

Echoes

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1. Introduction

Suppose you are at a fireworks display. You stand in an open field with a single brick building behind you. A colorful bomb's recognizable boom follows on the heels of its visual burst, but a moment later the boom's echo sounds at the brick wall behind the field. You have just heard a *primary sound* followed by its *echo*.

A theory of sounds should provide an account of echoes and echo perception. One widely accepted view is that sounds are compression waves that travel through a medium such as air or water. According to this conception of sounds, echoes are sounds that, in their travels through the medium, encounter and rebound from reflecting surfaces. Echo experiences are those caused by such reflected sounds, and may require the experience of an initial primary sound to count as true *echo experiences*.

Recently, several philosophers have challenged the orthodox view. These authors argue primarily on perceptual grounds that sounds are either properties of the objects ordinarily taken to be their sources, or events that take place in or near their sources. Pasnau claims that sounds are *properties* either identical with or supervenient upon the vibrations of objects.¹ Casati and Dokic claim that sounds are events constituted by such vibrations--sounds are *vibration events*.² I

have developed a view according to which sounds are events of objects interacting with and disrupting a surrounding medium--sounds are *disturbance events*.³ These three theories of sound are united in one dimension of disagreement with the orthodox *wave view* of sounds. What I will call the *distal theories* of sound hold that that sounds are located at or near their sources, and that sounds do not travel unless their sources do. The case of echoes thus must be addressed by all such distal theories of sound, since they cannot appeal to traveling sounds as explanations for echo experiences. Two main problems are pressing. First, echoes appear to be distinct sounds located at reflecting surfaces. But since the brick wall, for instance, merely reflects sound waves and does not vibrate or actively disturb the surrounding medium, the distal views appear to have no sound to identify as the echo. Second, if the existence of echoes shows that sounds themselves travel and can be re-encountered, then sounds are neither the properties Pasnau suggests nor the events Casati and Dokic and I suggest.

I will argue that to experience an echo is to re-experience a primary sound, and that the apparent echo just is the primary sound. This is perhaps surprising since I do not accept that sounds travel. One need not accept that sounds are particulars that persist and travel to identify the object of the echo experience as the primary sound. According to my account of echoes and echo perception, hearing an echo is hearing a primary sound, but with distortion of place, time, and qualities--hearing an echo is thus like seeing an object with a mirror. The echo experience and the primary sound experience seem to have distinct objects because we ordinarily perceive entire events only once. One claim is central to articulating and defending this conception of echo perception: Sounds need not travel since that by means of which we hear them does.

I aim primarily to develop the view that sounds are distal events of a certain sort, and to defend it against echo-related worries. Most of what I say therefore applies directly to the theories of sounds proposed by O'Callaghan and by Casati and Dokic. The event views are complete and elegant accounts of the metaphysics of sounds and the phenomenology of auditory experience. However, I present my general solution in the spirit of a family of views--the distal theories--that run counter to the widespread belief that sounds travel. The solution is, with small modification, available to Pasnau-style property theorists. Considering the issues brought to light by the case of echoes improves our understanding of the nature of sounds and serves as part of the positive case for the distal theories of sound.

2. The Locatedness of Sounds

The received view of physicists and auditory scientists, which I call the *wave view*, is that sounds are longitudinal pressure waves that propagate through a surrounding medium. Suppose we strike a tuning fork, then silence it with our fingers. The vibrating tines produce a series of waves that travel through the air. According to the wave view, the sound is a particular identical with or constituted by the moving bundle of waves.

The central argument against the wave view provides positive reason to recognize as the sound the property or event that the distal theories identify. The argument rests on the phenomenological claim that sounds themselves, and not just their sources, are perceived to be located. Ordinarily, they are heard to be located at a distance and in a particular direction. The sound seems to be right near the tuning fork.

