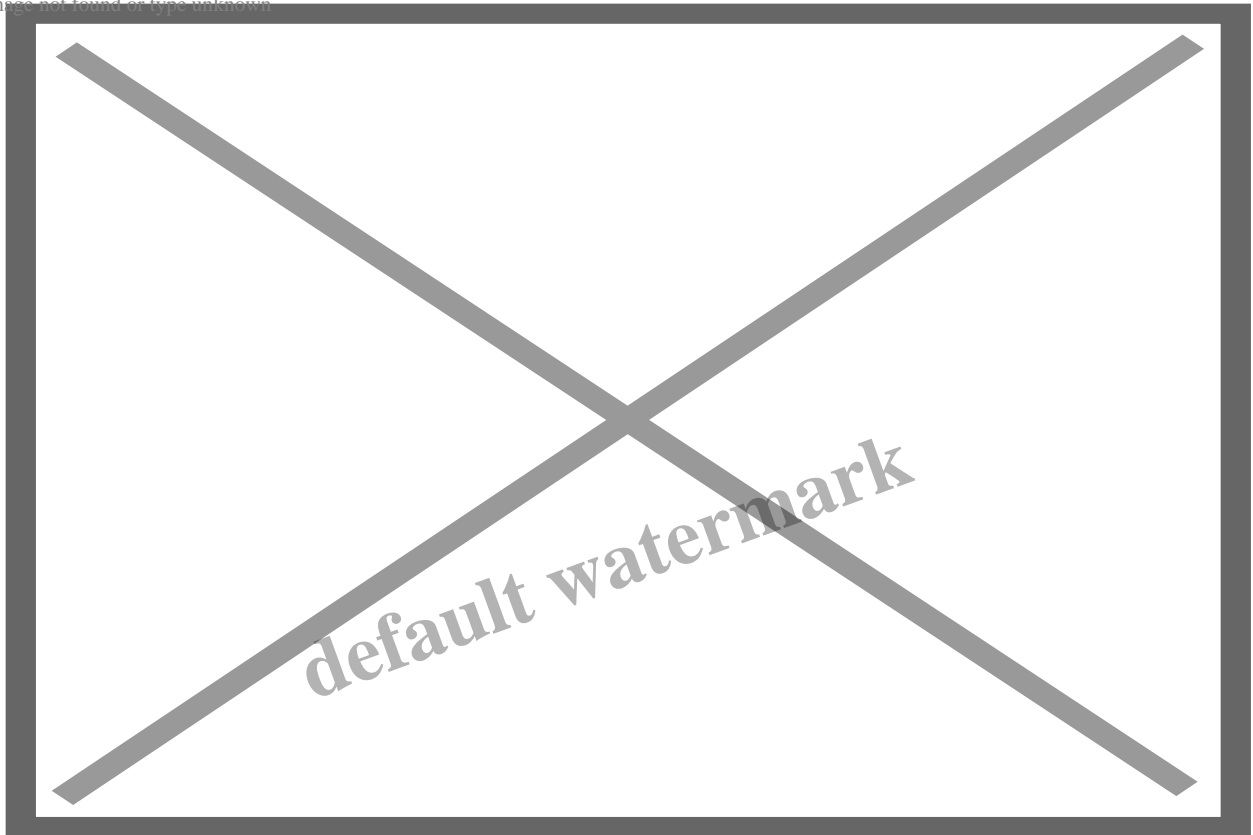


## Football, flowers and tone: objective reality versus perception

### Description

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Spring wildflowers at [Coyote Ridge](#), California

*Guitar tone and what contributes to it is a much discussed topic. While the acoustic aspects of tone can be measured, it's often forgotten that there is a large subjective element in how individuals perceive tone. Here we explore the world of human perception, starting with a college football anecdote and then considering the beauty of wildflowers, before focusing on how sound travels from a guitar through our ears and into our brain.*

### “The Play”

*“The Band is out on the field!”*

*Cal football announcer Joe Starkey exclaimed those memorable words in the final thrilling moments of the 85th Big Game between the Stanford Cardinal and Cal Berkeley Golden Bears.*

*On Saturday, Nov. 20, 1982, the Bay Area rivals met in Berkeley for their annual matchup. But what started like any other college football game would end with one of the most iconic – and bizarre – plays in American college sports.*

ALEX KEKAUOHA, [Stanford Report](#), November 2022

It was 1982. I had travelled to California in September to start a 2 year research fellowship there. I loved being back in California. And you couldn't really be at a US university without being caught up in the big cultural and sporting events. [The Big Game](#) – the annual football meet-up between Stanford and UC Berkeley (Cal) – was the biggest event on the calendar. Stanford and Berkeley are arch-rivals in most things, but football probably tops the lot.

Impossible to get tickets for and not televised, the only way to follow the game was on the radio. Hard to imagine these days. But there we were, listening on the radio in Palo Alto to the game being played over in Berkeley. It had taken me a while to get used to American football, having grown up in Scotland with rugby and soccer. But by the time the Big Game came along, I think I'd mostly figured out what was going on.

