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音乐训练对认知发展与情绪情感的影响

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摘　要

音乐在我们日常生活中，发挥着传达信号和情感这样至关重要的作用。音乐家常常被赞誉为是有才华、富有创造力的，那么音乐家是如何形成的？是先天注定还是后天练习？进一步地，音乐训练的过程会对人产生怎样的影响？以往研究中已经发现，音乐训练对人的认知发展有积极的影响，且在执行功能、记忆、注意力方面结论有不一致。此外，音乐训练对情绪情感相关能力的影响存在较大争议。因此本研究对以往的研究进行了总结和归纳，并提出了建立音乐训练对儿童发展轨迹影响的模型的研究计划。

关键词

认知发展，神经可塑性，情绪情感，音乐训练

The Effects of Music Training on Cognitive Development and Emotional-Affective Functions

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Abstract

Music plays a vital role in conveying signals and emotions in our daily lives. Musicians are often praised for their talent and creativity, but how are they formed? Is it predetermined by nature or shaped by nurture? Furthermore, what impact does the process of music training have on individuals? Previous studies have revealed that music training positively influences cognitive development, though findings regarding executive function, memory, and attention remain inconsistent. Moreover, the impact of music training on emotion-related abilities remains highly contested. Therefore,

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this study synthesizes and summarizes prior research, proposing a research plan to establish a model of music training's influence on children's developmental trajectories.

Keywords

Cognitive Development, Neuroplasticity, Emotional-Affectivity, Music Training

1. 问题提出

在当今社会，音乐与人类生活密切相关，它渗透到社会的各个领域。无论影视作品或广告，均配有背景音乐，其可调动听者的情绪，并传递信息。在工作或学习时，许多人习惯聆听音乐。个体音乐偏好各异，可能因特定旋律或歌词产生共鸣。音乐是一种艺术形式和文化活动，其媒介是按时组织的、有规律的声波(机械波的一种)。音乐起源虽无法考证，但其在社会生活中的作用极为重要。音乐能表达思想感情与社会现实，是迅速引起共鸣的艺术形式之一。通常，人们以表现手段的不同来区分音乐的不同种类，包括人声有无、乐器类型及节奏差异等。除听众外，部分个体作为音乐的创作者(即音乐家)，他们通过各类音乐训练来获得相关的技能，从而能够生产出各种各样被人们所喜爱的音乐作品，那么音乐家与非音乐家之间有何差异？是天生因素决定音乐家资质，还是后天训练造就了音乐家(Schellenberg & Lima, 2024)？这些问题在以往的研究中尚有争议。

音乐训练通常指的是通过系统性地学习和练习，以提高音乐技能和理解音乐的过程。音乐训练涵盖演奏乐器、歌唱、作曲、音乐理论等多个方面。中国义务教育课程包含音乐课，但训练时长与深度有限，缺乏系统性，且所有的适龄儿童都参与其中。因此，根据中国的现实情况，在本研究中需将音乐训练的操作性定义进行调整，即除了义务教育中的音乐课程外，参与音乐相关的全面系统的学习和训练，包括学习乐器、声乐、作曲、指挥等。

音乐训练除了对日常生活有积极作用之外，它对人的认知和情感发展也有积极作用。然而，音乐训练对大脑发展轨迹的塑造，尚无明确的证据和结论。音乐训练对认知能力的具体影响及机制仍需深入探讨。除此之外，音乐训练对个体情绪情感的影响也很大，音乐训练能够缓解个体的压力、消极情绪，但是音乐训练对音乐领域外情绪情感识别的影响尚无定论。厘清上述问题，有助于科学实施音乐训练，促进个体的认知和情感发展，使个体成长为更健康更完善的人。综上所述，本研究拟采用聚合交叉设计，通过行为实验、问卷量表以及 fMRI 技术对儿童进行追踪研究，旨在建立一个音乐训练对大脑的塑造过程的模型，为未来的音乐训练提供可靠的科学证据。

