

童年虐待影响攻击行为和抑郁的共同性和特异性神经机制

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摘 要

尽管童年虐待被广泛认为是各种内化和外化心理障碍的跨诊断风险因素,但其背后的神经机制尚不清楚。我们猜测研究结果不一致的原因可能是童年虐待对精神病理状况的影响涉及共同和特定神经通路。本研究旨在阐明童年虐待影响抑郁和攻击行为的共同和特定的神经通路。首先,我们对静息态功能磁共振成像数据进行网络基础统计(NBS)分析,以识别与抑郁和攻击行为相关的功能连接模式。然后,进行中介分析,以评估这些功能连接模式在童年虐待与攻击、抑郁之间的关系中的作用。结果表明,默认网络内的功能连接,以及扣带盖网络和背侧注意网络之间的功能连接介导了童年虐待与攻击行为之间的关系,而奖励系统内的功能连接以及扣带盖网络与奖励系统之间的功能连接介导了童年虐待与抑郁之间的联系。因此,我们推测,控制网络可能是解释童年虐待后果的跨诊断神经机制,而注意网络和奖励网络可能分别作为将童年虐待与抑郁和攻击行为联系起来的特定神经机制。

关键词

童年虐待, 抑郁, 攻击行为, 控制系统, 注意网络, 奖励网络

Common and Distinct Mechanisms Underlying the Influence of Childhood Maltreatment on Depression and Aggressive Behavior

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Abstract

Although childhood maltreatment (CM) is widely recognized as a transdiagnostic risk factor for various internalizing and externalizing psychological disorders, the neural mechanisms underlying this association remain unclear. The potential reasons for the inconsistent findings may be attributed to the involvement of both common and specific neural pathways that mediate the influence of CM on the emergence of psychopathological conditions. This study aimed to delineate both the common and distinct neural pathways linking CM to depression and aggression. First, we employed Network-Based Statistics (NBS) on resting-state functional magnetic resonance imaging (fMRI) data to identify functional connectivity (FC) patterns associated with depression and aggression. Mediation analyses were then conducted to assess the role of these FC patterns in the relationship between CM and each outcome. The results demonstrated that FC within the default mode network (DMN) and between the cingulo-opercular network (CON) and dorsal attention network (DAN) mediated the association between CM and aggression, whereas FC within the reward system and between the CON and the reward system mediated the link between CM and depression. We speculate that the control system may serve as a transdiagnostic mechanism accounting for the sequelae of CM, and the attention network and the reward network may act as specific mechanisms linking CM to depression and aggression, respectively.

Keywords

Childhood Maltreatment, Depression, Aggressive Behavior, Control System, Attention Network, Reward System

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1. 引言

童年虐待(Childhood Maltreatment, CM)是指个体在 18 岁以前遭受的各种形式的虐待和忽视,包括身体、性、情感虐待以及身体、情感忽视(Bernstein et al., 1998; Trickett & McBride, 1995)。童年虐待在全球范围内既普遍又严重,构成了重大的全球道德和公共卫生问题(Gilbert et al., 2009; Bellis et al., 2014)。全球约 10 亿儿童每年都会遭受情感虐待、身体虐待、性虐待、情感忽视和身体忽视(WHO, 2022)。一项系统评价显示,中国儿童遭受身体虐待、情感虐待、性虐待和情感忽视的患病率分别为 26.6%、19.6%、8.7% 和 26% (Fang et al., 2015)。童年虐待被证明是影响终身内化和外化问题的重大风险因素,包括抑郁(Frodl et al., 2017)、焦虑(Gardner et al., 2019)、攻击行为(Lee & Hoaken, 2007)和自伤行为(Liu et al., 2018)。

鉴于童年虐待与精神病理问题之间的强关联,大量研究试图调查童年虐待的神经生物学后果。研究发现,多个脑系统参与其中,包括威胁处理(杏仁核)(Hein et al., 2020; McCrory et al., 2013)、奖励处理(纹状体)(Dennison et al., 2016; Hanson et al., 2015a)、执行控制(背侧前额叶皮质, DLPFC, 背侧前扣带回皮质, dACC)(Zhong et al., 2020; Yip et al., 2019)和自传体记忆(海马体, 后扣带回, PCC)(Puetz et al., 2023; McCrory et al., 2017)。此外,研究还表明,这些脑区的异常不仅是童年虐待的神经后遗症,也是早期生活逆境暴露后精神病理症状发展的机制(Barch et al., 2018; Kasparek et al., 2020; Letkiewicz et al., 2021)。例如, Bounoua 等人发现了支持皮质厚度在额叶区域,尤其是在左侧眶额叶皮层周围,可能作为连接童年创伤和随后攻击行为风险增加的中间机制的证据(Bounoua et al., 2020)。此外,童年虐待可能会破坏额叶

与奖励系统之间的正常相互作用,导致冲动或成瘾行为(Barch et al., 2018; Koob & Schulkin, 2019; Kasperek et al., 2020)。与健康的同龄人相比,接触不良事件的儿童被发现杏仁核和海马体体积减少,这些减少与累积压力暴露增加和行为问题增加相关(Hanson et al., 2015b)。

与此同时,大量神经影像学研究阐明了童年虐待对抑郁影响的神经机制(McLaughlin et al., 2010; Zhu et al., 2017; Yang et al., 2017)。关键机制包括奖励处理系统、威胁处理系统、扣带盖网络和默认网络(Hanson et al., 2015a; Yu et al., 2019; Rakesh et al., 2021; Weissman et al., 2020)。Hanson 等人证明了奖励处理系统的异常发育与童年虐待后抑郁风险增加相关(Hanson et al., 2015a)。Nagy 等人发现,有虐待史的抑郁症患者在社会情感处理过程中表现出前额叶-纹状体通路的功能改变(Nagy et al., 2021)。Rakesh 等人进行的一项纵向研究检查了连接增加,特别是在默认网络(the Default Mode Network, DMN)、额顶叶网络(the Fronto-Parietal Network, FPN)、背侧注意网络(the Dorsal Attention Network, DAN)和显著性网络(the Salience Network, SAN)之间,在介导童年虐待与抑郁之间的关系中的作用(Rakesh et al., 2021)。Mao 等人认为,背外侧前额叶皮层(the dorsolateral Prefrontal Cortex, dlPFC)和杏仁核之间的功能连接介导了童年虐待与抑郁之间的联系(Mao et al., 2023)。此外,威胁系统(海马体、杏仁核)关键节点的灰质体积被确定为童年创伤和抑郁之间关系的中间机制(Weissman et al., 2020)。

先前的研究强调,童年虐待对攻击行为和抑郁的影响的潜在机制涉及多个系统,包括奖励处理系统、威胁处理系统和执行控制系统。然而,这些发现令人困惑。一些研究将威胁系统异常确定为与童年虐待相关的内化问题的机制(Čermaková et al., 2022; Gorka et al., 2014),而其他研究则关注奖励系统异常作为与童年虐待相关的外化问题的机制(Kasperek et al., 2020)。此外,另一项研究还表明,早期不良经历后奖励处理异常与抑郁风险增加相关(Nagy et al., 2021)。同时,威胁刺激的过度活跃性假说的提出也可能促进接触童年创伤个体的攻击行为(Hanson et al., 2015b; Peverill et al., 2019)。此外,一些研究还检查了内化和外化问题中普遍存在的认知处理特征(Heleniak et al., 2016; Jenness et al., 2021; Santens et al., 2020)。总的来说,这些调查尚未就童年虐待与攻击行为和抑郁之间联系的机制得出一致的结论。这种歧义可能源于两个主要因素。一个因素是童年虐待对攻击行为和抑郁的影响可能受到共同和特定潜在机制的影响。另一个因素是这些研究的样本量有限,可能限制了结果的普适性。本研究旨在利用大量静息态 fMRI 数据阐明童年虐待影响抑郁和攻击行为的共同和特异的神经机制。首先,我们使用网络基础统计(Network-Based Statistics, NBS)识别与攻击行为和抑郁相关的神经标志物。然后,进行中介模型分析,以评估这些功能连接模式是否可以解释童年虐待与攻击行为和抑郁之间的关系。最后,对这些功能连接模式进行比较分析,以阐明童年虐待与攻击行为和抑郁之间的共同和不同机制。