By all accounts it was a pretty good game, going down to the wire in the closing minutes. A score by Stanford with seconds to go looked like it had clinched the game. But there were still a few seconds on the clock, and Stanford had to have a final kick off. Cal caught the ball and kept running and passing it, while the Stanford Band thought the game was all over and started coming out on the pitch for the post-game celebration. In moments of complete chaos, Cal got the ball all the way down the field and through the band for a touchdown.

### *Cal Bears Football 82: The Play*

For a while nobody was sure what had happened and who had won, but the game was finally called for Cal. The final play of the game has gone down in history as one of the most extraordinary moments in college football, and has become known simply as ["The Play"](#). The result remains contested to this day, even as the game's 40<sup>th</sup> anniversary was celebrated in 2022. Whenever Stanford wins the Big Game, the trophy – the Stanford Axe – is altered so that 1982 score reads as a 20–19 Stanford victory. When the Axe is returned to Cal's possession, the plaque is changed back to California 25, Stanford 20.

"The Play" has had a [book](#) written about it and has its own [Wikipedia page](#). I didn't realise at the time what a momentous occasion it was. But it was certainly fun being part of that piece of sporting history. I was reminded of it the day English player [Jonny Wilkinson](#) stunned Australia with a superb drop goal in the dying seconds of the [2003 Rugby World Cup](#). I'm still scarred by that one.

*Jonny Wilkinson's drop goal to win the 2003 Rugby World Cup for England against Australia*

Back at the Big Game, the [classic photo](#) taken of the moment when Cal's Kevin Moen scored the winning touchdown shows the mayhem surrounding the moment. The guy on the right with the saxophone could easily have been obliterated by Moen. And it would have been a great pity if that had happened, because California would have missed out on one of the state's most committed and effective conservation scientists and practitioners. That guy was [Stu Weiss](#), whom I'll tell you more about shortly.

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*California's Kevin Moen (26) leaps into the air after scoring the winning touchdown for the Golden Bears against rival Stanford on Nov. 20, 1982. (Robert Stinnett / Associated Press. Source: [Los Angeles Times](#))*

## California Wildflowers

When I wasn't listening to football on the radio, I spent my time at Stanford working on the ecology of serpentine grasslands at [Jasper Ridge](#), a nature preserve in the hills behind Stanford University in the San Francisco Bay Area. In springtime when the grassland flowers are blooming, it's one of the most beautiful places I know. And I later also worked at [Coyote Ridge](#), south of San Jose, which is like Jasper Ridge on steroids – large expanses of wildflowers that carpet the area with colour. These grasslands are restricted to the areas of weird [serpentine soil](#) that occurs in patches across the area.

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I've been lucky enough to visit and work on these grassland areas over a number of decades, initially during a 2 year stint at Stanford and then traveling back to California each April. I had some patches of grassland that I examined each year, counting individuals of the various plant species present and estimating their abundance. These studies are being continued by my friend and colleague, [Lauren Hallett](#) at the University of Oregon. Putting numbers on wildflowers. But useful numbers that can tell us a lot about how the grassland works and how it's being affected by environmental changes. And what we might be able to do to conserve this amazing ecosystem in the future.

The composition and appearance of the grasslands vary greatly from year to year, depending mainly on what the rainfall's been like that season. And there are directional changes caused by pollution and invasive grass species. Each year is different, and the grassland areas can look dramatically different – some years, the areas are coated in yellows, other times there's more purples, and some years there's mainly just green.

## **Stu Weiss and “I sub B”**

## Stu Weiss at Coyote Ridge, 1993

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*Stu Weiss at Coyote Ridge, 1993*

For most of the time I worked on the California grasslands, I collaborated with that saxophone guy in “The Play” photo. When I first got to know him, Stu Weiss was completing a PhD on the [Bay Checkerspot Butterfly](#), which lives only on the serpentine grasslands. He’s now Chief Scientist at the [Creekside Center for Earth Observation](#) in California.

The Center applies “innovative science and technology to address critical conservation problems related to threatened and endangered species, habitat protection and restoration, and climate change”.

