritize the voice above all other sounds. To achieve this hierarchy, technicians regularly move music and effects to the background when mixing scenes with dialogue. A party sequence, for instance, might begin with source music blaring from the soundtrack, but once characters begin talking, the music drops in volume to aid the dialogue's intelligibility. If the music failed to move out of the way, and instead lingered in the soundtrack at a loud volume—as occurs during the "Pink Room" sequence in *Twin Peaks: Fire Walk with Me* (1992)—filmgoers might look for broader thematic meanings to explain this strange sound design.[20] In this regard, vococentrism is more than a storytelling aesthetic that prioritizes clarity and speech; it is also a system of repetition and difference that filmmakers harness to arouse our interpretative instincts.

Of course, audiences are not required to listen to films vococentrically. For music theorists like Frank Lehman, voices often take a backseat to the Neo-Riemannian chord progressions found in the orchestral score.[21] Similarly, when sound editor-turned-scholar Katie Quanz watches films, background sound effects often grab her attention, especially if they delineate a sound facility's house style.[22] I myself frequently mute the front speakers to isolate the surrounds and gain a better understanding of how a film is constructed. Indeed, there can be immense pleasure in listening to movies unconventionally. But such listening habits do not govern the way filmmakers design their soundtracks. By and large, the industry feels that speech should take precedence above all other elements. As Academy

Award-winning mixer Richard Portman once put it, "You've got people in the theater who want to hear the dialogue—this is the most important thing."[23] And though directors like Christopher Nolan like to test the limits of vocal clarity for dramatic purposes—as *Interstellar* (2014) and *Tenet* (2020) illustrate—criticisms of these experiments, as well as ongoing concerns regarding dialogue intelligibility more broadly, only reaffirm the need to adhere to industry conventions.[24] For most filmmakers and filmgoers, mainstream movies—even those that inundate audiences with music and effects—should center the final mix around the voices of actors. Hence, vococentrism.

Stereo films, I contend, follow similar monocentric guidelines. The voice remains the most important element of the soundtrack. But its prominence is now shaped by its location in theatrical space, a variable that I argue is governed by three principles. First, dialogue and other prominent sounds typically remain in the center channel. Second, background sounds like music and atmospheric effects are generally sent to the sides and surrounds. Third, any deviations from these principles can occur, but generally they do so to highlight important plot information. In other words, monocentrism draws on repetition, difference, and other formal contrasts to exploit the dramatic potential of three-dimensional sound. Sometimes an entire multichannel soundscape might abruptly collapse into the center speaker, as occurs in *Disturbia* (2007) when the prime suspect is reported to be innocent.[25] Other times the background score might suddenly pan to a different speaker to punctuate a character's disorientation, as occurs throughout *Gravity* (2013).[26] Unlike other stereo practices—such as most two-channel broadcasts of classical music—monocentrism is not about reproducing a performance space's acoustical signature as faithfully as possible. Rather, it is a set of options for manipulating the size and coherence of acoustical space for expressive ends.

Consider the horror-comedy *Get Out* (2017), a film that typifies the monocentric stereo designs of today's digital era. Like other contemporary releases, its soundtrack boasts impressively wide decibel ranges and richly layered soundscapes. And notably, it does so while adhering to the industry's norms of stereo mixing. The film follows Chris (Daniel Kaluuya), a Black photographer who spends a weekend with his white girlfriend Rose (Allison Williams) and her parents in upstate New York. At first her family

seems normal, but after a series of strange occurrences Chris discovers they intend to kidnap him. During one particularly dramatic moment, Chris tries to leave and drive back to the city. Rose, however, struggles to find her car keys, forcing Chris to confront her family in their foyer. The scene illustrates the first two principles of monocentrism. Dialogue almost always plays through the center (mono) speaker. In contrast, the music and background effects—including the crackling of the fireplace—play at louder volumes in the left, right, and rear speakers.