2. 研究现状与不足

2.1. 研究对象

既往研究通常将音乐训练等同于乐器训练(如钢琴、弦乐、打击乐等) (de Manzano & Ullén, 2018; Gleichmann et al., 2022; Norton et al., 2005; van Vugt et al., 2021; Yao et al., 2022)，而对声乐、创造、指挥等相关形式的探讨相对缺乏。鉴于此，为更全面地考察音乐训练的影响，本研究将接受上述各类音乐训练形式的个体均纳入研究范围。

2.2. 先天与后天的争论

关于音乐家与非音乐家的大脑结构差异源于先天遗传还是后天训练，目前学界尚无定论，存在多种竞争性假说。部分研究发现“音乐家大脑”的胼胝体前部的半球间连接模式与非音乐家有差异，这是先天的神经生物学基础(Rajan et al., 2019)。然而，相当一部分研究支持后天音乐训练导致大脑结构差异的观点，大脑结构的差异是因为神经具有可塑性，在进行音乐训练的过程中，相关的脑区被刺激激活，从而得到了更好的发展，并且大脑结构的差异会随着训练时长的增加而增大(Habibi et al., 2014, 2018; Schlaug et al., 2009)。当然，还有一些研究者认为“音乐家大脑”是先天和后天交互作用的产物(Olszewska et al., 2021; Vaquero et al., 2018)，有研究者尝试建立一个神经生物学模型以阐释其内在机制(Zuk & Gaab, 2018)。鉴于该问题的复杂性，在儿童发展早期开展纵向追踪研究，对于厘清先天与后天因素的各自贡献及其动态交互过程显得尤为必要。除此之外，音乐训练因其结构化、高参与度的特点，已成为探究人类学习过程中大脑神经可塑性机制的一个极佳方式(Tavor et al., 2020; Vaquero et al., 2018; Zuk & Gaab, 2018)，这将为我们深入揭示大脑发展的奥秘做出贡献。

2.3. 音乐训练对大脑结构和功能的影响

音乐训练通过调节神经遗传学、增强神经营养因子、改变荷尔蒙水平和减轻人类压力来诱导神经可塑性变化(Kunikullaya et al., 2025)，不仅会使大脑中某些脑区的结构发展改变，而且还会对大脑功能产生影响(Wang, 2022)，从而使受过音乐训练的个体和没有受过训练的个体产生不同的行为表现。本研究主要整合了音乐训练对个体认知能力的影响和作用，具体包括听觉、视觉、运动、执行功能、记忆、注意力、创造力、智力等方面。

在听觉方面，接受过音乐训练的个体，听觉区域的体积更大(Criscuolo et al., 2022)，弓状束右侧长段结构更开放(Vaquero et al., 2020)，由于在听觉脑干反应和听觉中潜伏期反应中，反应时更短，他们的听觉感知能力也更强(Choi & Cho, 2020)。音乐训练过程中，听觉技能会不断得到训练而提高(Banai & Ahissar, 2013; Hyde et al., 2009; Schlaug et al., 2005)，对听觉系统产生积极的影响(Badariya et al., 2023)。音乐训练能促进语音的基本听觉加工，包括对语音时长信息感知和语音频率信息感知两方面，进一步促进了语音编码，增强了语音运动表征(刘逸姝等，2022)，能促进语音分割能力的发展(François et al., 2013)，进而更好地编码听觉刺激(Barrett et al., 2013; Mandikal Vasuki et al., 2017)。并且“音乐家大脑”在聆听音乐的过程中，听觉系统的大脑激活更强(Criscuolo et al., 2022; Olszewska et al., 2021)，并且表现出更强的颞上回和脑岛的中心性(Bonetti et al., 2021)，脑干反应也更强烈(Skoe & Kraus, 2012)。此外，接受过音乐训练的人有更好的听觉模式识别、听觉记忆和听觉注意力(Altenmüller, 2023; Nina & Bharath, 2010)，发现音调变化的能力增强，听觉处理的成熟度加快(Habibi et al., 2016)。有抱负的音乐家在音程识别上表现得更好，网络强度和整体效率也强于业余音乐家(Papadaki et al., 2023)。

