

Terpsichoseismology

歌舞地震学

Look what you made me do

看看你们让我做了什么

The excitement of 70,000 Swifties can shake the Earth

7 万名霉粉的狂欢可以撼动整个地球

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“Shake, shake, shake, shake,” Taylor Swift sings from the stage of Lumen Field in Seattle at 10.35 in the evening on July 22nd. The fans respond, enthusiastically; the stadium **duly** shakes; a nearby **seismometer** **takes note**. To pop **aficionados** “Shake it off” is an **empowering up-tempo anthem** played at 160 beats per minute. To the Pacific Northwest Seismic Network, which is designed to monitor earthquakes, it is a 2.6 **hertz** signal in which the **amplitude** of the acceleration was as large as one centimetre per second, per second.

7月22日晚10点35分，泰勒·斯威夫特在西雅图流明球场的舞台上开唱：

“Shake, shake, shake, shake,” 台下歌迷们热情跟唱，连整个体育场也为之震动，附近的地震检波器检测到了震动。对于流行音乐爱好者来说，“Shake it off”是一首以每分钟160拍的速度演奏的快节奏歌曲。而对于专门监测地震的太平洋西北地震台网来说，这是一个每秒2.6赫兹的信号，其加速度的振幅高达每秒一厘米。

【词汇】

1. **Terpsichoseismology** n.：歌舞地震学。由 Terpsichore（忒耳西科瑞（司舞蹈和合唱的女神））和 seismology（the scientific study of earthquakes 地震学）组成
2. **duly** /'du:li/ adv. in the correct or expected manner 适当地；恰当地
例：The document was duly signed by the inspector.
这份文件已由检查员签妥。
3. **seismometer** /saiz'momɪtə/ n. 地震检波器

4. **aficionado** /əˌfiːəˈnɑːdəʊ/ n. a person who likes a particular sport, activity or subject very much and knows a lot about it 酷爱...者；...迷

例：This coffee is regarded by aficionados as one of the world's finest.

这种咖啡被爱好者们视为世界上最好的咖啡之一。

<同义替换> fan

5. **empower** /ɪmˈpaʊər/ v. 托福/专八 To empower someone means to give them the means to achieve something, for example to become stronger or more successful. 给予...力量；使有能力(实现...)

例：Empowering the underprivileged lies in assuring them that education holds the real source of power...

帮助贫困人民就要让他们相信教育是真正的力量源泉。

6. **up-tempo** /ˈʌptempəʊ/ adj. (especially of music 尤指音乐) fast 快节奏的；节奏渐快的

例：up-tempo dance tunes

快节奏舞曲

7. **tempo** /ˈtempəʊ/ n. the speed or rhythm of a piece of music (乐曲的) 速度，拍子，节奏

例：It's a difficult piece, with numerous changes of tempo.

这支曲子节奏变化多，难度很大。

<同义替换> beat

8. **anthem** /ˈænthəm/ n. a song that has a special importance for a country, an organization or a particular group of people, and is sung on special occasions 国歌；(组织或群体的) 社歌，团歌

例：The European anthem was played at the opening and closing ceremonies.

欧洲颂歌在开幕式和闭幕式上演奏。

9. **hertz** /hɜːrts/ n. a unit for measuring the frequency of sound waves 赫，赫兹 (声波频率单位)

10. **amplitude** /ˈæmplɪtuːd/ n. 六级 the greatest distance that a wave, especially a sound or radio wave, vibrates (声波、无线电波等的) 振幅

【短语】

1. **take note** : to pay attention to something 注意(到某事)，留意(到某事)

例：His first album made the music world stand up and take note.

他的第一张专辑引起了乐坛的反响和关注。

【长难句】

To the Pacific Northwest Seismic Network, which is designed to monitor earthquakes, it is a 2.6 hertz signal in which the amplitude of the acceleration was as large as one centimetre per second, per second.