2. 方法

2.1. 参与者

招募大学生被试完成了 fMRI 扫描,并使用行为问卷评估,如童年虐待、攻击行为和抑郁。排除了头部运动过多(平均 $fd > 0.2$)和没有行为数据的参与者。具体来说,342 名健康本科生(平均年龄 20.08 ± 1.39 岁;范围:17~26 岁;257 名女性和 85 名男性)完成了 Buss Perry 攻击问卷(Buss-Perry Aggression Questionnaire, BPAQ)和 fMRI 扫描,其中 254 名(平均年龄 19.94 ± 1.44 岁;范围:17~26 岁;187 名女性和 67 名男性)具有儿童创伤问卷简表(CTQ-SF)。518 名健康本科生(平均年龄 19.32 ± 1.46 岁;范围:16~26 岁;372 名女性和 146 名男性)完成了贝克抑郁自评量表-II(Beck Depression Inventory-II, BDI-II)、儿童创伤问卷简表和 fMRI 扫描。所有参与者均没有精神病理症状或神经疾病,并在实验前提供了书面知情同意。

2.2. 行为测量

儿童创伤问卷简表。它是一种广泛使用的回顾性自我报告工具,旨在评估各种类型的童年逆境。这

包括情感、身体和性虐待，以及情感和身体忽视。参与者被指示以 5 点李克特量表回答 28 个问题，从“从不”到“总是”(Jiang et al., 2018)。CTQ-SF 在先前的研究中显示出很强的可靠性和有效性，本研究中该量表的克隆巴赫 α 系数为 0.824，表明具有良好的结构效度。

Buss-Perry 攻击问卷。参与者完成了一份自我报告的攻击行为测量，包括 29 个项目，评分范围为 1~5 分，从“极不符合我”到“极符合我”(Buss & Perry, 1992)。BPAQ 由四个分量表组成：身体攻击、言语攻击、愤怒和敌意。先前的研究表明 BPAQ 具有良好的内部一致性和重测信度。本研究中该量表的克隆巴赫 α 系数为 0.93。

贝克抑郁自评量表-II。它是一种 21 个项目的自我报告问卷，用于评估过去两周内经历的抑郁症状的严重程度。BDI-II 中的每个项目都使用 4 点李克特量表进行评分，范围从 0 到 3。累积分数随后分为以下几类：0~13 表示没有抑郁，14~19 表示轻度抑郁，20~28 表示中度抑郁，29~63 表示重度抑郁(Beck et al., 1996)。本研究中使用了贝克抑郁自评量表-II 的中文版，该量表的克隆巴赫 α 系数为 0.86，表明在测量抑郁的潜在维度方面具有高度的内部一致性。

2.3. fMRI 数据采集和分析

2.3.1. 图像采集和预处理

静息态 fMRI 数据使用 Siemens 3T Trio 扫描仪(Siemens Medical Systems, Erlangen, Germany)获得。所有参与者都被告知闭上眼睛放松，但不要睡着，然后进行扫描。使用梯度回波类型回波平面成像(GRE-EPI)序列获得静息态 fMRI 数据：重复时间(TR)=2000 毫秒，回波时间(TE)=30 毫秒，翻转角(FA)=90°，视野(FOV)=220×220 mm²，切片数=32，厚度=3 毫米，切片间隙=1 毫米，体素大小=3.4×3.4×4 mm³。使用磁化准备快速采集梯度回波(MPRAGE)序列获得高分辨率三维 T1 加权结构图像：TR=1900 毫秒，TE=2.52 毫秒，FA=9°，切片数=176，FOV=256×256 mm²，厚度=1 毫米，体素大小=1×1×1 mm³。所有静息态 fMRI 数据都使用数据预处理和分析脑成像工具箱(the Data Processing & Analysis of Brain Imaging toolbox, DPABI, Version 3.1)(Yan et al., 2016)进行预处理，这是一个强大的工具，建立在稳健的统计参数映射(the Statistical Parametric Mapping, SPM; Version 8.0)框架上，并在通用的 MATLAB 平台(Version 18a)上执行。这个全面的工作流程包括几个关键步骤，旨在优化数据完整性并促进后续的功能连接分析：去除前 10 个图像、时间校正、配准、空间标准化、干扰信号回归、数据清洗、空间平滑和带通滤波。

2.3.2. 功能连接估计

数据预处理后，使用图论网络分析(GRETNA)工具箱(Wang et al., 2015)建立全面的脑功能连接(Functional Connectivity, FC)。Power 等人(2013)定义了一个包含 264 个潜在功能区域的模板，细分为 14 个网络。排除五个网络——听觉、手感觉、口感觉、视觉和不确定网络——剩下九个网络。这些包括额顶叶网络、扣带回网络、突显网络、背侧注意网络、腹侧注意网络、默认网络、皮层下网络、记忆检索网络和小脑网络，共包含 157 个节点。这些节点和网络随后被纳入研究。提取每个感兴趣区域(ROI)的时间序列，并计算每对 ROI 之间的皮尔逊相关系数来表示边。相关系数通过 Fisher 方程转换为 z 值(Baltosser, 1996)。尽管网络分析中可能包含负相关，但由于对负相关解释的固有歧义(Chai et al., 2012; Murphy et al., 2009)，数据矩阵中省略了负 z 值。每个参与者的最终数据矩阵是一个 157×157 的 z 矩阵，对角线和负值标准化为零。

2.3.3. 与攻击行为和抑郁相关的网络基础统计

使用 NBS 工具箱(version 1.2) (<https://www.nitrc.org/projects/nbs/>)获得与攻击行为和抑郁相关的不同

脑功能连接。这些模式显著预测了参与者的攻击行为和抑郁的方差(Zalesky et al., 2010)。此过程提供了增强的能力，以确定与感兴趣的协变量相关联的超阈值边链接形成的脑模式之间的连接。在这种分析方法中，攻击行为和抑郁被指定为感兴趣的变量，而年龄、性别和头部运动值被纳入作为协变量。首先，我们对全脑网络的边进行 t 检验，以评估 FC 强度与攻击行为/抑郁评分之间的关系，并将选择的 t 阈值下存活的边的 t 值存储起来，构建 t 矩阵。接下来，通过超过 5000 次排列生成了一个随机空矩阵，最大模式大小超过选择的阈值。将最大模式大小大于经验模式大小的排列数标准化为排列总数，以估计 p 值。本研究将显著性水平设置为 0.05。分析中最初使用 3.1 作为 t 阈值。结果形成的连接脑模式，这些连接模式与个人攻击行为和抑郁的变异性显著相关，被定义为后续分析中阈值个体 FC 的 mask。