The scene then deviates from these spatial principles whenever Chris's disposition changes. Each time this occurs, his voice either expands or contracts in size. As Rose frantically searches for her keys, for instance, Chris loses his temper and shouts, "Rose! Now! Now! The keys!" At this point, his voice erupts from every speaker in the theater, a contrast that amplifies his fearful demeanor. Rose's brother Jeremy (Caleb Landry Jones) then taunts Chris by swinging a lacrosse stick. Notably, the woosh of the weapon continues to play from the surrounds, as do Jeremy's warnings for Chris to "be careful." After this altercation, Chris's demeanor once again changes. He realizes that Rose's frenzied behavior is a ruse. He tilts his head and calmly asks, "Where are those keys, Rose?" as if to say, "Time to come clean." And to punctuate his delivery, Chris's voice once again changes in proportion, this time collapsing back to the center channel. The effect illustrates the third principle of monocentrism, that a film can intensify audience engagement by momentarily bypassing its norms of spatial representation. Sometimes this principle serves to underscore important beats, such as Chris's realization that Rose is lying. Other times it can work thematically to structure the surround sound design of an entire film.

The film's teacup motif best illustrates this broader structural patterning. Once Chris realizes that Rose has deceived him, Rose's mother Missy (Catherine Keener) taps the side of her teacup with a spoon. The high-pitched ringing of the glass subsequently hypnotizes Chris and causes him to fall into a strange state of paralysis, what Missy calls "the sunken place." And to distinguish this ringing from other noises in the scene, the film's sound team designed its frequency, timbre, and volume to take full advantage of the wider acoustical ranges afforded by digital audio technology. The echoes from the ringing and their slow decay in volume, for example, are extremely quiet yet rich with texture and detail, an effect that gives the

sound a seemingly material presence. Much like the tingling provoked by autonomous sensory meridian response-triggering noises (better known as "ASMR"), or the types of sensuous and intimate soundtrack encounters that Danijela Kulezic-Wilson dubs "the erotics of cinematic listening," the teacup's sound design invites us to experience its tapping and ringing on a visceral level.[27] In turn, it sends chills up our spine right as Chris himself falls into a state of paralysis.

At the same time, the sound team designed the teacup to play through every speaker, giving it a sense of depth absent from the other soundtrack elements. This spatial effect notably rhymes with an earlier moment in the film when Missy first hypnotizes Chris. In that scene, she swirls a spoon around in her teacup, creating a similar ring that temporarily paralyzes him. And like in the later scene, the ringing plays from the rear speakers, indicating its power over Chris. Taken together, these two moments establish a formal pattern, that when Missy uses sounds to send Chris to the sunken place, they emanate from the surrounds.

The payoff to this pattern occurs at the film's climax. After Missy once again hypnotizes Chris, he awakens to find himself tied to a leather chair that faces a television. He tries to escape by scratching his fingers against the chair, but he only manages to rip a hole in the leather. Soon after, the television shows an image of a spoon stirring a cup of tea, and its sounds again seem to paralyze Chris. However, we later learn that they fail to do so. Wisely, Chris removed the cotton from inside the leather chair and wedged it into his ears, blocking the sounds from entering his head. And to subtly alert filmgoers that this final attempt at hypnosis is different, the ringing of the teacup no longer plays through the surrounds. It instead only plays through the front speakers, signaling its sudden *lack of power* over Chris.

In some ways, we expect movies to deploy these sorts of narrative patterns and payoffs. For as formalists like Noël Burch, Viktor Shklovsky, and Kristin Thompson all show, such stylistic practices have long been a feature of cinema.[28] Though what makes monocentric stereo designs distinct from other stylistic parameters is that its uses of repetition and difference are less obvious. We may recognize, for instance, that some villains are defined by their gestures, or that Errol Flynn's green and brown Robin Hood costume matches the colors of Sherwood Forest.[29] But we

are unlikely to notice that Missy's teacup quietly rings from every speaker throughout the film, or that it suddenly loses its three-dimensionality at the film's climax. And yet this subtle acoustical change is what renders the moment ineffably peculiar. We are invited to feel, instinctually, that something is off when Chris seems to fall into the sunken place once again, even if we are unable to put our finger on what may be leading us to that inference.