## Bay Checkerspot Butterfly, Coyote Ridge

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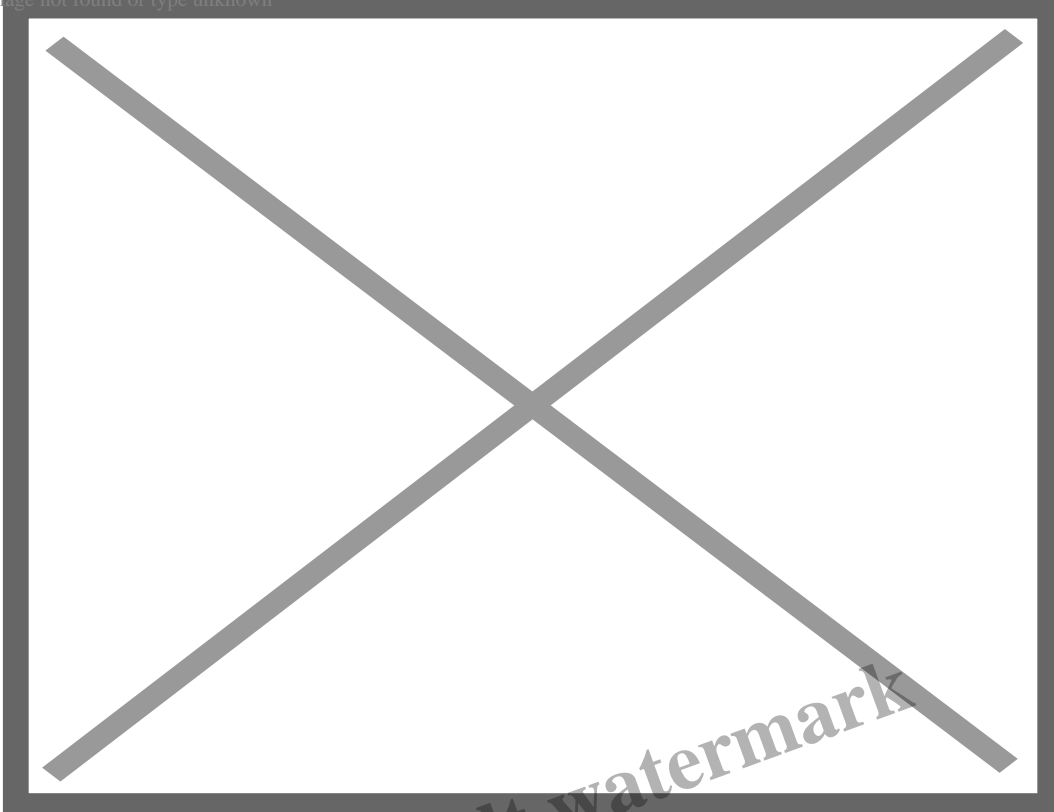
*A Bay Checkerspot Butterfly*

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Stu is perhaps the best example I know of someone with a strong scientific background that wants to ensure that the science gets put to work to generate positive conservation outcomes. He's worked tirelessly to further the conservation of the species and places he loves. He's recently been recognised for that work, through a [Bay Nature Local Hero Award](#).

Each year, a few weeks before I travelled to California, Stu would send an email foreshadowing our traditional get-together to drink margaritas and reporting on the state of the grassland that year. Rather than giving a lengthy account of which species were doing well that year, Stu simply reported the index he had invented –  $I_B$  (I sub B), or the Index of Beauty. The higher  $I_B$  was, the better the wildflower season was. The index never had any actual numbers, only degrees of high, medium and low.

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*Stu and I pause to assess I sub B at Coyote Ridge*

I don't think  $I_B$  ever appeared in any publications, but we used the term a lot. Of course, Stu recognised that it's patently absurd to think that you can quantify beauty. Although anything seems possible after a pitcher or two of margaritas. But the beauty of the grasslands is one of the primary drivers of why people want to conserve them. Much more than any numbers laboriously gathered by long hours of fieldwork. Indeed, during the long hours with my head down in the flowers counting plants, I would often pause and just sit and take in the sheer wonder of the place I was working.

We use the numbers to quantify the characteristics of the grasslands, but those numbers do not adequately capture one of the most important features. Science finds it hard to pin down something as fluffy and subjective as "beauty" –  $I_B$  celebrated that fact.

There have been a few attempts to measure and quantify beauty – for instance of the [human face](#) or of [art](#). And there may be a few universal characteristics that make things "beautiful". It's hard to argue that the fields of wildflowers we saw in California are anything other than beautiful. But what makes them beautiful and what elements contribute most to that is likely to vary considerably among different people.

So, while there's an objective reality of a field of wildflowers, there's a strong subjective element in how that is perceived. The phrase "[Beauty is in the eye of the beholder](#)" suggests that what one person finds beautiful another may not. There's a deep philosophical argument about whether beauty exists on its own or is created by observers.

While we're not going to delve into those choppy philosophical waters here, it does lead us to the whole question of how humans perceive the world around them. And – trust me on this – it will get us



to the topic of guitars before too long.

## Perception

We perceive things using our senses – hearing, sight, smell, touch, taste – and the information gathered by those senses is processed in the brain. [Perception](#) is: “the organization, identification, and interpretation of sensory information in order to represent and understand the presented information or environment”. The process of sensing and interpreting what happens around us involves an array of complex sensory and neural systems.

Let’s just pause and ponder that for a moment. There’s a world of things and other beings out there, and in order to interact with those things and beings we each have to receive and process countless sensory signals. Most of that is done without us really thinking about it.