2.4. 统计分析

2.4.1. 人口统计学和相关性分析

所有相关性分析都使用 SPSS 26.0 软件(IBM Corp, 2019)完成。首先，本研究确定了与攻击行为相关的脑 FC 强度与童年虐待评分和攻击行为评分之间的关系。通过 NBS 工具箱获得了与攻击行为相关的 mask (t 矩阵)。因此，每个参与者的矩阵通过相同的边具有相同的模式，这些边具有 FC 值和零边。然后，使用 Pearson 相关性来计算每个参与者的童年虐待评分与攻击行为评分和脑 FC 强度之间的关系。

此外，本研究还确定了与抑郁相关的脑 FC 强度与童年虐待评分和抑郁评分之间的关系。使用从 NBS 工具箱获得的脑掩模(t 矩阵)，为每个参与者计算了与抑郁评分相关的脑 FC 强度值。然后，计算童年虐待评分与抑郁评分和脑 FC 强度之间的相关性。

2.4.2. 中介分析

为了更全面地调查静息态 FC 在童年虐待与攻击行为之间关系中的潜在中介作用，使用专门为 SPSS 设计的 PROCESS 宏(Preacher & Hayes, 2008)进行了中介分析。具体来说，使用 PROCESS 宏中的模型 4 进行分析。在该模型中，我们使用童年虐待作为自变量，与攻击相关的 FC 作为中介变量，攻击行为作为因变量。使用 5000 次迭代的自举方法来评估中介效应的显著性。如果 95%置信区间(CI)不包含零，则中介效应显著。此外，为了检验另一个假设，即童年虐待与抑郁之间的关系可以通过静息态 FC 介导，还进行了另一个中介分析，其中童年虐待作为自变量，与抑郁相关的 FC 作为中介变量，抑郁作为因变量。

3. 结果

3.1. 童年虐待与攻击行为和抑郁的关系

我们计算了童年虐待评分与攻击行为/抑郁评分之间的关系。这些相关性的结果如表 1 所示。在 P 值 < 0.05 (双尾)的情况下确定统计显著性。在此阶段，没有排除任何参与者。以上计算使用 SPSS 26.0 完成。我们的发现表明，CM 评分与攻击行为评分和抑郁评分之间存在显著相关性。

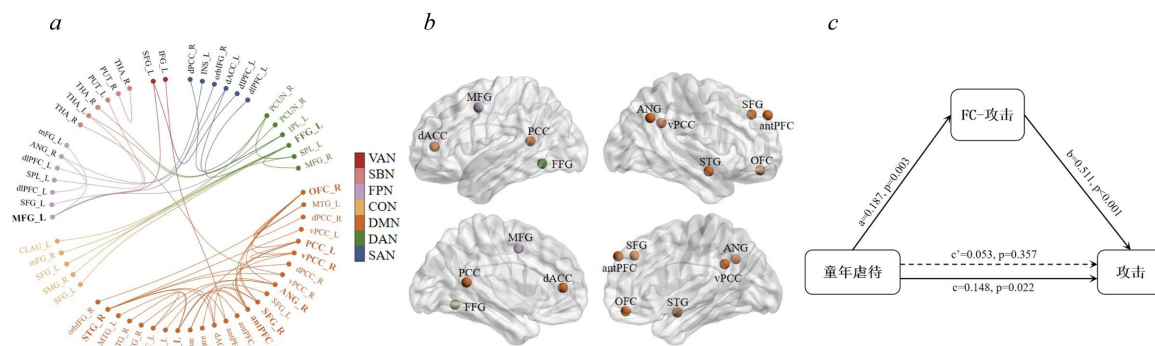
Table 1. The mean and standard deviation of the variables
表 1. 变量的平均数和标准差

	平均值	标准差	童年虐待	攻击
童年虐待	38.91	8.82	-	-
攻击	55.4	17.06	0.144*	-
抑郁	7.41	6.64	0.194**	0.241**

* $p < 0.05$; ** $p < 0.01$.

3.2. NBS 结果

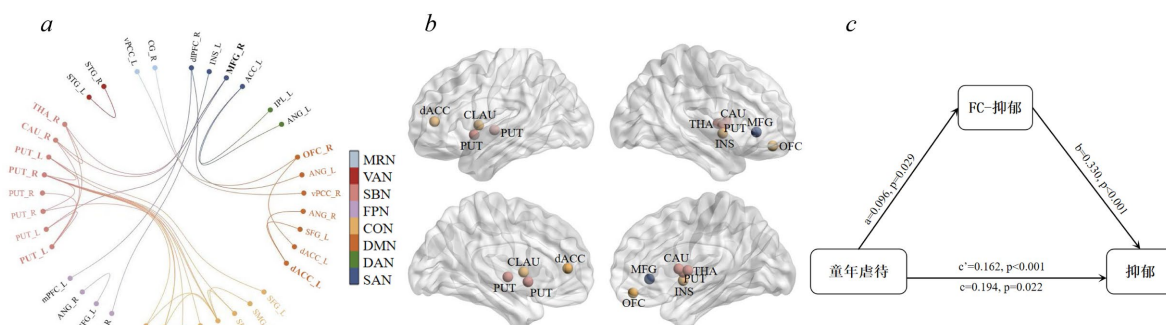
为了区分与童年虐待相关的攻击行为和抑郁的脑 FC 模式的组成部分, 我们首先使用 NBS 识别了与攻击行为和抑郁相关, 显著预测攻击行为和抑郁的脑 FC。接下来, 我们计算了每个参与者的 FC 强度, 并使用 Pearson 相关性来评估脑 FC 强度与童年虐待评分之间的关系。



PCC = 后扣带回皮层; INS = 脑岛; IFG = 额下回; ACC = 前扣带回皮层; PFC = 前额皮层; PCUN = 楔前叶; IPL = 顶叶下部; FFG = 梭状回; SPL = 顶叶上部; MFG = 额中回; OFC = 眶额叶; MTG = 颞中回; ANG = 角回; SFG = 额上回; STG = 颞上回; SMG = 缘上回; mFG = 额叶内侧; CLA = 屏状体; THA = 丘脑; PUT = 壳核; SAN = 突显网络; DAN = 背侧注意网络; DMN = 默认网络; CON = 扣带盖网络; FPN = 额顶网络; SBN = 皮层下网络; VAN = 腹侧注意网络。

Figure 1. (a) Visualization of all edges related to aggression (b) The perspectives of the top ten nodes related to aggression. (c) Mediating effects of the brain FC related to aggression on the relationship between CM and aggression

图 1. (a)与攻击行为有关的所有功能连接的可视化。(b)与攻击行为有关的前十个节点的视角。(c)与攻击有关的大脑功能连接对童年虐待与攻击之间的中介效应



PFC = 前额叶皮质; INS = 脑岛; MFG = 额中回; ACC = 前扣带回皮层; IPL = 顶叶下部; ANG = 角回; OFC = 眶额叶; PCC = 后扣带回皮层; SFG = 额上回; SMG = 缘上回; CLA = 屏状体; PUT = 壳核; CAU = 尾状核; THA = 丘脑; STG = 颞上回; CG = 扣带回; SAN = 突显网络; DAN = 背侧注意网络; DMN = 默认网络; CON = 扣带回网络; FPN = 额顶网络; SBN = 皮层下网络; VAN = 腹侧注意网络; MRN = 记忆检索网络。

Figure 2. (a) Visualization of all edges related to depression. (b) The perspectives of the top ten nodes related to depression. (c) Mediating effects of the brain FC related to depression on the relationship between CM and depression