In this regard, monocentric principles are more analogous to the principles that have governed film music practices since the transition to talking pictures.[30] By design, background scores and stereo effects both dramatically shape how we watch and interpret the actions on screen, and as a general rule both are meant to remain hidden from audiences. Yet in each case, filmmakers can break this rule to enhance the telling of story. As Claudia Gorbman explains, film music enjoys a "special status between conscious and unconscious perception, sometimes between diegetic, nondiegetic, and metadiegetic fictional levels, and between formal and narrative rhythms," and thus "mediates among many types of textual contradictions and itself participates in them."[31] A jazz score might turn into source music during a party to strengthen narrative continuity. Likewise, orchestral cues might momentarily rise in volume and grab our attention to render a scene more emotional. The revelation that Chris hid cotton in his ears, specifically, is punctuated by a brass stinger, a noise that can startle us due to its sudden salience and departure from the otherwise subdued electronic score (Figure 0.1). Were similar stingers to play repeatedly throughout the scene, the revelation would likely lose its full affective resonance.

Hollywood's stereo designs follow a similar logic. Like orchestral cues, they abide by basic principles for covertly situating sounds in theaters, where key sounds reside in the center speaker while other sounds play in the surrounds. And these monocentric principles give filmmakers the ability to experiment with alternate spatial designs to accentuate information and strengthen narrative closure, as the teacup motif demonstrates. Further, the structural importance of the center channel in monocentric releases allows filmmakers to expand and contract the proportions of sounds—be they dialogue, music, or effects—while preventing such proportional effects from simultaneously disrupting the industry's classical

Figure 0.1. Chris pulls cotton from his ears at the end of *Get Out*.

storytelling practices. In other words, monocentrism enables a film's stereo effects to be expressive without being evident.

PRACTICALLY CENTERED

Notably, these types of centering principles are not unique to film soundtracks. As art theorist Rudolph Arnheim contends in his 1982 monograph *The Power of the Center*, the concentricity of circles and the eccentricity of grid lines are integral to how we express ourselves aesthetically and, in turn, have become structural components of all audiovisual media.[32] Popular cinema can simply be less overt in its uses of them. Indeed, Arnheim would famously dismiss talking pictures for their apparent "violation" of basic aesthetic laws.[33] But as scholars have repeatedly shown, the allure of movies nevertheless derives from their adherence to these structural centricities, especially in the image.[34] David Bordwell, for instance, observes that most directors utilize the center of the frame to accentuate new material, simplify widescreen staging, and enhance onscreen action.[35] And James Cutting finds that filmmakers use luminance, motion, and the absence of clutter to guide our attention to the center of the screen so we can quickly extract information from the image, practices that he terms "mis-au-centre."[36] Monocentrism merely adapts these techniques for stereophonic storytelling.

At the same time, monocentrism helps to standardize film exhibition. Take, for instance, the soundtrack to *Wonder Woman* (2017). Like most Hollywood blockbusters, it was designed to play through a variety of sound systems, from the sixty-four channels of Dolby Atmos to the traditional left-center-right configurations of television sets, sound bars, and laptops. Yet like most blockbusters, the film can sound remarkably similar across these different formats. Such uniformity is deliberate. When mixing motion pictures, technicians conceptually divide acoustical space into (a) the center channel, and (b) the surrounding channels. This organizational principle simplifies workflows and eliminates the need to create entirely new sound designs for each stereo system. It also ensures that in large and small theaters alike, dialogue remains front and center while music and effects frame the voice and bolster its prominence. As a result, the most important element of the soundtrack, the voice, rarely loses its perceptual salience—even in cinemas that inundate audiences with surrounds and subwoofers. In other words, monocentrism enables the industry to preserve the principles of vococentrism in any theater, regardless of its sound system.[37]

Further, monocentrism strengthens cinematic absorption. Filmmakers want us facing the screen, as this leads us to pay closer attention to the story. Sound technicians subsequently send dialogue to the center speaker to keep us focused on the screen and to prevent us from turning our heads whenever someone speaks, as Randy Thom reportedly did during *Roma*. Consider once again *Apocalypse Now*. When designing the film's soundtrack, director Francis Ford Coppola sought inspiration from quadraphonic stereo, a short-lived vinyl format that employed two front channels and two rear channels.[38] Coppola hoped to adopt this configuration for his war epic, but Walter Murch believed the film also needed a fifth channel to keep audiences facing the screen. As Murch explains, "Unlike music, film has dialogue and the dialogue needs to have its own speaker right in the center of the screen so that when people speak it's not a phantom center, but it's a direct projection of sound from centrally behind the screen."[39] Murch, in effect, wanted audiences immersed in the story, so he created a sound mix that was highly monocentric, where dialogue and other key sounds play through the center (mono) speaker.