That sounds, not just sources, are heard to be located can be appreciated in several ways.⁴ Sounds are characterized by the audible qualities of pitch, timbre, and loudness. Reflection upon experience indicates that the bearers of audible qualities are themselves distally located. “Whatever is high pitched, it’s over there,” we might say. We also form perceptually-based beliefs concerning the locations of material things and events on the basis of auditory experiences. Such beliefs are made possible, in part, by impressions of the sounds that things and events produce. If information about the locations of things and events is to be gleaned from hearing sounds, then either sounds must be heard to be located roughly where those things and events are, or sounds must be heard to come from such locations.

How are we to take talk of sounds’ being heard to “come from” a location? It might be that sounds are heard to come from a particular place by first being heard at that place, and then being heard at intermediate locations. This is not the case with ordinary hearing. Sounds are not heard to travel through the air as scientists have taught us that waves do. Imagine yourself made to experience--by tricky sound engineers--a sound that seems to be generated across the room and which subsequently speeds toward your head like the auditory analog of a missile. This is certainly not like the ordinary experience of sounds, which presents them as stationary relative to the objects and events that are their sources.

It might also be that sounds are heard to *be* nearby, or nowhere at all, but to *have come from* a particular place. But this dismisses the primary explanandum of research into locational hearing and auditory awareness, which is that sounds are ordinarily heard to be located at a distance outside the head. Gelfand refers to this phenomenon as *extracranial localization*: “Sounds heard in a sound field seem to be localized in the environment.”⁵ Perceiving where a

sound comes from through audition is unlike feeling the direction of a breeze--we experience distance as well as direction in audition. Blauert, for example, says, "For familiar signals such as human speech at its normal loudness, the distance of the auditory event corresponds quite well to that of the sound source."⁶ Even though accuracy declines for unfamiliar sources, Blauert still claims that in such cases "The auditory event is, to be sure, precisely spatially located."⁷ Since sounds themselves are heard to be located, the only sense in which sounds do seem to "come from" particular locations is that they seem to have *causal sources*--to be generated--in those locations.

If auditory experience is not systematically illusory with respect to the perceived locations of sounds, and auditory perception presents information about the locations of ordinary objects and events, then the wave view is false. Theories according to which sounds travel or lack locations fail to capture a central feature of auditory phenomenology and its function.

Note also that the wave view entails a further illusion: that of a sound's duration. If sounds are particulars that persist and travel as waves do, then the experience of the duration of a sound--its having a beginning, a middle, and an end--results from encounters with the spatial parts and boundaries of the sound. The experience of duration is therefore an illusion. According to the wave view, only the auditory experience has the duration attributed to the sound. This illusion is particularly troublesome since we apparently experience, veridically, the durations of sound-producing events like violin bowings and fingernail scrapings by perceiving the durations of their sounds.

Though they also avoid the illusion of duration, the distal theories are designed to capture the locatedness of sounds. According to Pasnau's *property view*, the tuning fork's sound is a

property inherent in the vibrating tines. Casati and Dokic's *vibration event view* and my *disturbance event view* locate the sound at the source not as a property, but as an event of one kind or another.⁸ All three distal views agree, however, that pressure waves in the medium transmit information about sounds, but the sound is not the waves.

3. *The Problem of Echoes*

An account of echoes and echo perception should say what an echo is, explain the distinctive features of echo experiences, and respect scientific descriptions of the physical and perceptual processes involved.

When you hear the sound of the firework and its echo, certain features of the experience are distinctive. First, you hear the echo after you hear the primary sound. There is a time delay between the onset of the two experiences. Next, you hear the primary sound to be located near the explosion itself, but you hear the echo to be located near the reflective brick wall. Though the echo appears to be a distinct sound, investigation (perhaps mere visual awareness) reveals no sound source at the brick wall. Nothing at the reflecting surface generates the apparent sound. Finally, the echo and primary sound experiences ordinarily present similar qualities and durations. The degree of distortion depends on the qualities both of the sound and of the reflecting surface.