图 2. (a)与抑郁相关的所有功能连接的可视化。(b)与抑郁相关的前十个节点的视角。(c)与抑郁相关的大脑功能连接对童年虐待与抑郁之间关系的中介效应

结果表明, 有 57 个节点和 56 个边与攻击行为相关。我们确定了与攻击行为相关的神经解剖学特征。

图 1(a)显示了所有与攻击行为相关的 FC 的可视化。特别是, 我们发现 12 个 FC 强度增强与童年虐待评分呈正相关。具体而言, FC (右侧楔前叶 - 右侧缘上回) ($r=0.125, p<0.05$)、FC (右侧楔前叶 - 左侧背侧

前扣带回皮层) ($r = 0.168, p < 0.01$)与童年虐待评分呈正相关; FC (右侧颞上回 - 右侧/左侧腹侧后扣带回皮层) ($r = 0.197, 0.125, p < 0.01$)、FC (右侧颞上回 - 背侧后扣带回皮层) ($r = 0.171, p < 0.01$)、FC (右侧颞上回 - 右侧背外侧前额叶皮层) ($r = 0.129, p < 0.05$)和 FC (右侧颞上回 - 左侧背侧前扣带回) ($r = 0.127, p < 0.05$)与童年虐待评分呈正相关; FC (左侧背侧前额叶 - 与左侧额上回) ($r = 0.128, p < 0.05$)、FC (侧背侧前额叶 - 右侧颞中回) ($r = 0.163, p < 0.01$)与童年虐待评分呈正相关; 童年虐待评分还与 FC (右侧背侧前额叶 - 左侧额下回) ($r = 0.128, p < 0.05$)、FC (左侧额上回 - 左侧枕下叶) ($r = 0.126, p < 0.05$)和 FC (左侧顶上回 - 左侧丘脑) ($r = 0.168, p < 0.01$)的 FC 呈显著正相关。此外, 我们将通过 NBS 获得的攻击行为掩模输入 GREYNA 平台, 以计算掩模中所有节点的度中心性数量。图 1(b)显示了与攻击行为相关的度中心性排名前十的节点的透视图, 表 2 显示了攻击行为节点中贡献值最高的前十名节点。这些连接数量最多的区域是眶额叶皮层(OFC)、前额叶皮层(antPFC)、颞上回(STG)、后扣带回(PCC)、背侧前扣带回(dACC)、梭状回(FFG)、角回、额上回(SFG)、额中回(MFG)。

接下来, 结果表明有 37 个节点和 35 个边与抑郁相关。与抑郁相关的所有边集都与童年虐待评分显著相关。我们以同样的方式确定了与抑郁相关的神经解剖学特征。图 2(a)显示了与抑郁相关的所有边的可视化。其中, 我们发现童年虐待评分与左侧 ACC 和左侧角回之间的 FC (左侧 ACC - 左侧角回) ($r = 0.087, p < 0.05$)呈显著正相关。然后, 我们使用相同的方法计算掩模中所有节点的度中心性数量。图 2(b)显示了与抑郁相关的度中心性排名前十的节点的透视图, 表 3 显示了抑郁相关节点中贡献值最高的前十的节点。这十个节点集中在连接数量最多的四个区域, 即壳核、尾状核、岛叶、屏状核、额中回(MFG)、丘脑、眶额叶(OFC)和背侧前额叶(dACC)。

此外, 表 4 显示了攻击行为/抑郁内部和网络之间的边数。

Table 2. The top ten nodes related to aggression

表 2. 与攻击有关的前十节点

节点序号	节点名称	所属网络	X	Y	Z
76	OFC_R	DMN	8.36	47.59	-15.18
102	antPFC	DMN	12.73	54.87	38.19
123	STG_R	DMN	52.16	-2.43	-16.4
91	PCC_L	DMN	-2.94	-48.79	12.87
111	dACC_L	DMN	-11.06	44.62	7.61
262	FFG_L	DAN	-42.26	-60.12	-8.85
96	ANG_R	DMN	52.04	-59.37	35.52
101	SFG_R	DMN	22.11	39.21	38.9
174	MFG_L	FPN	-43.93	1.8	45.7
92	vPCC_R	DMN	7.94	-48.37	30.57

OFC = 眶额叶; antPFC = 前额叶皮层; STG = 颞上回; PCC = 扣带回后皮层; dACC = 背侧前扣带回皮层; FFG = 梭状回; ANG = 角回; SFG = 额上回; MFG = 额中回; vPCC = 腹侧后扣带回皮层; R, 右; L, 左; DMN = 默认网络; DAN = 背侧注意网络; FPN = 额顶网络。

Table 3. The top ten nodes related to depression

表 3. 与抑郁相关的前十节点

节点序号	节点名称	所属网络	X	Y	Z
231	PUT_R	SBN	28.52	0.82	4.01
52	INS_R	CON	36.73	0.78	-3.57

续表

227	PUT_L	SBN	-21.97	7.48	-4.78
57	CLAU_L	CON	-34.37	3.29	4.19
210	MFG_R	SAN	36.89	32.35	-2.24
232	PUT_L	SBN	-31.38	-11.48	-0.3
233	CAU_R	SBN	14.98	4.94	7.24
234	THA_R	SBN	8.62	-3.57	5.76
76	OFC_R	DMN	8.36	47.59	-15.18
111	dACC_L	DMN	-11.06	44.62	7.61

PUT = 壳核; INS = 脑岛; CLAU = 屏状体; MFG = 额中回; CAU = 尾状核; THA = 丘脑; OFC = 眶额叶皮层; dACC = 背侧前扣带回; R, 右; L, 左; SBN = 皮层下网络; CON = 扣带回网络; SAN = 突显网络; DMN = 默认网络。

Table 4. The edges number of aggression and depression within and between networks
表 4. 与攻击、抑郁相关的网络内和网络间的边缘数

攻击相关的功能连接	边数	抑郁相关的功能连接	边数
DMN-DMN	31	CON-SBN	9
CON-DAN	5	SBN-SBN	7
FPN-SAN	3	CON-CON	4
DAN-SAN	3	DMN-DMN	3
FPN-FPN	2	SAN-SBN	3
FPN-SBN	2	DMN-MRN	2
DAN-DAN	2	FPN-SAN	2
DAN-SBN	2	SAN-DAN	2
DMN-SBN	1	DMN-SAN	1
DMN-VAN	1	FPN-FPN	1
FPN-DAN	1	VAN-VAN	1
VAN-FPN	1		
VAN-SAN	1		
SBN-SBN	1		

SAN = 突显网络; DAN = 背侧注意网络; DMN = 默认网络; CON = 扣带回网络; FPN = 额顶网络; SBN = 皮层下网络; VAN = 腹侧注意网络; MRN = 记忆检索网络。

3.3. 功能连接在童年虐待与攻击行为之间的中介作用

为了研究童年虐待是否可以根据不同的脑 FC 与攻击行为和抑郁相关。使用中介分析，我们将童年虐待作为自变量，与攻击行为相关的脑 FC 作为中介变量，攻击行为作为因变量来建立中介模型。如图 1(c) 所示，中介分析表明，与攻击行为相关的脑 FC 介导了童年虐待与攻击行为之间的关系[$\beta = 0.096$, 95%置信区间(CI) = 0.0314 – 0.0392, $p < 0.05$]。

3.4. 功能连接在童年虐待与抑郁之间的中介作用

我们还使用中介模型检验了童年虐待与抑郁之间的中介作用，其中童年虐待作为自变量，抑郁作为

因变量, 与抑郁相关的脑 FC 作为中介变量。如图 2(c)所示, 中介分析表明, 与抑郁相关的脑 FC 介导了童年虐待与抑郁之间的关系[$\beta = 0.0316$, 95%置信区间(CI) = 0.0039 - 0.0606, $p < 0.05$]。