句子的主干部分为：it is a 2.6 hertz signal per second. 意思是：这是一个每秒 2.6 赫兹的信号

To the Pacific Northwest Seismic Network, which is designed to monitor earthquakes 为状语，其中 which is designed to monitor earthquakes 为定语从句，修饰 the Pacific Northwest Seismic Network，整句话意思是：而对于专门监测地震的太平洋西北地震台网来说

in which the amplitude of the acceleration was as large as one centimetre per second 也是定语从句，修饰 signal，意思是：加速度的振幅高达每秒一厘米

The well-situated seismometer first came to public attention in January 2011, when it recorded the response of fans of the Seattle Seahawks, an American football team, to a magnificent **touchdown** by Marshawn Lynch, a **running back** known as “Beast Mode”. The “Beast Quake” went down in local sporting history. When Ms Swift came to town for two nights of her Eras tour, Jacqueline Caplan-Auerbach, a **geology** professor at Western Washington University, used the opportunity to learn more about how events in the stadium shake its surroundings. On December 11th she presented some of her conclusions at the American Geophysical Union’s autumn meeting in San Francisco.

2011年1月，西雅图海鹰队（一支美式橄榄球队）中有“野兽模式”之称的跑卫马肖恩·林奇（Marshawn Lynch）触地得分，令人惊叹，其球迷一次次用震耳欲聋的吼叫和跺脚表达激动之情，引起了地面震动，此反应被记录了下来。由此，“野兽震”被载入了当地体育史。当泰勒·斯威夫特来到这里举办两晚的时代巡演时，西华盛顿大学的地质学教授杰奎琳·卡普兰·奥尔巴赫（Jacqueline Caplan-Auerbach）利用这个机会了解了更多有关体育场内进行的活动是如何对其周边带来震感的信息。12月11日，在旧金山举行的美国地球物理联盟秋季会议上，她介绍了她所得出的一些结论。

【词汇】

1. **touchdown** /'tʌtʃdaʊn/ n. in the sport of rugby, to score by putting the ball on the ground behind the other team’s goal line [英式橄榄球运动中，在对方球门线后] 持球触地得分

例：Manning and Brett threw nine touchdown passes between them.

曼宁和布雷特相互传球，投掷出9个达阵得分。

2. **running back** /'rʌnɪŋ bæk/ n. (in American football 美式足球) an attacking player whose main job is to run forward carrying the ball (带球进攻的) 跑卫

3. **geology** /dʒi'ɑ:lədʒi/ n. the scientific study of the physical structure of the earth, including the origin and history of the rocks and soil of which the earth is made 地质学

【长难句】

When Ms Swift came to town for two nights of her Eras tour, Jacqueline Caplan-Auerbach, a geology professor at Western Washington University, used the opportunity to learn more about how events in the stadium shake its surroundings.

句子的主干部分为：Jacqueline Caplan-Auerbach used the opportunity to learn more about how events in the stadium shake its surroundings. 其中 how events in the stadium shake its surroundings 为**宾语从句**，整句话的意思是：杰奎琳·卡普兰·奥尔巴赫（Jacqueline Caplan-Auerbach）利用这个机会了解了更多有关体育场内进行的活动是如何对其周边带来震感的信息。

a geology professor at Western Washington University 为**插入语**，对 Jacqueline Caplan-Auerbach 进行补充说明，意思是：西华盛顿大学的地质学教授

When Ms Swift came to town for two nights of her Eras tour 为**时间状语**，意思是：当泰勒·斯威夫特来到这里举办两晚的时代巡演时

In 1985 Bruce Springsteen and the E Street Band set the Nya Ullevi Stadium in Gothenburg shaking violently enough to alarm some of the audience, and doing enough damage to the structure for further concerts there to be banned. This, later analysis found, was not down to the intensity with which Mighty Max Weinberg was pounding his drums, though it is an intensity to be reckoned with. The audience on the pitch was moving at a frequency that resonated with the clay beneath the stadium and parts of the building.

1985年，布鲁斯-斯普林斯汀（Bruce Springsteen）和 E Street 乐队在哥德堡的 Nya Ullevi 体育场演出时，场馆剧烈摇晃，惊动了一些观众，这场演唱会对场馆内部结构造成的破坏还不小，正因如此，该场馆就被禁止继续举办演唱会了。事后分析发现，尽管麦克斯·温伯格（Mighty Max Weinberg）击鼓的力度很大，但这场事故这并不是由此导致的。其实是因为场上观众的晃动频率与体育场以及部分建筑下面的粘土产生了共振。

【词汇】

1. **intensity** /ɪn'tensəti/ n. the strength of something, for example light, that can be measured 强度；烈度

例：varying intensities of natural light

自然光不断变化的强度

2. **pound** /paʊnd/ v. to hit something/somebody hard many times, especially in a way that makes a lot of noise 反复击打；连续砰砰地猛击

例：Someone was pounding at the door.