When the firework explodes it disturbs the surrounding air, and pressure waves travel outward toward you and toward the brick wall. The waves reach you and contribute to your experience of the primary sound. As waves reach the brick wall, an elastic collision takes place and the wall re-directs the waves. These re-directed waves reach you and produce the experience

as of a second sound distinct from the initial sound. This time gap is essential to enjoying the distinctive multi-sound echo experience. When secondary sound waves arrive at the ears less than about fifty milliseconds after primary sound waves, the result is an experience as of a single sound located between the two wave sources. Between roughly fifty milliseconds and two seconds, the result is experience as of a primary sound and a distinct but somehow causally related secondary sound or echo. When the arrival delay is greater than about two seconds, the experience is as of two separate and entirely unrelated sounds. I will focus on the general case of reflected sounds and hope to explain the distinctive multi-sound echo experience in purely perceptual terms. The account of echo perception that I offer is consistent with the psychophysical facts, and makes the phenomenological differences that attend different time delays depend primarily on features of the auditory perceptual system.

The trouble for the distal theories is that a mere elastic collision occurs at the brick wall. Brick walls do not in ideal elastic collisions vibrate and actively introduce disturbances into the surrounding medium. They simply get in the way of sound waves that are already present. The distal views appear to have nothing to identify as the echo.

If sounds are particulars that persist and travel through the medium, a simple resolution exists. Hearing an echo after a primary sound is hearing the very same sound particular at two different stages of its continuous career. This, however, is incompatible with the distal theories, according to which sounds are properties or events whose locations are stationary relative to their sources. If the case of echoes shows that sounds themselves travel and can be re-encountered, then sounds are not what the distal views have suggested them to be.

4. The Solution

The echo just is the primary sound. According to the distal views, the apparent echo is the original or primary sound perceived with distortion of place, time, and qualities. For the event theorists, the apparent echo is the primary sound event. For the property theorist, it is the property of the source identified as the primary sound. The illusion, in either case, is caused by the behavior of sound waves and the way in which sounds are perceptually localized. Sound waves, which transmit information about sounds, are the proximal causes of auditory experiences. Their direction of onset determines the perceived location of a sound, and their rate of travel results in the delayed echo experience. Filtering and dispersal at the reflecting surface account for differences in the perceived echo's qualitative profile.

Hearing an echo, then, is hearing a primary sound. You hear the primary sound, then after a short delay you hear the sound *qua* echo. What you hear in each instance is the very same sound--the primary sound. The primary sound is not an object-like particular that travels through space. According to the version of the event view I prefer, it is an event that occurs only once at the location of the sound generating event.⁹ The traces of the primary sound--its sound waves--travel and encounter reflecting surfaces. When the waves return, an appropriately situated subject has an experience as of an echo, a seemingly distinct though causally related sound located in the direction of the reflecting surface. The subject, however, hears only the original primary sound on each occasion. Strictly speaking, the distinction between primary sound and echo is entirely perceptual and depends upon wave arrival-time delays at a subject. The interval between wave arrival times from the very same sound determines whether re-experiencing it results in a distinctive multi-sound echo experience or not. The apparent causal relation makes the experience distinctive.¹⁰

This account is analogous to a plausible treatment of seeing objects with mirrors. Mirrors facilitate our seeing the very same objects and events that occur in front of them, albeit with distortion of place (and perhaps qualities). Likewise, reflecting surfaces allow us to hear the very sounds that occur in front of them, albeit with distortion of place and time. But just as there is no new object that you see when you look in a mirror, there is no new sound that you hear at a reflective surface.

Hearing as of an echo after first hearing the primary sound is, on this account, an unobjectionable sort of re-encounter with the very same sound. The sound occurs once, say between t_a and t_b . You experience it once between t_c and t_d and then again between t_e and t_f because the waves it creates return. The sound neither travels nor returns to you; you experience the same distal property instance or event twice because of the way its traces travel. The situation is something like this. Suppose you hear the sound of a firework. You then travel faster than the speed of the sound waves, overtake them, and halt. You now hear the sound again--it seems to be in the same place it was before. We need not say that the sound travels, only that the sound waves travel. Because information about sounds is transmitted through a medium by means of relatively slow waves, you are lucky enough to enjoy the same sound twice. What you hear when you hear it for the second time is just the same distal property instance or event you heard earlier. Echo perception is similar. A reflecting surface, however, saves you the trouble of supersonic travel. You pay the price with distortion of location.