4. 讨论

这是第一个尝试利用大量静息态 fMRI 数据阐明童年虐待对攻击行为和抑郁影响共同和特异性神经机制的研究。首先, 我们使用 NBS 方法获取与攻击行为和抑郁分别相关的 FC。然后, 进行中介分析, 以探讨这些 FC 模式在童年虐待与攻击行为/抑郁之间关系中的中介作用。结果表明, 与攻击行为相关的 FC 模式主要包含 DMN 内部的连接、CON-DAN 间的连接, 而与抑郁相关的 FC 模式主要涉及奖励系统内部的连接、CON 内部、DMN 内部以及 CON-奖励系统之间的连接。进一步地比较发现, CON 和 DMN 在童年虐待与抑郁/攻击行为之间的关系中起着同样重要的作用。此外, 注意网络是童年虐待与攻击行为之间独特的机制, 而奖励系统仅在童年虐待与抑郁的相关性中起作用。

4.1. 童年虐待与攻击行为/抑郁的共同机制

在遭受过童年虐待的个体中, 无论是表现出攻击行为的个体还是具有抑郁症状的个体, 其 DMN 内部和 CON-其他区域的 FC 都一致表现出显著的异常变化。CON 是构成执行控制网络的关键组成部分, 负责执行诸如自我调节思想、行动和情绪等高级认知过程(Gratton et al., 2018; Séguin & Zelazo, 2005)。CON 的功能异常与具有攻击行为或抑郁个体的反应抑制、自我控制和情绪调节能力下降相关(Hofmann et al., 2012; Joormann & Stanton, 2016; Biederman et al., 2004)。一项研究提供了早期童年虐待对青春期早期与反应抑制相关的神经模式影响的初步证据(Jankowski et al., 2017)。在目标适当行为的选择过程中无法抑制习惯性主导反应可能会导致攻击行为(Puiu et al., 2018)。此外, 一些研究表明, 与正常对照组相比, 抑郁患者 CON 内部的功能连接中断会导致认知控制和情绪调节功能障碍, 这是抑郁的特征(Repovs et al., 2011; Dosenbach et al., 2007, 2008; Wu et al., 2016)。

此外, DMN 是最稳健可识别的网络, 在外部注意力需求最小的情况下支持内部注意力和自我参照性思维(Raichle, 2015)。一些证据表明, 早期生活压力与 DMN 结构和功能的异常相关(Zeev-Wolf et al., 2019; Daniels et al., 2011)。一种可能的解释是, CM 通过增加沉思加剧了不愉快的心情(Raes & Hermans, 2008)。DMN 的高连接性, 它专注于内部状态, 可能会加剧个体沉溺于负面情绪和经历的趋势, 从而导致抑郁症状(Hamilton et al., 2011; Sheline et al., 2010)。

同时, DMN 相关的功能连接异常也可能反映(情感)自我参照过程中维度特定的变化, 表明缺乏同情和无情特质(Andrews-Hanna et al., 2010)。值得注意的是, 一项研究综述表明, 具有无情和不关心人际风格的个体构成了反社会和攻击性青少年的一个重要亚群(Frick & White, 2008)。与先前的研究一致, 我们的研究结果也表明, DMN 的功能障碍可以阐明童年虐待与攻击行为/抑郁之间的关系(Ibrahim et al., 2022; Demir-Lira et al., 2016; Sripada et al., 2014; Saxbe et al., 2018)。总而言之, 我们的结果表明, 涉及 CON 和 DMN 的 FC 模式是童年虐待影响抑郁和攻击行为的一个共同神经机制。

4.2. 童年虐待与攻击行为的特异性神经机制

在当前的研究中, 我们强调 CON 和 DAN 之间与攻击行为相关的 FC 在童年虐待与攻击行为之间的关系中起中介作用。CON 涉及高级认知功能, 如注意力和工作记忆的控制(Séguin & Zelazo, 2005)。DAN 主要控制自上而下的注意力、持续注意力和工作记忆(Chica et al., 2013; Aboitiz et al., 2014)。fMRI 研究表明, CON 指导 DAN 关注持续和目标导向的刺激反应(Corbetta & Shulman, 2002; Dosenbach et al., 2006)。Hart 等人发现, 在早期逆境环境中, 受虐个体可能表现出与持续注意力相关的脑区之间沟通减少, 从而导致注意力缺陷(Hart et al., 2017)。分心和注意力调节能力差可能会助长情绪失调, 这种情绪失调被认为

是在受虐儿童中导致行为失调和攻击行为的基础(Shields & Cicchetti, 1998)。另一项任务态 fMRI 研究发现, DMN 和注意力网络之间的 FC 与愤怒和攻击行为指标呈正相关, 这与努力控制受损和冲动性反应抑制降低的机制相符(Weathersby et al., 2019)。因此, 本研究也揭示了类似的证据, 表明 DAN 和 CON 是童年虐待影响攻击行为的特异性神经机制。

4.3. 童年虐待与抑郁的特异性神经机制

此外, 我们的结果表明, CON 和奖励系统之间的 FC 介导了童年虐待与抑郁之间的关系。根据奖励的双过程理论, 人脑包含两个不同的神经网络: 奖励网络, 负责处理主要奖励; 认知控制网络, 参与处理次要奖励(McClure et al., 2004)。一系列研究表明, 有虐待史的个体可能表现出异常的奖励处理(Hendrikse et al., 2022; Fan et al., 2021; Kasparek et al., 2020)。这种现象可以归因于快感缺乏, 这是大脑奖励系统功能障碍的主要特征, 特别是涉及纹状体、OFC 和 ACC 的额纹状体回路(Stringaris et al., 2015; Haber & Knutson, 2010)。Lumley and Harkness (2007)发现, 有情感虐待史的人报告的快感缺乏水平升高。同时, Gong 等人认为, 奖励网络和认知控制网络中大量的异常 FC 可能是抑郁患者快感缺乏的基本机制(Gong et al., 2018)。另一项研究还发现, 奖励处理异常与早期逆境后抑郁风险增加相关(Nagy et al., 2021)。同样, 本研究揭示了 CON 对奖励系统的调节可能是童年虐待影响抑郁的潜在特异性神经机制。

4.4. 局限性

尽管我们利用大量样本证实了童年虐待与攻击行为和抑郁之间的共同和独特机制, 但仍需纵向研究来进一步确定因果关系。此外, 由于本研究基于自我报告问卷, 并依赖于参与者的记忆, 因此存在回忆偏差的可能性。最后, 本研究中的参与者是年轻人; 未来的研究可以从纳入更多年龄段的参与者中受益, 以增强研究的外部效度。

