A song's structure can be linked to its popularity

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Think of your favourite pop song. Can you explain why you like it so much? It might remind you of a memorable event, or move you in a way that makes you feel happy or sad. A new study, published in the open-access journal *Frontiers in Human Neuroscience*, has uncovered a simple, measurable explanation that can determine your preference for one song over another. It has linked the harmonic structure of pop songs to their placement in the charts.

"The most popular songs tend to include relatively rare chords, that is, they typically have high harmonic surprise," says Norberto Grzywacz, a Professor of Neuroscience and Physics, who conducted this research at Georgetown University, Washington, USA. "These songs also tend to have choruses with relatively low harmonic surprise preceded by sections with many rare chords."

Harmonic surprise can be described as where the music deviates from the listeners expectations. Scientists have predicted that these changes in structure could elicit a pleasurable reward response in the brain. In other words, harmonic surprise can increase the likelihood a song will be a hit.

Professor Grzywacz explains, "When listening to music, we enjoy some pieces and dislike others. Multiple reasons govern how much we like a piece of music, including compositional, emotional and cultural. We evaluated the role of a compositional element - the harmonic surprise. Surprise is important because it is a measure of new information; something that the reward centers of the brain recognise as being of

value, leading to a positive emotional response. Therefore, our finding that the most popular songs tend to include surprising chords reflects our brains in-built preference."

It is not just the surprise element of a song that the brain deems as pleasurable, but the return to normality too.

"The brain enjoys surprise only up to a point, because unexpected events indicate a failure of prediction," says Professor Grzywacz. "Hence, the release of tension from surprising sections of a song to common choruses is also signalled positively by the reward centers. Our research reveals that the brain has a deep-rooted preference, which can affect whether people enjoy a piece of music."

The study analyzed chord-by-chord transcriptions of the harmonies of 545 songs that entered the American Billboard Hot 100 charts between 1958 and 1991. Professor Grzywacz and his colleagues measured how far the chords of the song deviated from what was expected. For example, C major is usually followed by G and F major in Western tonal music and a change from this would be classed as a surprise. These measures of surprise were compared throughout the entire song and between song sections.

"We then used the peak position of the song in the weekly Billboard Hot 100 chart to determine its popularity," says Professor Grzywacz.

It revealed that verses, not the choruses or bridges, accounted for much of the difference in harmonic surprise between the most and least popular songs in the Billboard Hot 100 chart. Professor Grzywacz and his colleagues suggest that high surprises in the harmony of a song, as well as high surprises followed by a lower-surprise section, can both contribute to the enjoyment of an unfamiliar piece of music.

Professor Grzywacz details where the research is heading next, "Our group is taking this line of inquiry in many directions. We are assessing whether harmonic surprise has a historical memory; does a song released in 1980 have to be surprising relative to songs released in that year, or to songs released in previous years - 1979, 1978, 1977, ...or 1950...? We have a theory that chords from past music matter for surprise in new songs. For example, imagine that someone today composes a piece of music like Mozart. They would not be deemed a creative genius, even if the composition was excellent."

The group also hopes to measure the effect of harmonic surprise - how big it needs to be to make a song popular. "We've composed artificial music that have different levels of surprise and contrasts between high and low surprise sections. Volunteers will evaluate preference for these pieces of music, to assess how much these factors can affect their preference," says Professor Grzywacz.

He continues, "My colleagues and I are performing similar measurements and experiments with portrait paintings. Our overall goal is to use this knowledge to develop a general theory of how the brain experiences beauty in art."

More information: Scott A. Miles et al, A Statistical Analysis of the Relationship between Harmonic Surprise and Preference in Popular Music, *Frontiers in Human Neuroscience* (2017). DOI: 10.3389/fnhum.2017.00263

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