Hearing a sound that is past is thus like seeing an event that is past. When you see a supernova from across the galaxy, you see it as it happened long ago. But you experience it to be present--to be taking place *now*. So your experience includes a temporal illusion. Now, suppose

there were big mirrors in outer space. You could then see the very same earthly event twice: once when it happens and once after its traces are reflected. I could watch the World Cup final on July 9, 2006, and then watch it again on July 9, 2007, in a mirror located one-half light year away. If the mirror was big enough, I might even think there was a game being played on a far-off planet that looked remarkably like Earth. The case with echoes is a less exaggerated parallel.

Hearing an echo does not involve such great distances. Still, the echo experience and the primary sound experience seem not to have the same object. If the apparent echo is the same sound as the primary sound, why do we not recognize it as such?¹¹

Here the event theorist has a compelling account to offer. The apparent distinctness, according to the event views, is due to the nature of events and to how we conceive of them in contrast to objects. If a primary sound and an echo were one object experienced at different times during a single continuous career, we would expect ordinary object recognition and re-identification to occur, given the qualitative similarity of an echo to a primary sound. With objects we count on this sort of recognition to ground the perceived continuity of the material world. *Capgras syndrome* is one form of *delusional misidentification syndrome* in which patients suddenly begin to believe that people and continuant objects familiar to them have been replaced by exact qualitative duplicates. This failure of perceived continuity is notable and debilitating.¹² Events and time-taking particulars, however, are tied to a specific time and place at which they occur. Though the 2006 World Cup final might have been located at any of various times and places, it in fact occurred July 9, 2006, at Berlin. That very event cannot occur again or elsewhere. And we implicitly recognize this: similar events experienced at different times and places are taken to be distinct events. So, if we happen to perceive the very same event over

again, it should seem like a distinct event. What about watching an instant replay? The same event perceived a second time does not seem distinct. But this is simply a matter of habituation--we are used to seeing instant replays, which we know are re-presentations of prior events. If you have been asleep since the days of entirely live television, you might take a live picture and its replay to be pictures of qualitatively similar events. Thus, we might become used to thinking of echoes as primary sounds heard again with distortions of place, time, and qualities. This capacity is much more fundamental to object perception.¹³

Since echo phenomenology arises when the very same event is heard to be at a later time and different place, precisely what we should expect is that the echo should seem distinct from the primary sound. The perceived distinctness of echoes from primary sounds is predicted by the event views. Whether or not the distal property theorist can appeal to a similar explanation depends on whether we take properties to be tied to particular times and places. If, as I am inclined to think, we do not take properties themselves to be tied to particular times and places, this counts against the property view. A property view that appeals to trope-like properties or property instances could escape the worry.

The distal views therefore have the resources to identify the objects of echo experiences despite the absence of their characteristic property, vibration event, or disturbance event from the perceived location of the echo. The accounts rely on securing the correct way to conceive of hearing a reflected sound. Upon doing so, we see that the distal views have the right events and properties on offer--the *primary* sound events and properties.

5. *Are Echoes Images?*

It has been suggested to me, in light of the foregoing arguments, that an echo is an *image*. There are advantages to thinking that an echo is an image of a sound, but not a genuine sound. This view appears to minimize the illusion we attribute to perceivers. One might veridically perceive an image and its audible qualities near the brick wall, and suffer no more temporal illusion than in ordinary hearing. Reflection might be the occasion for the production of an image of a sound, where the echo is the image. Why think that hearing an echo is hearing a primary sound with illusions of place and time, and not that an echo is a primary sound's image?

We sometimes speak as if images are mental. The image of a musician playing fiddle might stay with you through an afternoon after the musician has gone. An echo's existence, however, is not in this way merely mental. Hearing one may involve illusion, but illusion is *misperception*. Hallucination is mere seeming to perceive. Even if echo experience involves mishearing, it is not seeming but failing to hear. Echoes are not mere mental images.