As I sit at my desk writing this, I’m feeling the keyboard keys under my fingers, hearing the taps as I press them, and seeing the string of words appearing on the computer screen. If I stop to think about it, I can also feel my butt comfortably sitting on my chair. I can also see and hear the rain outside and a car passing by. Or I can focus on the guitars in the rack beside me, or the flowers growing on the shrub outside my window. There’s not much going on in the smell department at the moment, which is probably a good thing.

This simple little set of observations shows that, as well as receiving sensory information, my brain is also filtering it so that I can focus on particular things. I can type without being distracted by the passing car. I don’t get messages from my butt all the time telling me I’m sitting on a chair.

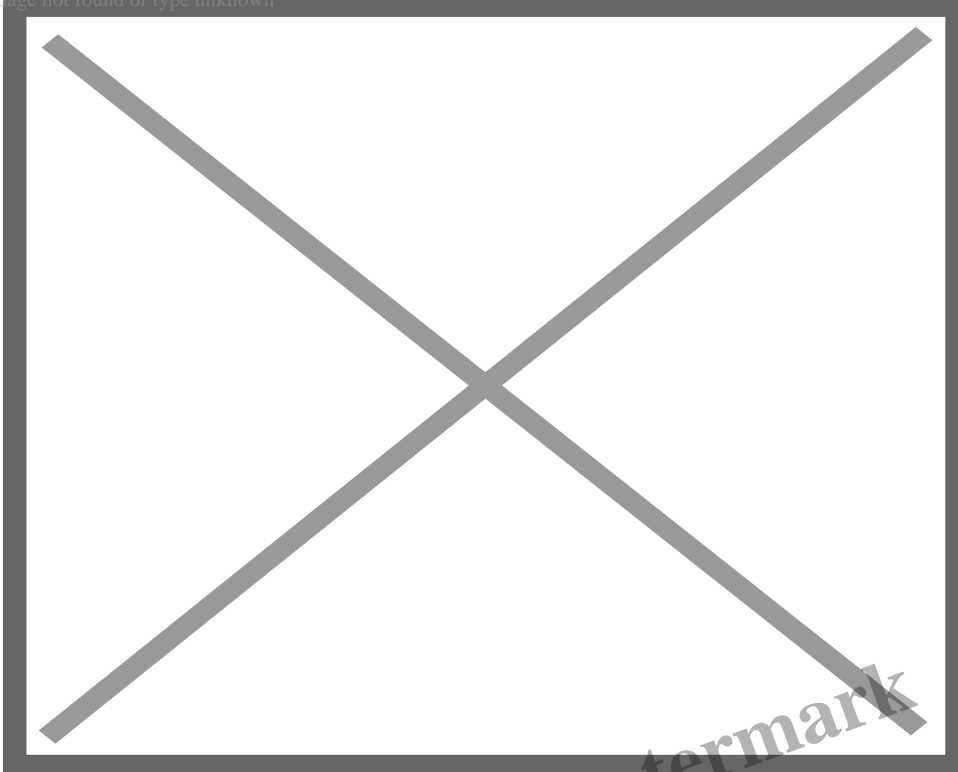
So perception – our interface with the world outside ourselves – is a largely hidden set of processes that do a wide array of complex operations to help us interpret the reality around us.

## Is there an objective reality?

Here we come back to the very squelchy quagmire of philosophical and sociological thought that ponders deeply on the relationship between perception and reality. Some versions of this go as far as to question whether we can be sure there is any sort of objective reality out there. If I see a flower outside my window, I’m perceiving it through my eyes and processing it as “flower” in my brain. If it wasn’t raining, I could go outside and gain further information by touching and smelling it, but that’s just adding more layers to the perception of a flower – rather than proving that the flower objectively exists outside my mind.

I’ve always thought this line of thinking is a bit daft. I’m pretty certain that if I walk into the tree next to my house it will smack me in the face. And the rain will make me wet at the same time. I’m comfortable with the thought that the tree and flower exist independently of whether I’m perceiving them or not. Nevertheless, it is distinctly likely that the way I perceive the flower and the tree may not be the same as how another person perceives them.

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*Pincushion Hakea flower outside my window. I'm pretty sure it's still there even if I'm not looking at it. And I think it's beautiful.*

Add to that the fact that people's preferences also differ – one person may prefer red flowers to white flowers, or daisies to weird Australian Proteacea flowers, or pine trees to gum trees – and you start to see why there are differences of opinion on virtually every aspect of our lives.