有人在砰砰地敲门。

3. **pitch** /pɪtʃ/ n. 四级/六级/雅思/GRE/考研 an area of ground specially prepared and marked for playing a sports game (体育比赛的) 场地；球场

例：a football pitch 足球场

<同义替换> stadium

4. **resonate** /'rezəneɪt/ v. (of a place 地方) to be filled with sound; to make a sound continue longer (使) 回响，起回声

例：The room resonated with the chatter of 100 people.

屋里充满了 100 人唧唧喳喳的声音。

5. **clay** /kleɪ/ n. a type of heavy, sticky earth that becomes hard when it is baked and is used to make things such as pots and bricks 黏土；陶土

例：The tiles are made of clay.

这些砖是用陶土制成的。

【短语】

1. **be down to somebody/something** : to be the result of one person's actions or one particular thing 是某人/某事的结果，归因于某人/某事

例：Any mistakes are entirely down to us.

任何过错全是我们造成的。

2. **reckon with somebody/something** : someone or something that is powerful and must be regarded seriously as a possible opponent, competitor, danger etc 必须认真考虑[对待]的某人/某事物

例：Barcelona will be a force to be reckoned with this season.

巴塞罗那队将是这个赛季不可忽视的一支球队。

Dr Caplan-Auerbach wanted to see whether such **resonant amplification** might also be at **play** elsewhere, and to distinguish between the effect of the music itself and the

卡普兰·奥尔巴赫博士希望了解这种共振放大效果是否也会在其他地方发生，她还想要区分音乐本身的效果

audience's response. Her concert-night data showed two distinct sets of signals, one in higher frequencies (30-80hz), one in lower frequencies (1-8hz). The higher-frequency signals were present during the **sound check**, when the band were on stage but the stadium empty, and absent during the concerts' "surprise songs", played without the band by Ms Swift alone. The lower frequencies were absent when the audience had yet to arrive. Clearly those higher frequencies were from the music itself.

和观众的反应。她收集的演唱会当晚的数据显示了两组不同的信号，一组是高频信号（30-80 赫兹），一组是低频信号（1-8 赫兹）。高频信号出现在试音期间，此时乐队在舞台上，但体育场内空无一人；而在演唱会的"惊喜歌曲"中，泰勒·斯威夫特在没有乐队的情况下独自演唱时，则没有检测到高频信号。当观众还未到场时，低频信号也没有出现。显然，这些较高的频率来自音乐本身。

【词汇】

1. **resonant** /'rezənənt/ adj. **雅思/GRE** causing sounds to continue for a long time 共振的；谐振的；共鸣的

例：resonant frequencies

谐振频率

2. **amplification** /,æmplɪfɪ'keɪʃn/ n. the act of increasing the strength of something, especially sound 放大，增强（声音等）

例：To project their song, they use another amplification technique.

为了使歌声更突出，它们采用了另一种扩音技巧。

3. **play** /pleɪ/ n. the activity or operation of something; the influence of something on something else 活动；作用；影响

例：the free play of market forces

市场力量的自由调节作用

4. **sound check** /'saʊnd tʃek/ n. a process of checking that the equipment used for recording music, or for playing music at a concert, is working correctly and producing sound of a good quality（对录音或音响设备的）校音

The lower frequency signals changed from song to song in line with the tempo of the music; they were clearly driven by the audience's response rather than a general **resonance** on the part of the building itself. **Harmonics** above the main

低频信号随着音乐节奏的变化而变化；它们显然是由观众的反应而不是建筑物本身的共振所驱动的。在主信号之上的谐波似乎是由于信号分析

signal seem to be down to what is known in signal analysis as the **Dirac comb** effect, in which repetitive signals at one frequency create harmonics at multiples of that frequency. Jordi Díaz and colleagues had suggested as much in their **seismic** analysis of another Springsteen concert, this one at Camp Nou, in Barcelona, in 2016. But Dr Caplan-Auerbach also suggests that they might in some cases reflect fans differing in their **interpretations** of the rhythms.