在视觉方面，受过音乐训练的个体在视觉任务中表现更佳，且 ERP 显示出的刺激激活反应更强(Mandikal Vasuki et al., 2017)，视觉空间能力有所提高(Schlaug et al., 2005)。

在感觉运动方面，音乐训练使得与音乐相关的运动技能提高(Hyde et al., 2009)，音乐家的感觉运动区域体积更大更活跃(Criscuolo et al., 2022; Gleichmann et al., 2022)。聆听音乐时，音乐家的运动控制区域激活更强(Olszewska et al., 2021)。进行器乐训练可以加速儿童感觉运动的成熟(Altenmüller, 2023)。

除了单独影响以上这些脑区，音乐训练还会影响它们之间的交互。比如，在听或者创作音乐的过程中，音乐家运动网络与听觉系统的连接更强(Olszewska et al., 2021)，主要中枢包括大脑和小脑感觉运动区域(Vinoo et al., 2017)；音乐训练可以使个体的左半球的听觉运动网络皮质的更大且更厚(de Manzano & Ullén, 2018)，增强听觉和运动脑区之间的信息整合(刘逸姝等，2022)，并且促进皮质－小脑网络的成熟

(Shenker et al., 2022)；接受音乐训练的儿童连接额叶上段、感觉段和运动段的交叉通路的胼胝体各向异性更高(Habibi et al., 2018)；音乐家的纹状体－枕骨－额叶－小脑网络连通性更高(van Vugt et al., 2021)。

2.4. 音乐训练对认知能力的影响

在执行功能方面，受过音乐训练的儿童在反应抑制(Chen et al., 2022)、执行控制(Benz et al., 2016)、抑制控制(Porflitt & Rosas-Díaz, 2019; Rodriguez-Gomez & Talero-Gutiérrez, 2022)、处理速度(Roden et al., 2014)、任务转换和双任务(Moradzadeh et al., 2015)等方面更有优势；音乐训练对认知灵活性的影响不同的研究结论不一致，部分研究者认为音乐训练可以提高个体的认知灵活性(Hao et al., 2023; Kiarostami et al., 2022)，部分研究者认为音乐训练对认知灵活性的影响不显著(Chen et al., 2022; Rodriguez-Gomez & Talero-Gutiérrez, 2022)。

在记忆方面，受过音乐训练儿童的工作记忆(Benet et al., 2022; Chen et al., 2022; Lee et al., 2007; Lippolis et al., 2022; Posedel et al., 2012; Ribeiro & Santos, 2012; Rodriguez-Gomez & Talero-Gutiérrez, 2022; Schmithorst & Holland, 2004; Yurgil et al., 2020)，特别是语音环路、视觉空间模板和中枢执行系统发展得更好(Nie et al., 2022; Porflitt & Rosas-Díaz, 2019; Roden et al., 2014)；音乐训练对视觉记忆、听觉记忆、言语工作记忆和长时记忆有利(Cheung et al., 2017; Degé et al., 2011; Roden et al., 2012; van Vugt et al., 2021)，并且能使运动记忆专业化(Gagnon & Nicoladis, 2021)；受过音乐训练的个体，在晚年对情景记忆和语义记忆的改善有利(Gooding et al., 2014)；音乐训练对记忆的影响和所选的实验材料有关，受过音乐训练的人对古典音乐的记忆水平更高，对流行音乐的记忆与未受过训练的无显著差异(Wilbiks & Hutchins, 2020)，受过音乐训练的人提取词汇音调信息的工作记忆更强(Lu & Greenwald, 2016)。当然，也有研究得到了不同的结论，认为音乐家和非音乐家在工作记忆任务上没有显著差异，但是能使其在工作记忆中有更大的跨模态和多模态整合(Gagnon & Nicoladis, 2021)；音乐训练没能改善儿童的视觉记忆(Ho et al., 2003; Roden et al., 2012)。