It is natural to say that to see or hear an image is to perceive something extra-mental: it is to perceive *a likeness* of an object or sound. An echo then would be a likeness of a sound. Echo perception, however, is not like seeing a photographic image of a face or hearing a "phonographic image" of a voice. The likeness of mirrors and echoes is not an actual photographic object or phonographic sound that bears likeness to the original. It is not a separate object or sound at all.

The image of reflection can be no more than a complex of qualities, visible or audible, at the reflecting surface. A mirror image, if it is a likeness, is at most an arrangement of colors at the mirror. An echo is then at most a complex of audible qualities in the absence of a sound that bears them. Thinking of echoes as images of this sort has the advertised advantages.

We need not, however, commit ourselves to such property instances or the entities we are supposing they constitute: images or likenesses. Images so conceived are not required to explain the experience once we recognize the primary sound, its waves, and how those waves cause experiences. Just as there need not in general be elephants or colors at a location in order for you to enjoy an experience that purports to be of elephants or colors at that location, there need not be audible qualities at a brick wall for you to think there are. We do not in general require entities or property instances at a place to account for why an experience seems to be of such entities or properties. That would be to adopt an overly charitable stance on experience, and in the case of property experiences would banish illusions entirely. In the case of reflection, it would multiply property instances at the whim of barriers and experiences. Since there is no sound at the reflecting surface to bear the audible qualities, we have little reason to suppose that audible qualities exist at that surface. If images are complexes of audible qualities, it is therefore unwarranted to posit images at the apparent location of an echo without further reason to believe that a sound exists at that location. We are left with the economical explanation of echo experience as hearing a sound with illusion.

Suppose hearing an image of a sound is enjoying an experience as of a sound where there is none, where that experience has as its cause a genuine sound located elsewhere. Hearing an image, in this sense, does not commit us to saying that the image is merely mental, or that it has some extra-mental existence, because hearing or seeing an image is neutral on the nature of the image. This is just to redescribe what I have called hearing a reflected sound or hearing an echo, where a reflected sound is one experienced with illusion due to sound wave behavior.

6. Is the Illusion Tolerable?

The distal property or distal event theorist's account of echo perception posits *spatial*, *temporal*, and *qualitative* illusions. Why, since I took the wave view to task for its systematic location illusion, is this not objectionable? One might even think that the wave view fares better in the case of echoes, since it only posits a location illusion and an explicable duration illusion.

Illusions, *per se*, are not reasons for objection. But we are interested in perception for what it can potentially reveal to us about the world. To the extent that we take perception to be a reliable guide to certain aspects of the world, we have an interest in reducing the amount of illusion we attribute to perceptual experience. But illusions can inform us about the mechanisms involved in perception and about aspects of the world that we cannot directly observe. So we also have an interest in discovering the illusions we actually fall prey to. If, however, an account proposes an illusion whose spell we have independent reason to believe we are not under, all else equal we should prefer an alternative that does not posit that illusion.

I have suggested that we have no reason to think that we are under the illusions posited by the wave view, and also that in the case of echoes there are compelling reasons to believe that we do fall prey to the illusions posited by the distal theories of sound. The distal theories' illusions have a significantly different status from the wave view's.

According to the account I have given of echoes and echo perception, the illusions arise as a *special case*. While in ordinary sound experience we hear sounds for the most part as they are, the experience of an echo occurs only in quite special circumstances. The illusions posited by the wave view are systematic and pervasive.

The distal theorists' illusions are *explicable*. Quality illusions occur because filtering and scattering that occur at reflecting surfaces distort information contained in sound waves. Illusions of place and time occur because sound wave reflection mimics the situation in which a sound source exists at the reflection site. So there are external states of affairs that explain why experience attributes the properties it does when the illusion occurs. Because of this, the illusions in the case of echo perception are also *predictable* once the mechanisms of ordinary sound perception are known.