## From guitar to your ears and brain

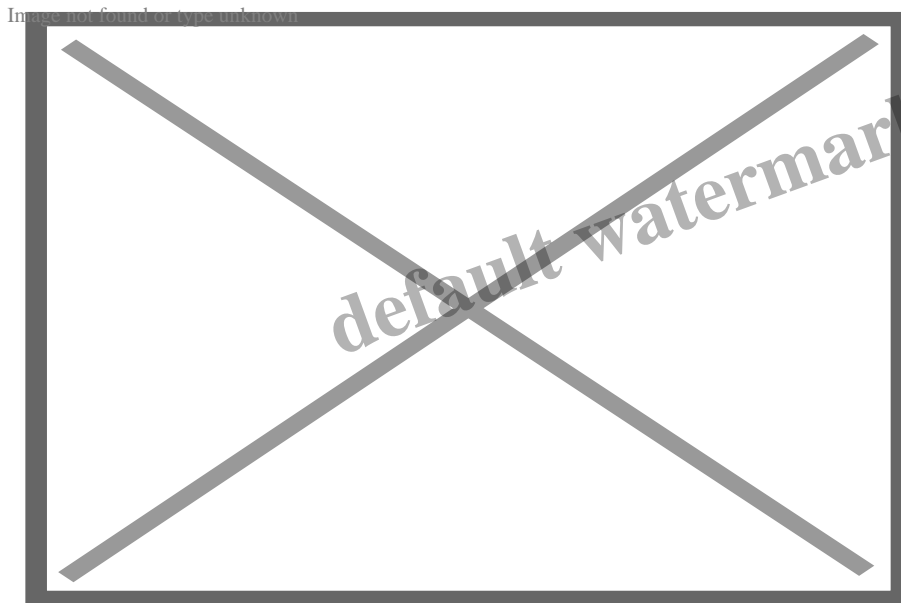
So, finally this meandering story brings us to something approximating relevance to guitars and trees. The journey of the sound made by a vibrating guitar string through the guitar body and surrounding air to our ears involves a set of well-documented physical processes. The journey of that sound from our ears into our brain involves a complex set of physiological, neurological and psychological processes. So, there's the physical reality of the sound and there's the perceptual reality of how our brain interprets that sound.

How guitars make sounds and how that process is affected by the various materials and characteristics of the guitar is a huge topic to cover. Of course, imbedded in that topic is the question of which materials produce the best results acoustically – leading to the underlying premise for the Nature of Music, and the ongoing debate over the best tonewoods.

We'll look at this area in more detail in a subsequent post and consider how you go about assessing the impact of differing materials on tone. Here we'll focus on the second, often overlooked, part of the equation – what happens when the sound leaves the guitar and reaches our ears and brain. And when you do that, you'll see that it's hardly surprising that differences in opinion abound when it comes to how guitars sound. We're diving into the world of [auditory perception](#) and psychoacoustics.

## Crazy noise

I don't know what image pops into your head when you hear the term "psychoacoustics", but for me it's the famous shower scene from Alfred Hitchcock's movie "[Psycho](#)". [Psycho](#) is a term used to describe a crazy or mentally unstable person, and Hitchcock's movie centers around one of those people. The music in the movie is credited with adding greatly to the tension and horror – truly psychoacoustic, if you ask me.

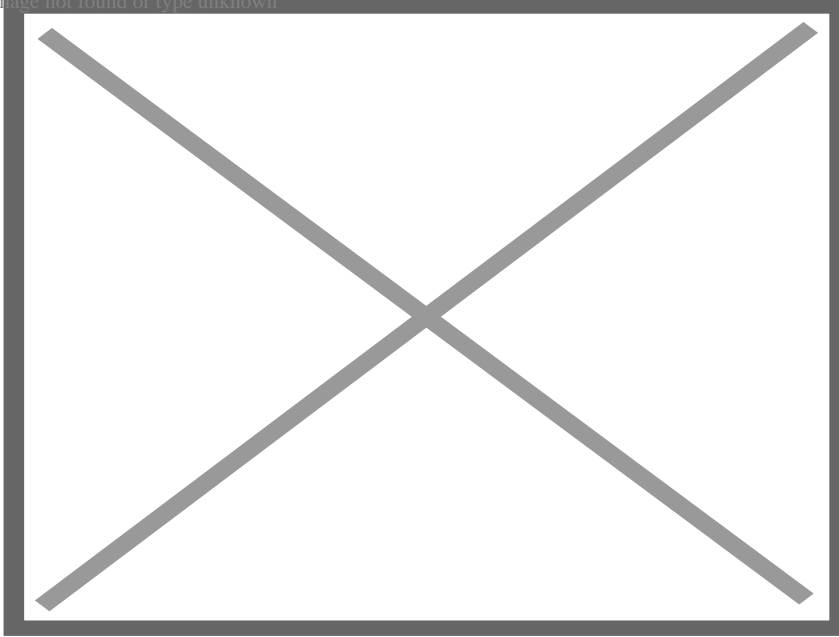


*Janet Leigh in the infamous shower scene in Psycho. Source: [NY Post](#)*

[Psychoacoustics](#) is actually the scientific study of how we perceive sound – including speech and music. A related field, [audiology](#), involves identifying, diagnosing and treating health disorders relating to hearing and balance.

## Ear, ear

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*The human ear.* Source: [Integrated-MCAT](#)

There's a lot more to the ear than the funny flaps we see on the side of our heads. In fact, they're pretty amazing pieces of equipment designed to move sounds from the external environment to inside your head. This little video gives an entertaining account of how they work.