This strong adherence to mono storytelling techniques may seem counterintuitive. After all, audiences often associate surround sound with

ostentatious flourishes like the shootouts in *The Matrix*, the D-Day snipers in *Saving Private Ryan* (1998), and the helicopters that circle our heads at the start of *Apocalypse Now*. But these riveting effects are usually limited to one-off sequences that grab our attention and sear themselves into our memories precisely because they deviate from industry norms. And when critics define film stereo by these exceptionable moments, they miss the forest for the trees—namely, that stereo soundtracks are remarkably similar to mono soundtracks. Indeed, what makes stereo such a fascinating object of study is not its potential to regularly shock audiences with adventurous and conspicuous auditory attractions, but that such potential is rarely activated in mainstream motion pictures.

UPROOTING MONO

This book explains how and why such a peculiar construction of film stereo came into being. It shows that today's practices are not new at all but are instead a continuation of stereo techniques developed during the studio era. In turn, it seeks to revise film sound histories that conflate technological change with aesthetic change, and that suggest the adoption of new theater formats—such as Dolby Stereo or Dolby Atmos—led to entirely new stereo storytelling practices. The clearest articulation of this historical framework is found in Mark Kerins's 2011 monograph *Beyond Dolby (Stereo)*.[40] It claims that the advent of 5.1 surround sound formats in the 1990s—specifically Dolby Digital, Digital Theater Systems (dts), and Sony Dynamic Digital Sound (SDDS)—ushered in a new era of sound design defined by lower noise levels and wider frequency ranges. These acoustical capabilities, Kerins argues, enabled technicians to generate extraordinarily detailed surround sounds and points of audition that place filmgoers in unique locations within the film's setting. He calls this digital stereo aesthetic an "ultrafield" and contends that it distinguishes today's stereo effects from those of earlier decades.[41]

Kerins's book remains an important contribution to film sound studies thanks to its methodological innovations. It introduces new ways of analyzing multitrack signals, methods that continue to inform the work of scholars like Randolph Jordan, Matthew Malsky, and Jeff Smith.[42] (In fact,

the book you are currently reading would not exist had I not pored over Kerins's theories many years ago.) Yet its broader claims about the history of stereo have generated far less discussion, a product of their complexity and scope. As a book on digital sound, it primarily analyzes contemporary movies. In contrast, the stereo effects that predate 5.1 are discussed only in passing. And this limited focus leads Kerins to overlook a major historical finding, that the stereo aesthetic he sees as a new phenomenon is not actually new. Indeed, when we apply his analytic methods to earlier surround sound releases, such as *Journey to the Center of the Earth* (1959), we see that this aesthetic originated well before the advent of digital sound. The technological affordances of 5.1 merely made the ultrafield and other monocentric effects easier and faster to generate, and thus more systematic and ubiquitous in their implementation.

As the following chapters detail, Hollywood developed its norms of stereo design at a time when the industry was economically reliant on mono technology and resistant to three-dimensional sound. By the late 1930s, the major studios had built an entire economy to improve the quality, cost, and efficiency of single-channel playback. This included a legal apparatus to support the licensing of patents, the development of ancillary equipment—including mixing consoles and loudspeakers—to bolster the format's functionality, and divisions of labor to streamline the creation and distribution of mono release prints.[43] In turn, the new infrastructure boosted single-track sound's capabilities, if not also its appeal, all but ensuring that mono would see a long and anodyne tenure as the industry's preferred theater format.