参考文献

- Aboitiz, F., Ossandon, T., Zamorano, F., Palma, B., & Carrasco, X. (2014). Irrelevant Stimulus Processing in ADHD: Catecholamine Dynamics and Attentional Networks. *Frontiers in Psychology*, 5, Article 183. <https://doi.org/10.3389/fpsyg.2014.00183>
- Andrews-Hanna, J. R., Reidler, J. S., Sepulcre, J., Poulin, R., & Buckner, R. L. (2010). Functional-Anatomic Fractionation of the Brain's Default Network. *Neuron*, 65, 550-562. <https://doi.org/10.1016/j.neuron.2010.02.005>
- Baltosser, W. H. (1996). Biostatistical Analysis. *Ecology*, 77, Article 2266. <https://doi.org/10.2307/2265725>
- Barch, D. M., Albaugh, M. D., Avenevoli, S., Chang, L., Clark, D. B., Glantz, M. D. et al. (2018). Demographic, Physical and Mental Health Assessments in the Adolescent Brain and Cognitive Development Study: Rationale and Description. *Developmental Cognitive Neuroscience*, 32, 55-66. <https://doi.org/10.1016/j.dcn.2017.10.010>
- Beck, A. T., Steer, R. A., Ball, R., & Ranieri, W. F. (1996). Comparison of Beck Depression Inventories-IA and-II in Psychiatric Outpatients. *Journal of Personality Assessment*, 67, 588-597. https://doi.org/10.1207/s15327752jpa6703_13
- Bellis, M. A., Hughes, K., Leckenby, N., Jones, L., Baban, A., Kachaeva, M. et al. (2014). Adverse Childhood Experiences and Associations with Health-Harming Behaviours in Young Adults: Surveys in Eight Eastern European Countries. *Bulletin of the World Health Organization*, 92, 641-655. <https://doi.org/10.2471/blt.13.129247>
- Bernstein, D. P., Fink, L., Handelsman, L., & Foote, J. (1998). Childhood Trauma Questionnaire. In *Assessment of Family Violence: A Handbook for Researchers and Practitioners* (p. 2). Amer Psychological Assn.
- Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., Ferrero, F. et al. (2004). Impact of Executive Function Deficits and Attention-Deficit/Hyperactivity Disorder (ADHD) on Academic Outcomes in Children. *Journal of Consulting and Clinical Psychology*, 72, 757-766. <https://doi.org/10.1037/0022-006x.72.5.757>
- Bounoua, N., Miglin, R., Spielberg, J. M., & Sadeh, N. (2020). Childhood Assaultive Trauma and Physical Aggression: Links with Cortical Thickness in Prefrontal and Occipital Cortices. *NeuroImage: Clinical*, 27, Article 102321. <https://doi.org/10.1016/j.nicl.2020.102321>
- Buss, A. H., & Perry, M. (1992). The Aggression Questionnaire. *Journal of Personality and Social Psychology*, 63, 452-459.

- <https://doi.org/10.1037/0022-3514.63.3.452>
- Čermaková, P., Andrášková, L., Brázdil, M., & Marečková, K. (2022). Socioeconomic Deprivation in Early Life and Symptoms of Depression and Anxiety in Young Adulthood: Mediating Role of Hippocampal Connectivity. *Psychological Medicine*, 52, 2671-2680. <https://doi.org/10.1017/s0033291720004754>
- Chai, X. J., Castañón, A. N., Öngür, D., & Whitfield-Gabrieli, S. (2012). Anticorrelations in Resting State Networks without Global Signal Regression. *NeuroImage*, 59, 1420-1428. <https://doi.org/10.1016/j.neuroimage.2011.08.048>
- Chica, A. B., Bartolomeo, P., & Lupiáñez, J. (2013). Two Cognitive and Neural Systems for Endogenous and Exogenous Spatial Attention. *Behavioural Brain Research*, 237, 107-123. <https://doi.org/10.1016/j.bbr.2012.09.027>
- Corbetta, M., & Shulman, G. L. (2002). Control of Goal-Directed and Stimulus-Driven Attention in the Brain. *Nature Reviews Neuroscience*, 3, 201-215. <https://doi.org/10.1038/nrn755>
- Daniels, J. K., Frewen, P., McKinnon, M. C., & Lanius, R. A. (2011). Default Mode Alterations in Posttraumatic Stress Disorder Related to Early-Life Trauma: A Developmental Perspective. *Journal of Psychiatry & Neuroscience*, 36, 56-59. <https://doi.org/10.1503/jpn.100050>
- Demir-Lira, Ö. E., Voss, J. L., O'Neil, J. T., Briggs-Gowan, M. J., Wakschlag, L. S., & Booth, J. R. (2016). Early-Life Stress Exposure Associated with Altered Prefrontal Resting-State fMRI Connectivity in Young Children. *Developmental Cognitive Neuroscience*, 19, 107-114. <https://doi.org/10.1016/j.dcn.2016.02.003>
- Dennison, M. J., Sheridan, M. A., Busso, D. S., Jenness, J. L., Peverill, M., Rosen, M. L. et al. (2016). Neurobehavioral Markers of Resilience to Depression amongst Adolescents Exposed to Child Abuse. *Journal of Abnormal Psychology*, 125, 1201-1212. <https://doi.org/10.1037/abn0000215>
- Dosenbach, N. U. F., Fair, D. A., Cohen, A. L., Schlaggar, B. L., & Petersen, S. E. (2008). A Dual-Networks Architecture of Top-Down Control. *Trends in Cognitive Sciences*, 12, 99-105. <https://doi.org/10.1016/j.tics.2008.01.001>
- Dosenbach, N. U. F., Fair, D. A., Miezin, F. M., Cohen, A. L., Wenger, K. K., Dosenbach, R. A. T. et al. (2007). Distinct Brain Networks for Adaptive and Stable Task Control in Humans. *Proceedings of the National Academy of Sciences*, 104, 11073-11078. <https://doi.org/10.1073/pnas.0704320104>
- Dosenbach, N. U. F., Visscher, K. M., Palmer, E. D., Miezin, F. M., Wenger, K. K., Kang, H. C. et al. (2006). A Core System for the Implementation of Task Sets. *Neuron*, 50, 799-812. <https://doi.org/10.1016/j.neuron.2006.04.031>
- Fan, J., Liu, W., Xia, J., Li, S., Gao, F., Zhu, J. et al. (2021). Childhood Trauma Is Associated with Elevated Anhedonia and Altered Core Reward Circuitry in Major Depression Patients and Controls. *Human Brain Mapping*, 42, 286-297. <https://doi.org/10.1002/hbm.25222>
- Fang, X., Fry, D. A., Ji, K., Finkelhor, D., Chen, J., Lannen, P. et al. (2015). The Burden of Child Maltreatment in China: A Systematic Review. *Bulletin of the World Health Organization*, 93, 176-185. <https://doi.org/10.2471/blt.14.140970>
- Frick, P. J., & White, S. F. (2008). Research Review: The Importance of Callous-Unemotional Traits for Developmental Models of Aggressive and Antisocial Behavior. *Journal of Child Psychology and Psychiatry*, 49, 359-375. <https://doi.org/10.1111/j.1469-7610.2007.01862.x>
- Frodl, T., Janowitz, D., Schmaal, L., Tozzi, L., Dobrowolny, H., Stein, D. J. et al. (2017). Childhood Adversity Impacts on Brain Subcortical Structures Relevant to Depression. *Journal of Psychiatric Research*, 86, 58-65. <https://doi.org/10.1016/j.jpsychires.2016.11.010>
- Gardner, M. J., Thomas, H. J., & Erskine, H. E. (2019). The Association between Five Forms of Child Maltreatment and Depressive and Anxiety Disorders: A Systematic Review and Meta-Analysis. *Child Abuse & Neglect*, 96, Article 104082. <https://doi.org/10.1016/j.chiabu.2019.104082>
- Gilbert, R., Widom, C. S., Browne, K., Fergusson, D., Webb, E., & Janson, S. (2009). Burden and Consequences of Child Maltreatment in High-Income Countries. *The Lancet*, 373, 68-81. [https://doi.org/10.1016/s0140-6736\(08\)61706-7](https://doi.org/10.1016/s0140-6736(08)61706-7)
- Gong, L., He, C., Zhang, H., Zhang, H., Zhang, Z., & Xie, C. (2018). Disrupted Reward and Cognitive Control Networks Contribute to Anhedonia in Depression. *Journal of Psychiatric Research*, 103, 61-68. <https://doi.org/10.1016/j.jpsychires.2018.05.010>
- Gorka, A. X., Hanson, J. L., Radtke, S. R., & Hariri, A. R. (2014). Reduced Hippocampal and Medial Prefrontal Gray Matter Mediate the Association between Reported Childhood Maltreatment and Trait Anxiety in Adulthood and Predict Sensitivity to Future Life Stress. *Biology of Mood & Anxiety Disorders*, 4, 1-10. <https://doi.org/10.1186/2045-5380-4-12>
- Gratton, C., Sun, H., & Petersen, S. E. (2018). Control Networks and Hubs. *Psychophysiology*, 55, e13032. <https://doi.org/10.1111/psyp.13032>
- Haber, S. N., & Knutson, B. (2010). The Reward Circuit: Linking Primate Anatomy and Human Imaging. *Neuropsychopharmacology*, 35, 4-26. <https://doi.org/10.1038/npp.2009.129>
- Hamilton, J. P., Furman, D. J., Chang, C., Thomason, M. E., Dennis, E., & Gotlib, I. H. (2011). Default-Mode and Task-Positive Network Activity in Major Depressive Disorder: Implications for Adaptive and Maladaptive Rumination.