*How Hearing Works – Journey of Sound to the Brain*

If you want to explore how hearing works in more detail, you can check out a wide array of other videos by Lesley Samuel on [Interactive Biology](#).

However, as Lesley Samuel says at the end of the video, once sounds reach the brain, another set of amazing processes are at work that sift, sort and interpret the sounds. These processes allow us to concentrate on particular sounds, recognise voices, tell roughly how far away and from which direction the sound might be coming from and so on.

In terms of music, the brain can identify individual notes, chords, harmonies and instruments and much more. If you say someone "has an ear for music", this indicates that they have a good ability to process things like individual notes, keys, pitch etc. Others struggle with all of that. And some are called "tone-deaf". This can be related to a variety of things such as age, experience, training and so on – and it can change with time and practice.

## Do you hear what I hear?

Even then, how an individual's brain processes auditory information can vary considerably depending on things like our state of mind, the local environment, or whether we're concentrating or distracted.

Sometimes, the brain plays tricks and alters the perception of the sounds coming in through the ears. As an article on [Humanbeatbox](#) suggests, "What you hear with your ears is not necessarily what you hear with your brain."

Here's a quote from a Teufelaudio blog titled "Do you hear what I hear?":

*"Just like visual illusions, our brain can also interpret audio information in an unusual way. This can be due to a range of factors, such as visual prompts and our own speech patterns. Our assumptions and prior knowledge can affect our overall impression of something that occurs in our present reality."*

[Teufelaudio](#)

This is also open to external manipulation. For an example of this in visual perception, have a look at the Open Voice video "[Manipulation Is Part Of Humanity's Reality](#)". In the same way, you may hear what you expect to hear, not the real sound. Freaky, huh? So, if you hear a [bamboo guitar](#), you might expect it to sound crap regardless of how it actually sounds.

Here's another quote, this time from takelessons.com, discussing [timbre](#) and tone in music:

*"The human ear hears only the fundamental A as the defined pitch, but it hears those overtones as what is called "timbre" or "tone." That allows us to hear which instrument or voice has sounded the fundamental note. Your ear takes in the sound of the fundamental note, plus all the overtones, then your brain recombines this information into a perception of tone."*

[Takelessons.com](#)

Let's just repeat that last phrase: "... your brain recombines this information into a perception of tone". So, there may be an objective reality of the actual fundamental notes and overtones, but that is then interpreted by the brain to give us our auditory perception of "tone".

It's likely that people's brains do this in different ways. Some brains appear capable of detecting very fine distinctions among the different aspects of tone while others seem less able to parse things out. The main take-away message, though, is that there is an objective reality to tone BUT there's also a more subjective side to it based on how different people's brains respond – so, perception of tone varies.

## Perception and preference

On top of all that comes the actual preferences that different people have – which also vary hugely! And hurrah for that – what a dull place the world would be if everyone's brains worked exactly the same and everyone preferred exactly the same musical characteristics.

Here's a few quotes extracted from an [Acoustic Guitar Forum thread](#) from a few years ago, on the perception of tone:

Isn't hearing like taste buds.... We all taste things differently. Some like Chocolate and others

Strawberry.... Some love black liquorice and others can't stand it.

Not only is tone subjective, but one's perception of it changes literally hour to hour, due to environmental factors, stress, etc. Sometimes I pick up one of my guitars and hardly recognize it, compared to what I expect to hear.

There are so many variables. Strings, how new the strings are, how hard you pick/pluck the string, where you pick/pluck the string and with what. What exactly the strings are tuned to (a half-step can make a big difference in tone). That's all before you get into personal preferences on what constitutes "good", which is influenced by how many other guitars you've been familiar with, what kind of music you intend to play, and (especially for beginners) how much experience you have playing music rather than listening to it on a playback machine of your choice, which nowadays is often ipods with earphones.

There are a lot of variables that impact a player's choice of an instrument. 1. We each have our own frequency response curve from our ears. In fact, each of our ears often have different frequency response curves. 2. We each have our own brains, which influences how those frequencies are processed. 3. We each have our own playing styles. Some people can make dull sounding guitars sound bright; some people make a bright guitar sound dull because of how they play. 4. We each have our own preferences. I have noticed that a lot of people like bright sounding guitars. I don't. I like to hear the treble and the mid range, but I also like to hear bass.

Consider my mind blown! It's not so much that one thing sounds better than another, it's just that our brains form a familiarity with certain sounds.