在注意力方面，受过音乐训练的儿童在视觉注意力(Roden et al., 2014)、注意力抑制(Chen et al., 2022)、注意力转换和分配(Moradzadeh et al., 2015; Porflitt & Rosas-Díaz, 2019)和注意力的保持(Wang et al., 2015)上表现更佳；音乐训练还能改善胎儿酒精谱系障碍儿童的注意力神经指标(Gleichmann et al., 2022)；在选择性注意上没有显著差异(Strait et al., 2015; Welch, 2020)。

还有研究发现，接受过音乐训练的个体表现出更强的学习能力(Cheung et al., 2017)；音乐训练对个体的创造力发展有利(Benz et al., 2016)；音乐训练与流体智力和一般智力的提高相关(Lippolis et al., 2022; Porflitt & Rosas-Díaz, 2019; Roden et al., 2014)；长期音乐训练引起的大脑变化，还有可能在高龄时减少认知能力的下降(Hanna-Pladdy & Menken, 2020)。

2.5. 音乐训练对情绪情感的影响

在情绪调节方面，音乐训练不仅能够缓解压力，降低焦虑、抑郁这两种消极情绪的水平(Che et al., 2022)，而且还是有效的防止适应不良的保护因素(Miranda, 2022)。当研究关注聆听音乐的动机时，未受过音乐训练的人更倾向于使用聆听音乐来调节情绪，而受过音乐训练的个体聆听音乐的动机出于认知原因(Laura et al., 2014)。但是在两者使用音乐调节情绪时，使用情绪调节策略的相似性高于差异性(Miranda, 2022)。

在情绪识别方面，以往研究中使用的研究材料与音乐相关时，部分研究结果表明音乐训练可以提升个体的同理心(Kiarostami et al., 2022)，接受过音乐训练的个体有更优秀的情绪识别、情感感受能力(Di Mauro et al., 2018; Good et al., 2017)，且情绪识别的模式更具有一致性(Battcock & Schutz, 2022; Emese,

2013)。但部分研究者认为，音乐训练无法预测情绪识别的能力，预测情绪识别能力的是情商分数(Trimmer & Cuddy, 2008)。以往研究中使用的研究材料与音乐无关时，没有证据表明音乐训练能够提升个体的情绪识别能力(Schellenberg & Lima, 2024; Schellenberg & Mankarious, 2012)。还有研究者使用不同感觉通道的情绪情感材料进行研究，在使用听觉通道的刺激材料，接受过音乐训练的个体在情绪识别上表现出优势(Farmer et al., 2020; Good et al., 2017; Martins et al., 2021)；在使用视觉通道的刺激材料时，接受过音乐训练与没接受过音乐训练个体的情绪识别能力没有显著差异(Che et al., 2022; Farmer et al., 2020; Martins et al., 2021)，但是接受过音乐训练的个体在进行情绪判断时更注重视觉表演(Di Mauro et al., 2018)；在使用视听刺激材料时，不同的研究结果不一致(Che et al., 2022; Farmer et al., 2020)。

研究者在对音乐参与进行研究时发现，个体差异对音乐训练和非音乐能力之间关联的影响巨大，是一个不可忽视的因素(Corrigall et al., 2013)，且音乐参与对个体幸福感有积极作用(Leung & Cheung, 2020)。

2.6. 以往研究结果不一致的原因

综上所述，音乐训练在个体成长的过程中能发挥诸多积极作用，但既往研究在某些具体问题上的结论仍存有异质性。

首先，研究方法学的差异是导致结论不一致的重要原因。不同研究采用的测量技术各异，例如，部分研究依赖功能性磁共振成像(fMRI)、脑电图(EEG)、事件相关电位(ERP)等脑成像技术，而另一部分研究则依赖于行为学实验或心理学量表测量。一般而言，脑成像技术能够更为直接地观测行为背后的神经生理基础，但通常因成本和技术复杂度而样本量较小，结果可能受个体差异影响较大，统计效力有时不足。行为实验与量表则通过行为输出和主观报告来间接推断神经可塑性的行为表现，通常能获取更大样本，具有更好的群体代表性，但其测量指标与特定大脑改变之间的因果链条较长，推论时需要审慎。此外，行为量表还可能受到社会赞许性等主观报告偏差的影响。这两种路径各有优劣，无法完全规避的固有误差来源。