- Biological Psychiatry*, 70, 327-333. <https://doi.org/10.1016/j.biopsych.2011.02.003>
- Hanson, J. L., Hariri, A. R., & Williamson, D. E. (2015a). Blunted Ventral Striatum Development in Adolescence Reflects Emotional Neglect and Predicts Depressive Symptoms. *Biological Psychiatry*, 78, 598-605. <https://doi.org/10.1016/j.biopsych.2015.05.010>
- Hanson, J. L., Nacewicz, B. M., Sutterer, M. J., Cayo, A. A., Schaefer, S. M., Rudolph, K. D. et al. (2015b). Behavioral Problems after Early Life Stress: Contributions of the Hippocampus and Amygdala. *Biological Psychiatry*, 77, 314-323. <https://doi.org/10.1016/j.biopsych.2014.04.020>
- Hart, H., Lim, L., Mehta, M. A., Chatziefraimidou, A., Curtis, C., Xu, X. et al. (2017). Reduced Functional Connectivity of Fronto-Parietal Sustained Attention Networks in Severe Childhood Abuse. *PLOS ONE*, 12, e0188744. <https://doi.org/10.1371/journal.pone.0188744>
- Hein, T. C., Goetschius, L. G., McLoyd, V. C., Brooks-Gunn, J., McLanahan, S. S., Mitchell, C. et al. (2020). Childhood Violence Exposure and Social Deprivation Are Linked to Adolescent Threat and Reward Neural Function. *Social Cognitive and Affective Neuroscience*, 15, 1252-1259. <https://doi.org/10.1093/scan/nsaa144>
- Heleniak, C., Jenness, J. L., Vander Stoep, A., McCauley, E., & McLaughlin, K. A. (2016). Childhood Maltreatment Exposure and Disruptions in Emotion Regulation: A Transdiagnostic Pathway to Adolescent Internalizing and Externalizing Psychopathology. *Cognitive Therapy and Research*, 40, 394-415. <https://doi.org/10.1007/s10608-015-9735-z>
- Hendrikse, C. J., du Plessis, S., Luckhoff, H. K., Vink, M., van den Heuvel, L. L., Scheffler, F. et al. (2022). Childhood Trauma Exposure and Reward Processing in Healthy Adults: A Functional Neuroimaging Study. *Journal of Neuroscience Research*, 100, 1452-1462. <https://doi.org/10.1002/jnr.25051>
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive Functions and Self-Regulation. *Trends in Cognitive Sciences*, 16, 174-180. <https://doi.org/10.1016/j.tics.2012.01.006>
- Ibrahim, K., Noble, S., He, G., Lacadie, C., Crowley, M. J., McCarthy, G. et al. (2022). Large-Scale Functional Brain Networks of Maladaptive Childhood Aggression Identified by Connectome-Based Predictive Modeling. *Molecular Psychiatry*, 27, 985-999. <https://doi.org/10.1038/s41380-021-01317-5>
- Jankowski, K. F., Bruce, J., Beauchamp, K. G., Roos, L. E., Moore, W. E., & Fisher, P. A. (2017). Preliminary Evidence of the Impact of Early Childhood Maltreatment and a Preventive Intervention on Neural Patterns of Response Inhibition in Early Adolescence. *Developmental Science*, 20, e12413. <https://doi.org/10.1111/desc.12413>
- Jenness, J. L., Lambert, H. K., Bitrán, D., Blossom, J. B., Nook, E. C., Sasse, S. F. et al. (2021). Developmental Variation in the Associations of Attention Bias to Emotion with Internalizing and Externalizing Psychopathology. *Research on Child and Adolescent Psychopathology*, 49, 711-726. <https://doi.org/10.1007/s10802-020-00751-3>
- Jiang, W., Zhong, B., Liu, L., Zhou, Y., Hu, X., & Li, Y. (2018). Reliability and Validity of the Chinese Version of the Childhood Trauma Questionnaire-Short Form for Inpatients with Schizophrenia. *PLOS ONE*, 13, e0208779. <https://doi.org/10.1371/journal.pone.0208779>
- Joormann, J., & Stanton, C. H. (2016). Examining Emotion Regulation in Depression: A Review and Future Directions. *Behaviour Research and Therapy*, 86, 35-49. <https://doi.org/10.1016/j.brat.2016.07.007>
- Kasperek, S. W., Jenness, J. L., & McLaughlin, K. A. (2020). Reward Processing Modulates the Association between Trauma Exposure and Externalizing Psychopathology. *Clinical Psychological Science*, 8, 989-1006. <https://doi.org/10.1177/2167702620933570>
- Koob, G. F., & Schulkin, J. (2019). Addiction and Stress: An Allostatic View. *Neuroscience & Biobehavioral Reviews*, 106, 245-262. <https://doi.org/10.1016/j.neubiorev.2018.09.008>
- Lee, V., & Hoaken, P. N. S. (2007). Cognition, Emotion, and Neurobiological Development: Mediating the Relation between Maltreatment and Aggression. *Child Maltreatment*, 12, 281-298. <https://doi.org/10.1177/1077559507303778>
- Letkiewicz, A. M., Weldon, A. L., Tengshe, C., Niznikiewicz, M. A., & Heller, W. (2021). Cumulative Childhood Maltreatment and Executive Functioning in Adulthood. *Journal of Aggression, Maltreatment & Trauma*, 30, 547-563. <https://doi.org/10.1080/10926771.2020.1832171>
- Liu, R. T., Scopelliti, K. M., Pittman, S. K., & Zamora, A. S. (2018). Childhood Maltreatment and Non-Suicidal Self-Injury: A Systematic Review and Meta-Analysis. *The Lancet Psychiatry*, 5, 51-64. [https://doi.org/10.1016/s2215-0366\(17\)30469-8](https://doi.org/10.1016/s2215-0366(17)30469-8)
- Lumley, M. N., & Harkness, K. L. (2007). Specificity in the Relations among Childhood Adversity, Early Maladaptive Schemas, and Symptom Profiles in Adolescent Depression. *Cognitive Therapy and Research*, 31, 639-657. <https://doi.org/10.1007/s10608-006-9100-3>
- Mao, Y., Li, L., Li, Y., Hou, X., & Duan, S. (2023). Cognitive Reappraisal and Corresponding Neural Basis Mediate the Association between Childhood Maltreatment and Depression. *Biological Psychology*, 184, Article 108716. <https://doi.org/10.1016/j.biopsycho.2023.108716>