And finally, from a [Martin Guitar Owners & Friends](#) Facebook post where someone asked whether there's a difference in tone between natural finish and sunburst tops, one tongue in cheek response was:

*"One has a more sunny sound, one sounds more natural. Maybe?"*

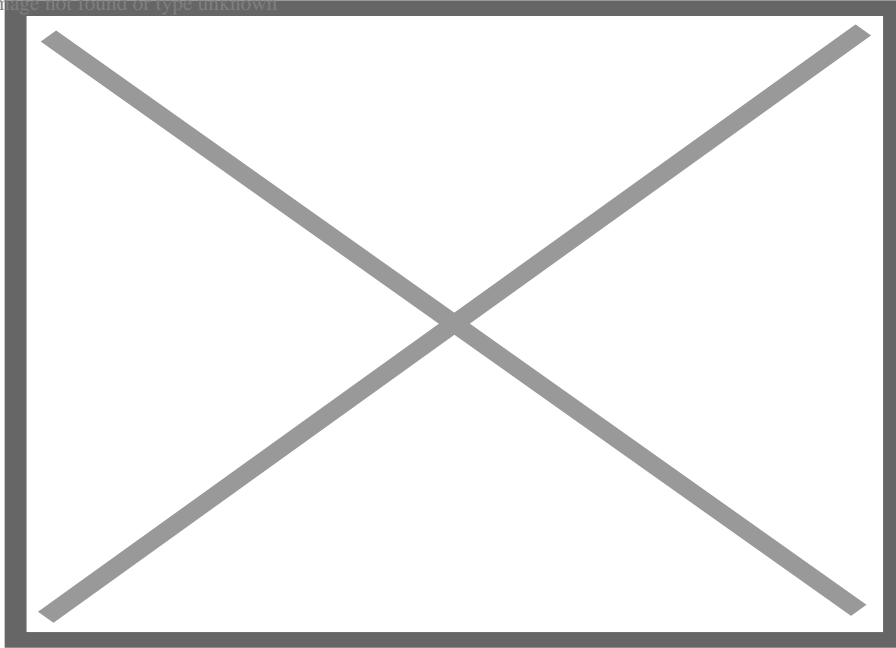
This remark highlights another issue regarding how we even describe tone effectively. We haven't got an off-the-shelf  $I_T$  (Index of Tone) and tend to use descriptive words like warm, mellow or bright, none of which can realistically be quantified. Chris Herrod, in an article in [American Lutherie](#), has likened this to how people describe wines.

## Perception is personal

So, what's the point of all this? We've meandered through football, wildflowers and beauty to get to how different people perceive the sounds that guitars make. It's pretty clear to me that there's a world of observable and measurable facts and reality, and then there's another world of perceptions and preferences. People perceive objective reality in different ways. That's it in a nutshell.

In the words of two articles on perceptions, "[your perception IS your reality](#)" but also "[perception is personal](#)". In other words, we each perceive the external world using our senses, but we need to be aware that we may be seeing/feeling/smelling/tasting/hearing – and interpreting – things differently from other people.

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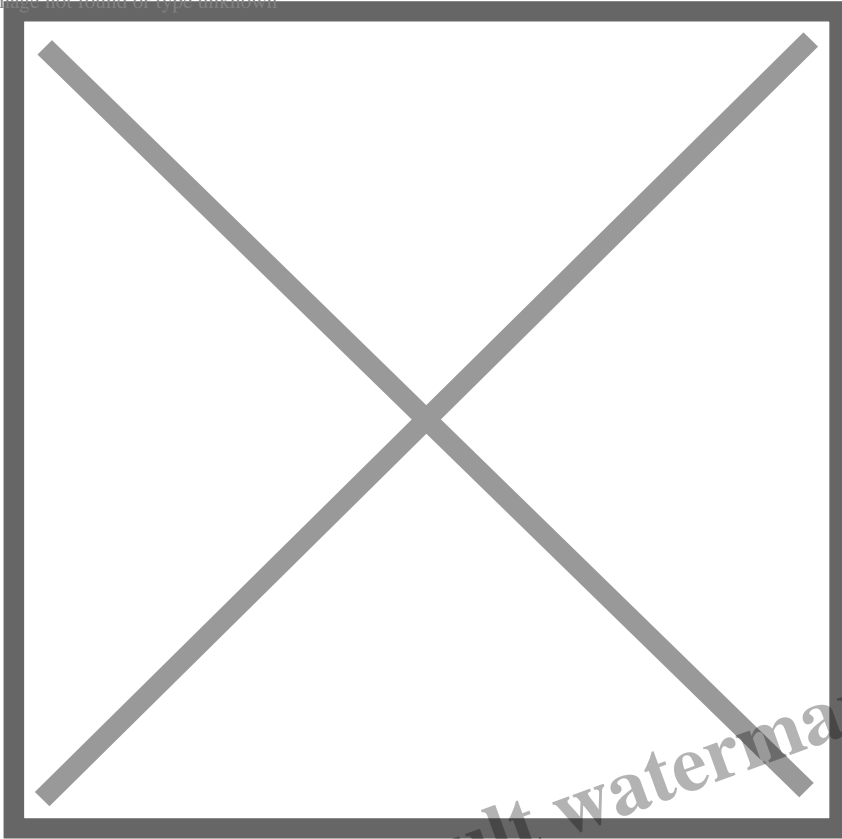


Source: [DrJimTaylor](#)

We'll look in a later post at how guitar folks are working on separating out the objective aspects of guitar tone from the subjective perceptions and preferences of different people. But the bottom line is that different guitars certainly sound different for all sorts of reasons, but which guitar sounds "better" is a matter of personal perception and preference. And that itself varies through time and in different contexts.