Such investments typified a phenomenon that economists term *path dependence*.[44] In essence, when institutions like Hollywood adopt a new technology, they simultaneously build systems to help streamline the technology's implementation. And the costs of these additional investments often disincentivize companies from ever replacing their older equipment with newer and better technologies. The standardization of mono specifically led to investments in engineering departments, labor offices, and workflows that optimized the format for existing modes of representation, production, and distribution. And such developments discouraged studios from updating their single-channel sound systems with higher-quality alternatives. Indeed, the adoption of entirely new technology might require

the industry to uproot and rebuild its economy to support the licensing, manufacturing, and servicing of the new technology—the costs of which would be exorbitant. As such, it was not the price of stereo per se but its structural demands that led studios to resist it. Once the industry transitioned to mono, the rewards from any future technological change had to exceed the sunk costs of single-track sound. Stereo in its earliest forms was unable to overcome this obstacle.[45]

Thus, to make the technology more economical, sound engineers spent much of the studio era reformatting it to fit inside mono's infrastructure. They jettisoned playback channels to squeeze stereo systems into theaters initially designed for only one loudspeaker. They also narrowed the physical width (and, in turn, the decibel range) of each track so that a single 35 mm print could house multiple signals. Further, technicians refined their techniques for mixing films in stereo to ensure that their sound designs adhered to predetermined norms of representation. Namely, they continued to privilege dialogue over all other elements, practices that curbed the use of flashy surrounds. Their goal was to avoid disrupting the stylistic conventions that proved popular with audiences. Spatial effects became noticeable enough to advertise stereo's benefits, but not enough to diminish box office returns or incur other expenses for exhibitors. That is, to render the technology less risky to an industry largely resistant to change, studios made its stereo formats extraordinarily mono-like in size, shape, and form. Monocentrism was the result.

It is perhaps no surprise that stereo underwent such devitalization efforts. After all, cinema itself was initially forced to fit within the limitations of existing infrastructure. Its images were cropped and squeezed into the narrow confines of perforated filmstrips. Its stories were similarly compressed into familiar act structures, with running times edited to the length of traditional evening entertainment. Even the sizes of movie screens were a by-product of fit. As William Paul explains, when films moved from fairgrounds to theaters, they inherited "horseshoe"-shaped auditoriums and other architectural designs that were optimized for public forums and symphonies, not unincumbered views of motion pictures.[46] In turn, movie screens were relocated from the foot of the proscenium toward the back of the stage, where they became more visible to filmgoers but considerably smaller in the process. Stereo was simply another

iteration of this broader cinematic phenomenon. It inherited an economy optimized for prior media and that, over time, tempered its aesthetic capabilities. Stereo systems of the 1940s and 1950s—such as Fantasound and Cinerama—reveal how extensively studio-era engineers explored the acoustical possibilities of three-dimensional sound. And the more successful and more monocentric formats of later decades—such as Dolby Stereo and 5.1—continue to serve as records of the industrial constraints that mitigated earlier multichannel innovations.

Popular histories of film sound regularly overlook the importance of these economic concerns to stereo's development. Instead, critics are prone to repeat the claim that studio-era practices were uneventful, if not historically insignificant.[47] These misunderstandings are traceable to John Belton's famous but often misconstrued article "1950s Magnetic Sound," published in 1992. It argues that stereo had the potential to replace mono as Hollywood's preferred playback technology during the studio era. But due to stereo's perceived limitations at the time—specifically its association with 70 mm road shows and other cinematic spectacles—its widespread adoption was delayed by several decades, a phenomenon that Belton terms a "frozen revolution." Accordingly, it was not until the arrival of Dolby in the 1970s that stereo would be seen as aesthetically versatile, and this frozen revolution would finally thaw.[48]

Belton's article remains exceedingly influential to film sound historians, despite citing just a handful of titles, formats, and documents. Presumably, Belton intended to provide a framework for scholars who wished to research this era even further. However, it is not uncommon for scholars to treat Belton's thirty-year-old article as the definitive account of 1950s stereo. Some even use his essay to argue the studio era was just an era of short-lived failures, and that Hollywood only discovered the full potentials of stereo artistry in the late 1970s.[49] Such characterizations of history, though, are gross simplifications. It is more accurate to describe the studio era as a period when the principles for three-dimensional sound were debated and disseminated, principles that—as *Get Out* illustrates—continue to inform Hollywood's creative decisions well into the twenty-first century. In this regard, the pre-Dolby era was not a frozen revolution so much as a moment of conceptual standardization. And it could not be more significant to stereo history and more worthy of in-depth investigations.