中所谓的狄拉克梳状效应（Dirac comb effect）造成的，在这种效应中，一个频率的重复信号会产生有多倍频率的谐波。约尔迪·迪亚斯（Jordi Díaz）及其同事在对另一场斯普林斯汀的演唱会（2016年在巴塞罗那诺坎普球场举行）产生的震感分析时也提出了同样的观点。但奥尔巴赫博士也认为，在某些情况下，它们可能反映了歌迷对节奏不同的演绎方式。

【词汇】

1. **resonance** /'rezənəns/ n. 托福/GRE/专八 the sound or other vibration produced in an object by sound or vibrations of a similar frequency from another object 共鸣；共振；谐振

例：The ear has a set of filaments to vibrate in resonance with incoming sound-waves.

耳朵里有一组细丝能和进入的声波产生共振。

2. **harmonics** /hɑ:r'mɑ:nɪks/ n. a note that sounds together with the main note being played and is higher and quieter than that note 泛音（奏法）；谐波

例：Together, the fundamental wave and the overtones make up what are known as harmonics.

它们共同构成基本波和泛音 所谓的谐波。

3. **seismic** /'saɪzmɪk/ adj. connected with or caused by earthquakes 地震的；地震引起的

例：seismic waves

地震波

4. **interpretation** /ɪn'tɜ:prə'teɪʃn/ n. the particular way in which somebody chooses to perform a piece of music, a role in a play, etc. 演绎；演奏方式；表演方式

例：a modern interpretation of 'King Lear'

《李尔王》的现代演绎

【其他】

1. **Dirac comb**：狄拉克梳状函数(也被称为沙赫函数、脉冲列车或采样函数)是一个周期性的函数

The effects of the songs and Ms Swift's performance, as captured on **time-stamped** pictures of the event taken by fans like Dr Caplan-Auerbach's teenage neighbour (cited in her presentation as a co-author), proved highly **replicable**, though the first-night crowd was a **tad** more energetic (perhaps they were the more **committed** set of fans). On both occasions that "Love Story's" final **crescendo** reached its peak with the line "Pulled out a ring and said 'Marry me Juliet'" the **oscillations** came to a **climax** as the singer's left arm rose in triumph.

奥尔巴赫博士的一个十几岁邻居（在她的演讲中被引述为合著者）就是歌迷之一，他们拍摄的带有时间戳的照片显示，斯威夫特演唱的歌曲和她本人的表演效果具有很强的感染力，尽管第一晚的观众更有活力一些（也许他们是更忠实歌迷）。《Love Story》最后高潮部分的歌词 "Pulled out a ring and said 'Marry me Juliet'"（掏出一枚戒指，说'嫁给我吧，朱丽叶）现场观众的反应两次都达到了顶峰，当歌手的左臂高举起来时，现场的震撼达到了最高点。

【词汇】

- time-stamped** adj. 带时间戳的
- stamp** /stæmp/ v. to print letters, words, a design, etc. onto something using a special tool 在...上盖（字样或图案等）；把（字样或图案等）盖在...上
例：The box was stamped with the maker's name.
盒子上盖有制作者的印章。
- replicable** /'replɪkəbl/ adj. that can be copied exactly 可复制的
例：The design is easily replicable.
这个设计很容易复制。
- tad** /tæd/ n. a very small amount 少量；一点儿
例：Could you turn the sound down just a tad?
你把音量调低一点儿好吗？
- committed** /kə'mɪtɪd/ adj. willing to work hard and give your time and energy to something; believing strongly in something 尽心尽力的；坚信的；坚定的
例：a committed member of the team
忠于职守的队员
- crescendo** /krə'ʃendəʊ/ n. **GRE** a slow steady increase in how loudly a piece of music is played or sung （音乐的）渐强

例：The curtains opened as the music reached a crescendo.

当音乐到达高潮时，大幕拉开了。

7. **oscillation** /ˌɑːsɪˈleɪʃn/ n. a single movement from one position to another of something that is oscillating 一次波动；浮动；振幅

例：the oscillations of the pound against foreign currency

英镑兑外币汇价的波动

8. **climax** /ˈklaɪmæks/ n. the most exciting part of a play, piece of music, etc. that usually happens near the end (戏剧、音乐等通常接近结束时出现的) 高潮

例：The story works up to a climax as it draws to a close.