The same goes for the idea of beauty. What's beautiful to me may not be so beautiful to you – again for all sorts of reasons. I'd like to think that you'd find the California wildflowers that I love beautiful too. But other living things like spiders and snakes? Some folks find these beautiful, while others find them horrific and terrifying. Putting a number on level of beauty or repulsion is next to impossible, but that doesn't make them any less real.

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*Some see beauty, some see terror. This is, in fact, an amazing animal – a [trapdoor spider](#) from here in Western Australia that a colleague of mine, [Barbara York Main](#), studied for 40 years. It was 43 years old when it died, making it the oldest known spider. Photo: [New Yorker](#).*

And football? Back to where we started with “the Play” – here again there is an objective reality of what actually happened in the final moments of the 1982 Big Game. But the actual objective details are hazy at best. Back then, they didn’t have action replays and multiple camera angles that could be referred to remote match officials to ponder over in slow motion and advise the on-field officials of what happened. Attempts to sort out whether all of Cal’s final passes were legal or not suggest that at least one of them may not have been legitimate. So, there are different perceptions of the reality of those final moments. Stanford people see it one way and Cal people see it another. And so the Axe inscription gets changed every time it changes hands.

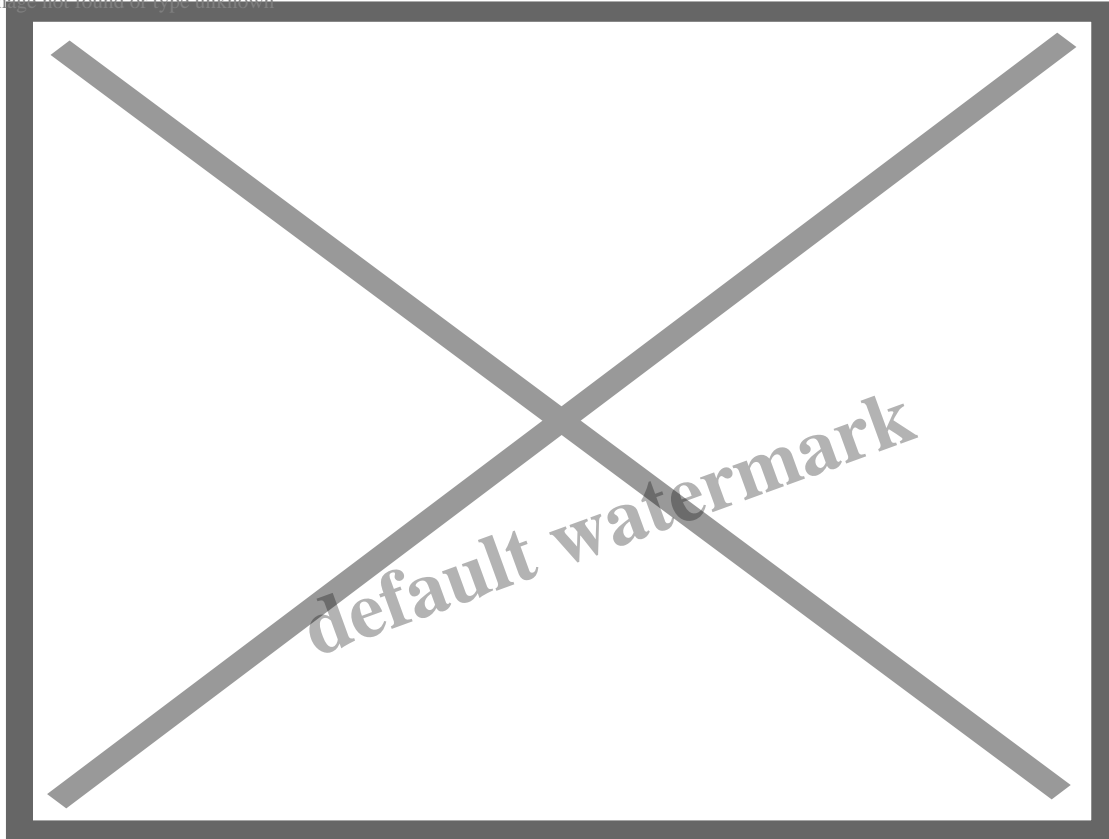
All of that is little more than a bit of fun (although maybe I’m treading on thin ice here with Cal and Stanford supporters). But different perceptions also cause marriage break-ups, civil unrest, wars and much more. Taking a pause to consider whether your perceptions might differ from someone else’s could prevent a whole lot of trouble. And it might make some guitar chat rooms and discussion threads friendlier and more supportive places!



*Still a man hears what he wants to hear.....And disregards the rest*

Simon & Garfunkle, [The Boxer](#) (Paul Simon, 1969)

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[Carrizo Plain](#), about 160km northwest of Los Angeles, during the 2019 wildflower superbloom.

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