METHODOLOGY

This book presents the results of such historical investigations. Throughout, I chronicle how stereo innovations of the studio era were developed and promoted, how they reinforced power structures within the industry, and how they ultimately shaped the way film stories were told. Much like the work of Jay Beck, Liz Greene, Helen Hanson, and Katie Quanz, this history seeks to reconstruct the formation of stylistic techniques within Hollywood's production and postproduction sound communities.[50] Such practices can be quite elusive. For much of the studio era, the industry's methods for designing films in stereo did not circulate among technicians in the form of memoranda. Instead, ideas were shared among sound workers as "tacit knowledge" gained through on-the-job experience, a phenomenon that Susan Schmidt Horning notes is common to the field of audio engineering.[51] Consequently, correspondence between sound technicians—or any other paper trails that could shed light on the development of the film industry's mixing techniques—is seldom found in studio archives.

Research for this book thus required an archeological dig through a wider range of historical documents—what sound scholar Rick Altman playfully characterizes as a "rummage around at the bottom of the barrel."[52] And this dig revealed a bounty of relevant information that has remained hidden from scholars who rely exclusively upon interviews with contemporary sound workers. To wit, experts in their craft are not always experts in the history of their craft, and sound workers are no different. Like anyone, their memories are unreliable, their stories can be inconsistent, and their claims might be prone to hyperbole.[53] Extremely deep dives into the historical record are therefore necessary to qualify the information they readily volunteer.

Among the more useful of bottom-dwelling documents were legal records, such as the patent for Lee de Forest's 1929 variable-hue stereo format, whose citations to prior inventions point to a rich intellectual history surrounding the early development of binaural technology.[54] Other documents included rare oral histories of forgotten engineers like James G. Stewart, who in the 1940s invented one of the first theater systems with a dedicated track for surround sound effects.[55] Further, I traced the reception of technical innovations by reading the transcripts of public debates,

including the heated 1954 quarrel between Fox and Westrex over the quality of Westrex's two-track PhotoStereo format.[56] Notably, Fox eventually adopted the technology, but not for another twenty years and only after it was repackaged as Dolby Stereo.

My investigations also involved combing through trade papers, bulletins, and specialty publications, which revealed several films that were integral to stereo's development, but that are regularly excluded from scholarship. Disney's *Fantasia* (1940), for instance, is widely credited as the first feature-length film released in stereo, though other titles—including *Hell's Angels* (1930) and *A Midsummer Night's Dream* (1935)—saw comparable multitrack and multi-speaker sound designs prior to *Fantasia*.[57] Similar historical gaps surround Dolby Stereo. The two-track format is often associated with blockbusters like *Star Wars* (1977). But the first Dolby Stereo film made in Hollywood was actually *The River Niger* (1976), a melodrama about a Black family's day-to-day struggles in Los Angeles.[58] Despite Dolby's frequent celebrations of its milestones—such as *A Star Is Born* (1976), the first Dolby title to feature a "matrixed" surround channel, or *Don Giovanni* (1979), the first Dolby title made in France—the first American Dolby Stereo film, *The River Niger*, is regularly absent from company timelines.[59]

Even more interesting, job listings from old issues of London's *Daily Mail* indicate that Dolby technology was not solely the product of male ingenuity, as is often assumed. Instead, the company actively recruited young women to build its famed circuit boards, women whose contributions to film sound have since been written out of history.[60] Indeed, my rummaging around at the bottom of the barrel revealed a host of misconceptions about the history of stereo. And though it was beyond the scope of my book to explore them all in detail, the many stories uncovered throughout this endeavor indicate just how complex stereo's development was, and how much research is still necessary to fully unpack this often-misconstrued area of study.