故事快到结束时逐渐达到了高潮。

Overall, the signal was considerably stronger than the original Beast Quake, **presumably** because the Swifties are **co-ordinated** by the beat in a way that football fans are not. But differences in audience **demographics**, and tastes, may provide further insights. In August 2024 **veteran** heavy-metal band Metallica will play the Lumen Field. The seismometer will be waiting to see what a bit of **headbanging** adds to the mix.

总体而言，霉霉演唱会的观众狂欢信号要比最初的“野兽震”强得多，这可能是因为霉粉们的狂欢更带节奏感，而球迷的欢呼没有节奏感。不过，也可能是受众人群和喜好的差异。2024年8月，经典重金属乐队 Metallica 将在流明球场演出。届时，地震监测仪将准备就绪，看看热烈的狂欢将给现场带来怎样的动感视听盛宴。

【词汇】

1. **presumably** /prɪˈzu:məbli/ adv. 六级/雅思/考研/专八 used to say that you think that something is probably true
很可能；大概；想必是

例：Presumably this is where the accident happened.

这大概就是事故现场。

<同义替换> perhaps

2. **co-ordinate** /kəʊˈɔːrdɪneɪt/ v. to organize the different parts of an activity and the people involved in it so that it works well 使协调；使相配合

例：They appointed a new manager to coordinate the work of the team.

为协调这个队的工作，他们任用了一位新经理。

3. **demographics** /,demə'græfɪks/ n. data relating to the population and different groups within it 人口统计数据

例：the demographics of radio listeners

电台听众统计数据

4. **veteran** /'vetərən/ n. 四级/雅思/考研 a person who has a lot of experience in a particular area or activity 经验丰富的人；老手

例：the veteran American actor, Clint Eastwood

美国资深演员克林特·伊斯特伍德

5. **headbanging** /'hedbæŋɪŋ/ n. the act of shaking your head violently up and down while listening to rock music (听

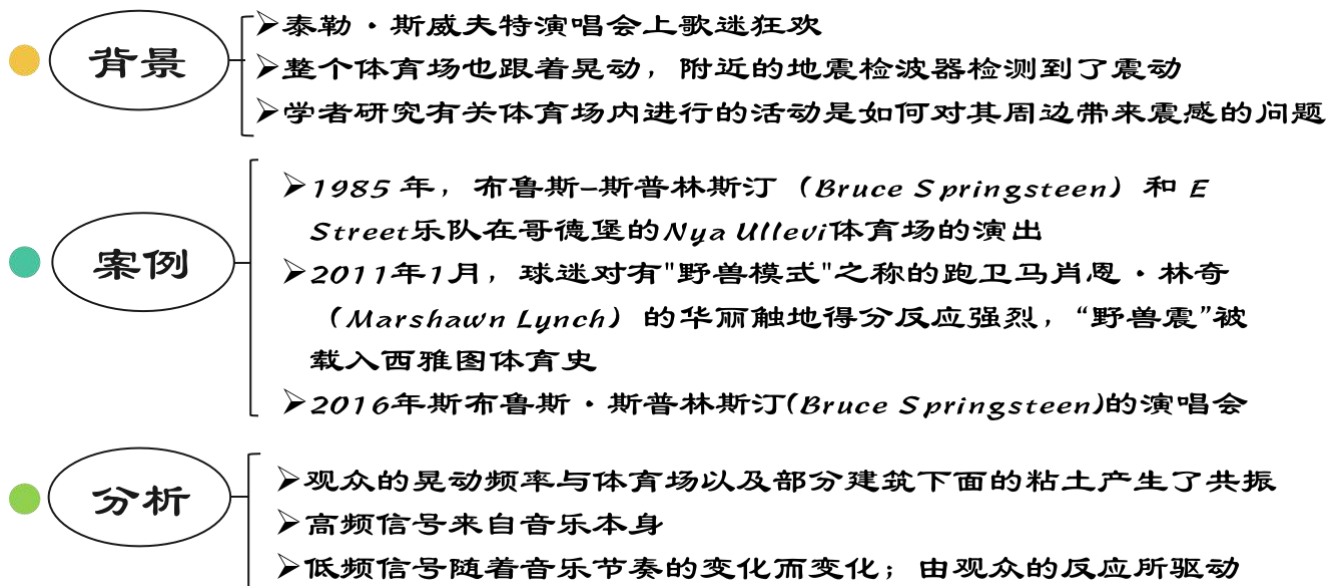
摇滚乐时) 拼命摇头

例：The study authors say devotees may maintain their headbanging habit, as such bleeds are so uncommon.