Finally, the illusions that occur during echo experience are analogous to visual illusions that we find interesting but unproblematic. Hearing the firework's echo to be at the brick wall is like facing a large mirror and thinking there is a piano in a room ahead of you. Hearing the echo to occur after the primary sound is like seeing a supernova from across the galaxy. You might worry that if some distal theory is correct, the time gap that occurs even in ordinary sound perception--because sound waves travel relatively slowly--is problematic. But it is simply an exaggeration of the time gap that occurs in vision, and goes undetected unless somewhat large distances are involved. According to the views being defended, Armstrong incorrectly thought sounds might *not* pose a time gap problem.

In the case of a star, it may be questioned whether our immediate perception really involves any temporal illusion. It may be suggested that what we immediately perceive is not the star, but a *present* happening, causally connected with the extinction of the star many years ago. The star sends a *message* to us, as it were, and we immediately perceive the message, not the star. Now this suggestion may be correct in the case of a sound. There seems to be some force in thinking of sound as actually spreading out from its source, like a balloon

rapidly inflating. (And here I am not speaking of the sound-*waves*.) So when two people “hear the same sound” it may be argued with some plausibility that they *immediately* hear two different things, because they are in different positions.¹⁴

Armstrong goes on to reject the analogy in the case of a star, since the only immediate object of sight is “the star itself” and not light waves. He concludes that we sometimes immediately perceive past happenings, though they seem present. I find it implausible that a sound presents like a rapidly inflating balloon, and that two people cannot hear the same sound. So I reject Armstrong’s characterization of sounds and accept that hearing past sounds is like seeing past events. Both involve a time gap and a temporal illusion.

7. Concluding Remarks

I have provided an account of echoes and echo perception that complements the distal theories of sounds, according to which sounds are properties or events located in or near sound sources. An echo just is a primary sound whose perception involves distortion of place, time, and perhaps qualities. Echoes are not distinct from primary sounds. The impression of distinctness occurs because when we immediately perceive past happenings we perceive them as present, and because without special tricks we perceive events in their entirety only once.

Once we recognize that echoes are not distinct from their primary sounds, we need not be forced into the view that sounds are object-like particulars that persist and travel through a medium. Since sound waves are not themselves the sounds, but bear information about the distal properties or events that are the sounds, hearing thanks to waves that rebound from a reflecting

surface is just a way of hearing a sound again with illusion. Echoes pose no novel problem for the distal theories of sound.¹⁵

Notes

1. Pasnau (1999; 2000).

2. Casati and Dokic (1994).

3. O'Callaghan (2007).

4. I treat this issue at greater length in O'Callaghan (2007).

5. Gelfand (1998, p. 374).

6. Blauert (1997, p. 45).

7. Blauert (1997, p. 46); see also, e.g., Shinn-Cunningham (2001a; 2001b), Bregman (1990), and Mills (1972).

8. I prefer the view that sounds are events in which objects or interacting bodies disturb the surrounding medium in wave-like fashion because both Pasnau's theory and Casati and Dokic's theory entail that sounds can exist in vacuums. I have argued in O'Callaghan (2007) that a descendent of Berkeley's argument involving vacuums, from *Three Dialogues Between Hylas and Philonous*, can be developed which shows that a surrounding medium is a necessary condition for a sound.

9. *Sound generating events* are the events, such as collisions, that cause sound events.
10. This does not imply that the echo seems caused *by* the primary sound. Rather, the two may seem to share a causal source.
11. Of course, we sometimes fail to recognize an object as one we have seen before, but when the object is qualitatively similar on both occasions this requires special circumstances, such as great distances or the type of disorder mentioned in the text below. Barring failures of recognitional capacities (including memory), we can usually be made to recognize persisting objects.
12. See Breen, et al. (2000).
13. See, e.g., Scholl and Pylyshyn (1999) and Xu (1999).
14. Armstrong (1961, pp. 147–8).
15. Thanks to audiences at Princeton University, Florida State University, U.C. Santa Barbara, and University of St. Andrews for helpful discussion of an ancestor of this paper. Thanks, also, to Simon Keller and an anonymous referee for *The Monist*, whose comments helped me to improve this paper.

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