In addition to combing through newspapers and specialty publications, I visited several archives to understand how filmmakers conceived of stereo technologies throughout the studio era. The many production files housed at University of Wisconsin-Madison and University of Texas at Austin were especially useful in unpacking the technical practices of

independent producers. Just as important were the papers of Fox engineer Earl Sponable, housed at Columbia University. They contained extensive correspondence detailing the development of the studio's four-track stereo technology. They also included the details of Fox's reconnaissance at rival studios in the 1950s, including internal research on Paramount's five-channel surround sound format, a forerunner of 5.1.[61] Equally valuable—though more difficult to access—were private archives, such as David Strohmaier's personal restoration files, which contain a bounty of technical documents written by Cinerama's chief recording engineer, Richard Pietschmann. Other private collections included the diaries and unpublished memoirs from Cinerama inventor Hazard Reeves, held by his son Alex Reeves. These papers collectively shed much needed light on the origins of Cinerama's seven-track surround sound system, a format that propelled studios to develop their own stereo formats throughout the 1950s.

Lastly, I analyzed various multichannel soundtracks throughout history. Though many stereo mixes are currently lost or unavailable, quite a few have been preserved in some form. The original four-track versions of Fox's CinemaScope titles, for instance, are available on most of the studio's DVD and Blu-ray releases. The original mixes for numerous Cinerama and Todd-AO releases are available on Blu-ray as well. Other stereo titles, though, required a bit more work to excavate. To analyze Perspecta releases like *Forbidden Planet* (1956) and *Silk Stockings* (1957), for instance, I used Sonic Visualizer software to recreate the control tones that generated the film's stereo effects. The WarnerPhonic mix of *House of Wax* (1953) was even more challenging. Three of its four stereo tracks are lost, and its rear-effects channel survives only in a Dolby Stereo remix that Warners commissioned for the film's home video release in 1992. To reconstruct its original surround sound design, I conducted research at Chace Audio in Burbank, where this remix was produced. There, I combed through the facility's production files, which included detailed notes on every sound that appeared on the original surround track as well as every acoustical change that Chace administered when it converted it to Dolby Stereo (each change was subsequently billed to Warners).[62] Using these production files, I inferred how the original four-channel mix sounded. I then drew upon similar records to analyze other titles restored

at Chace Audio, including *Around the World in 80 Days* (1956), one of the first films released with multiple surround channels (later known as "split-surrounds").[63]

Remarkably, each of these analyses continued to point to the same basic finding, that the stereo aesthetics associated with contemporary Hollywood originated in the studio era. The use of surrounds to signal danger in *Disturbia*, for instance, has its roots in the effects track for *House of Wax*. The panning of music throughout *Gravity* is likewise comparable to the localization effects found in *Forbidden Planet*. Even the split-surrounds made famous by *Apocalypse Now* were preceded by the aforementioned split-surrounds developed for *Around the World in 80 Days*. What happened in the 1970s and in later decades was merely a rediscovery of these studio-era practices. Contemporary filmmakers who sought to create highly intricate stereo effects replicated their predecessors' experiments, often without realizing it, and proceeded to take them in louder and more detailed directions. To this end, my research offers not only new insight into the mechanisms that determine Hollywood's norms of spatial representation, but also new contexts for appreciating the acoustical innovations of today's filmmakers.

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The fruits of this research are divided into six chapters, each covering different stages in stereo's evolution from a mere technological curiosity to Hollywood's dominant mode of sonic representation. Chapter 1 chronicles the film industry's experiments in three-dimensional sound throughout the 1930s. During this decade, talking pictures were beset by numerous acoustical problems, the most significant being poor amplification. As a result, several filmmakers and engineers—including Howard Hughes, Abel Gance, Alan Blumlein, and Joseph Maxfield—introduced multi-speaker sound systems to widen the decibel ranges of motion pictures in an artful and nonabrasive manner. Among the more consequential of these systems was a three-speaker technology developed by Harvey Fletcher, an engineer at BTL. I trace the acoustical theories that informed the design of his technology—dubbed "auditory perspective"—and explain why its unique representations of three-dimensional space

soon became the foundation for the film industry's subsequent forays into stereo storytelling.

Chapter 2 details the problems that major studios faced in the 1940s as they attempted to adapt Fletcher's ideas into commercial stereo formats. Throughout the chapter, I document various multi-speaker experiments—including Disney's Fantasound, Warners' Vitasound, Fox's 50 mm Stereophonic Sound. Additionally, I explain why these systems were never widely adopted. The reasons, I argue, were economic in nature. Though auditory perspective seemed practical in theory, it necessitated the use of expensive and unwieldy equipment that was unappealing to the cost-conscious industry. In turn, studios shelved these formats and invested in new encoding systems and better loudspeakers—technologies that were less expensive but more effective at improving soundtrack quality.