研究人员表示这样的脑部出血很少见，因此音乐爱好者们可能会继续他们的疯狂举动。

总结

1) 文章架构



2) 同义替换

✓ 粉丝；对...着迷的人

fan

The fans respond, enthusiastically...

台下歌迷们热情跟唱...

aficionados

To pop aficionados “Shake it off” is an empowering up-tempo anthem played at 160 beats per minute.

对于流行音乐爱好者来说，“Shake it off”是一首以每分钟160拍的速度演奏的快节奏歌曲。

其他：enthusiast

例：a football enthusiast

足球爱好者

✓ 球场；体育场

pitch

The audience on the pitch was moving at a frequency that resonated with the clay beneath the

stadium and parts of the building.

其实是因为场上观众的晃动频率与体育场以及部分建筑下面的粘土产生了共振。

stadium

...the stadium duly shakes...

...连整个体育场也跟着晃动...

其他：field

例: a football sports field

足球运动场

3) 一词多义

✓ stamp

✓ 文章原句：...as captured on time-stamped pictures of the event taken by fans...
...歌迷拍摄的带有时间戳的照片显示...

✓ 释义：

① to print letters, words, a design, etc. onto something using a special tool 在...上盖（字样或图案等）；把（字样或图案等）盖在...上

The maker's name was ~ in gold on the box.

盒子上盖有制作者的金字印章。

② to make a feeling show clearly on somebody's face, in their actions, etc. 显示出（感情）

Their faces were ~ with hostility.

他们的神情充满敌意。

③ to walk with loud heavy steps 迈着重重的步伐走

The children came ~ down the stairs.

孩子们走下楼梯。

✓ pound

✓ 文章原句：This, later analysis found, was not down to the intensity with which Mighty Max Weinberg was pounding his drums, though it is an intensity to be

reckoned with. 事后分析发现，尽管麦克斯·温伯格（Mighty Max Weinberg）击鼓的力度很大，但这场事故这并不是由此导致的。

✓ 释义：

① **to hit something/somebody hard many times, especially in a way that makes a lot of noise**
反复击打；连续砰砰地猛击

Someone was ~ at the door.

有人在砰砰地敲门。

② **to beat quickly and loudly**（心脏）狂跳，怦怦地跳

Her heart was ~ with excitement.

她激动得心脏怦怦直跳。

③ **to attack an area with a large number of bombs over a period of time** 狂轰滥炸

The area is still being ~ by rebel guns.

这个地区仍然遭受着叛军炮火的轰击。

4) 仿写训练

✓ 描述不同反应的原因

✓ 文章原句：

The lower frequency signals changed from song to song in line with the tempo of the music; they were clearly driven by the audience's response rather than a general resonance on the part of the building itself...But Dr Caplan-Auerbach also suggests that they might in some cases reflect fans differing in their interpretations of the rhythms.

✓ 句型及表达：

...change from...to...in line with the tempo of... ...随着...的节奏发生变化

...be clearly driven by...rather than... 这显然不是由于...而导致的，而是...

...suggests that they might in some cases reflect...differing in their interpretations of... ...提出它们在某些情况下反映了...对...的不同解读

✓ 仿写示例：

The lights changed from dance to dance in line with the tempo of the music; they were clearly

driven by the audience's response rather than the stomping effect on the floor. Some also suggests that they might in some cases reflect dancers differing in their interpretations of the rhythms.

✓ 仿写作业——描述不同反应的原因

个人态度随着生活的节奏而每天发生着变化，它们显然不是由于单调的环境而造成的，而是受到个人经历的驱使。有人还提出，这些变化可能在某些情况下反映了个人对生活的不同解读。

5) 主题词总结

今日主题——演唱会	
1. stadium	体育场
2. aficionados	粉丝
3. tour	巡回演出
4. resonance	共振
5. rhythm	节奏