其次，实验任务所采用的材料属性不同也可能导致结论分歧。一部分研究使用音乐材料(如音高或节奏辨别)，主要评估的是音乐领域内特定的感觉、认知与情绪情感能力；而另一部分研究则采用非音乐领域或一般性的任务材料，旨在探究音乐训练是否能够产生远迁移效应。

再次，被试样本的异质性也是导致研究结论不一致的重要因素。现有研究涵盖了从儿童到老年人等不同年龄阶段的个体，而个体在不同发展阶段的感知觉与认知能力本身存在显著差异。研究的被试还有音乐训练时长、强度、规范性的区别，部分研究直接选取了音乐家和非音乐家作对比，部分研究选择接受音乐训练时长不一的儿童作为被试。鉴于音乐训练对神经可塑性的影响既取决于训练累积程度(如训练强度与持续时间) (Schlaug et al., 2005, 2009; Zuk & Gaab, 2018)，也与训练开始的年龄(即关键期)密切相关(Schlaug et al., 2009; Shenker et al., 2022)，因此不同研究的发现不一致，是可预期的。

因此，未来的研究有必要将多种研究方法结合起来，将行为测量、神经成像技术(如 fMRI，EEG)与主观报告相结合，得出更加科学全面的结论。未来的研究还需要对音乐领域内特定能力和一般能力的研究加以区分，研究音乐训练对一般能力的影响更具有普适性和参考价值，有助于了解音乐对个体的发展的积极作用，对人类的发展进步的作用。最后，在未来研究中，应依据具体研究问题选择被试样本，超越简单的音乐家－非音乐家二分法。尤为重要的是，应采用纵向追踪设计，从儿童未接受训练伊始，长期追踪其发展轨迹，从而描绘音乐训练影响神经可塑性与认知发展的完整路径模型。此类研究有望识别出音乐训练促进认知发展的关键敏感期，为科学地规划音乐教育干预的时机提供关键证据，最终优化音乐训练对儿童发展的积极影响。

3. 研究构想

基于现有研究的不足，本研究提出一个合理的研究计划，以回应以往尚未解决的关键问题。

本研究计划采用聚合交叉设计，通过 fMRI 技术，结合一般认知能力测试、工作记忆任务、双任务范式、语音情绪识别任务、图像情绪识别任务、视听情绪识别任务，以及托兰斯创造性思维测验(Torrance Tests of Creative Thinking, TTCT)、韦氏儿童智力量表第四版(WISC-IV)对 9~15 岁的儿童(包括接受过音乐训练、将要接受音乐训练、没接受音乐训练三种类型)进行 3 年的追踪研究。旨在考察音乐训练过程对儿童大脑的塑造作用，即接受音乐训练对儿童大脑结构的影响，如检验接受过音乐训练儿童的听觉、视觉、运动、记忆、注意脑区是否得到了更好地发展，与前人的研究结果是否一致。探索受过音乐训练的儿童的创造力、智力水平是否高于同龄没有接受音乐训练的儿童，音乐训练的儿童的认知发展速度是否比同龄没有接受音乐训练的儿童更快。并建立一个以年龄和接受音乐训练时长为参考系的模型，刻画在儿童成长发育过程中，音乐训练对大脑结构和认知发展轨迹的影响。在情绪识别任务中，分别采用音乐材料和非音乐材料，以检验音乐训练是否有利于音乐领域的情绪识别，并且探究音乐训练对情绪识别的促进能否在非音乐领域发挥作用。采用不同感觉通道的情绪识别任务，以探究不同感觉通道在音乐训练对情绪识别影响过程中的调节作用。

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