Chapter 3 covers the rise and fall of Cinerama, the popular seven-track sound system that reinvigorated Hollywood's interests in stereo throughout the 1950s. I contend that the format's successes at the box office were due to its unique surround sound aesthetic. Rather than prioritizing acoustical realism on its mixing stages, its engineers introduced thrill-inducing spatial effects that challenged prevailing conceptions of fidelity. I trace the origins of this new aesthetic to Cinerama's convoluted corporate structure and to the many technical problems inherent to its seven-track sound system. I then show how rerecording mixers addressed these problems by employing stereo effects that concealed the system's shortcomings. The widespread enthusiasm for these effects subsequently led to a new way of conceptualizing three-dimensional film sound, one that became the model for all future stereo formats.

Chapter 4 looks at how Hollywood initially tried to transform Cinerama into a more versatile theater system. I begin by examining the short-lived and often overlooked triple-track stereo format, which several studios used in early 1953, and which sparked several controversies caused by the format's reliance on multiple filmstrips. I then detail how Fox developed its four-track CinemaScope format as an antidote to these problems. Specifically, the studio simplified Cinerama's and triple-track's projection processes by squeezing four different magnetic soundtracks onto a single filmstrip. It then promoted a conservative mixing style that effectively rendered spatial effects inaudible in most cinemas. Though four-track did

not become standard for all motion pictures, its technological design and nondisruptive aesthetic nevertheless led the format to become the first stereo system widely adopted by larger, first-run venues.

Chapter 5 explores the factors that led Fox to replace this conservative mixing style with the more narratively integrated monocentric aesthetic. I chronicle the resistance to four-track stereo among the industry's independent exhibitors. I then consider how various engineers exploited this resistance by developing stereo formats that compressed multiple playback channels into a standard mono soundtrack, making them cheaper and easier to install. One such format, Perspecta, became so popular with smaller theater chains that it forced Fox to reconceive its four-track format entirely. The studio redesigned its release prints to make them backwards compatible with mono technologies. It also revised its surround sound aesthetic to incorporate more lavish spatial effects. Such alterations were not enough to reignite industry enthusiasm for four-track. However, Fox's monocentric principles remained the dominant aesthetic for all road show releases—including 70 mm six-track releases—by the end of the 1960s.

The final chapter chronicles Dolby Stereo's success in becoming the first theater format to overtake mono as Hollywood's preferred playback technology for 35 mm releases. Its success, I show, was tied less to aesthetic innovations and more to the efficiency of its processors, which enabled the format to be affordable, easy to use, and thus amenable to the needs of studios and theaters. I begin by chronicling the many economic and technological changes within Hollywood that aided Dolby's meteoric rise as a soundtrack standard. I then detail how new editing and mixing techniques employed at postproduction facilities allowed Dolby films to both abide by traditional aesthetic norms and appear acoustically distinct from prior stereo releases. In sum, I argue that Dolby succeeded where prior formats failed precisely because its engineers found a way to repackage the innovations of earlier formats without undermining its brand identity as a highly original, if not revolutionary, sound technology.

Hollywood's fifty-year struggle to standardize stereo was unpredictable, circuitous, and humorous. It involved drunken producers, stink bombs, Russian spies, patent thieves, and even small-town parades in honor of failed formats. But underneath such pandemonium is a story that illuminates the market forces that shaped Hollywood's technical innovations

and governed their aesthetic value during the twentieth century. Flashier formats—though often exploited to advertise the ingenuity of studios—seldom saw widespread adoption. Instead, the more conservative and derivative the technology, the greater likelihood of its market success. For stereo, the more fashionable formats were those that either fit comfortably within the industry's mono infrastructure or that led filmmakers to recycle monocentric techniques. Such priorities explain why the acoustical effects envisioned by Gance and heard throughout *Roma* remain controversial and rare, and why even today's most technologically adventurous blockbusters continue to boast a surround sound aesthetic developed more than seventy years ago.