- McClure, S. M., Laibson, D. I., Loewenstein, G., & Cohen, J. D. (2004). Separate Neural Systems Value Immediate and Delayed Monetary Rewards. *Science*, 306, 503-507. <https://doi.org/10.1126/science.1100907>
- McCrory, E. J., De Brito, S. A., Kelly, P. A., Bird, G., Sebastian, C. L., Mechelli, A. et al. (2013). Amygdala Activation in Maltreated Children during Pre-Attentive Emotional Processing. *British Journal of Psychiatry*, 202, 269-276. <https://doi.org/10.1192/bjp.bp.112.116624>
- McCrory, E. J., Puetz, V. B., Maguire, E. A., Mechelli, A., Palmer, A., Gerin, M. I. et al. (2017). Autobiographical Memory: A Candidate Latent Vulnerability Mechanism for Psychiatric Disorder Following Childhood Maltreatment. *British Journal of Psychiatry*, 211, 216-222. <https://doi.org/10.1192/bjp.bp.117.201798>
- McLaughlin, K. A., Green, J. G., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., & Kessler, R. C. (2010). Childhood Adversities and Adult Psychiatric Disorders in the National Comorbidity Survey Replication II. *Archives of General Psychiatry*, 67, 124-132. <https://doi.org/10.1001/archgenpsychiatry.2009.187>
- Murphy, K., Birn, R. M., Handwerker, D. A., Jones, T. B., & Bandettini, P. A. (2009). The Impact of Global Signal Regression on Resting State Correlations: Are Anti-Correlated Networks Introduced? *NeuroImage*, 44, 893-905. <https://doi.org/10.1016/j.neuroimage.2008.09.036>
- Nagy, S. A., Kürtös, Z., Németh, N., Perlaki, G., Csernel, E., Lakner, F. E. et al. (2021). Childhood Maltreatment Results in Altered Deactivation of Reward Processing Circuits in Depressed Patients: A Functional Magnetic Resonance Imaging Study of a Facial Emotion Recognition Task. *Neurobiology of Stress*, 15, Article 100399. <https://doi.org/10.1016/j.ynstr.2021.100399>
- Peverill, M., Sheridan, M. A., Busso, D. S., & McLaughlin, K. A. (2019). Atypical Prefrontal-Amygdala Circuitry Following Childhood Exposure to Abuse: Links with Adolescent Psychopathology. *Child Maltreatment*, 24, 411-423. <https://doi.org/10.1177/1077559519852676>
- Power, J. D., Schlaggar, B. L., Lessov-Schlaggar, C. N., & Petersen, S. E. (2013). Evidence for Hubs in Human Functional Brain Networks. *Neuron*, 79, 798-813. <https://doi.org/10.1016/j.neuron.2013.07.035>
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and Resampling Strategies for Assessing and Comparing Indirect Effects in Multiple Mediator Models. *Behavior Research Methods*, 40, 879-891. <https://doi.org/10.3758/brm.40.3.879>
- Puetz, V. B., Viding, E., Maguire, E. A., Mechelli, A., Armbruster-Genç, D., Sharp, M. et al. (2023). Functional Brain Plasticity Following Childhood Maltreatment: A Longitudinal fMRI Investigation of Autobiographical Memory Processing. *Development and Psychopathology*, 35, 1382-1389. <https://doi.org/10.1017/s0954579421001292>
- Puiu, A. A., Wudarczyk, O., Goerlich, K. S., Votinov, M., Herpertz-Dahlmann, B., Turetsky, B. et al. (2018). Impulsive Aggression and Response Inhibition in Attention-Deficit/hyperactivity Disorder and Disruptive Behavioral Disorders: Findings from a Systematic Review. *Neuroscience & Biobehavioral Reviews*, 90, 231-246. <https://doi.org/10.1016/j.neubiorev.2018.04.016>
- Raes, F., & Hermans, D. (2008). On the Mediating Role of Subtypes of Rumination in the Relationship between Childhood Emotional Abuse and Depressed Mood: Brooding versus Reflection. *Depression and Anxiety*, 25, 1067-1070. <https://doi.org/10.1002/da.20447>
- Raichle, M. E. (2015). The Brain's Default Mode Network. *Annual Review of Neuroscience*, 38, 433-447. <https://doi.org/10.1146/annurev-neuro-071013-014030>
- Rakesh, D., Kelly, C., Vijayakumar, N., Zalesky, A., Allen, N. B., & Whittle, S. (2021). Unraveling the Consequences of Childhood Maltreatment: Deviations from Typical Functional Neurodevelopment Mediate the Relationship between Maltreatment History and Depressive Symptoms. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, 6, 329-342. <https://doi.org/10.1016/j.bpsc.2020.09.016>
- Repovs, G., Csernansky, J. G., & Barch, D. M. (2011). Brain Network Connectivity in Individuals with Schizophrenia and Their Siblings. *Biological Psychiatry*, 69, 967-973. <https://doi.org/10.1016/j.biopsych.2010.11.009>
- Santens, E., Claes, L., Dierckx, E., & Dom, G. (2020). Effortful Control—A Transdiagnostic Dimension Underlying Internalizing and Externalizing Psychopathology. *Neuropsychobiology*, 79, 255-269. <https://doi.org/10.1159/000506134>
- Saxbe, D., Khoddam, H., Piero, L. D., Stoycos, S. A., Gimbel, S. I., Margolin, G. et al. (2018). Community Violence Exposure in Early Adolescence: Longitudinal Associations with Hippocampal and Amygdala Volume and Resting State Connectivity. *Developmental Science*, 21, 1-11. <https://doi.org/10.1111/desc.12686>
- Séguin, J. R., & Zelazo, P. D. (2005). Executive Function in Early Physical Aggression. In: *Developmental Origins of Aggression* (pp. 307-329). The Guilford Press.
- Sheline, Y. I., Price, J. L., Yan, Z., & Mintun, M. A. (2010). Resting-State Functional MRI in Depression Unmasks Increased Connectivity between Networks via the Dorsal Nexus. *Proceedings of the National Academy of Sciences*, 107, 11020-11025. <https://doi.org/10.1073/pnas.1000446107>
- Shields, A., & Cicchetti, D. (1998). Reactive Aggression among Maltreated Children: The Contributions of Attention and Emotion Dysregulation. *Journal of Clinical Child Psychology*, 27, 381-395. https://doi.org/10.1207/s15374424jccp2704_2

- Sripada, R. K., Swain, J. E., Evans, G. W., Welsh, R. C., & Liberzon, I. (2014). Childhood Poverty and Stress Reactivity Are Associated with Aberrant Functional Connectivity in Default Mode Network. *Neuropsychopharmacology*, 39, 2244-2251. <https://doi.org/10.1038/npp.2014.75>
- Stringaris, A., Vidal-Ribas Belil, P., Artiges, E., Lemaître, H., Gollier-Briant, F., Wolke, S. et al. (2015). The Brain's Response to Reward Anticipation and Depression in Adolescence: Dimensionality, Specificity, and Longitudinal Predictions in a Community-Based Sample. *American Journal of Psychiatry*, 172, 1215-1223. <https://doi.org/10.1176/appi.ajp.2015.14101298>
- Trickett, P. K., & McBride-Chang, C. (1995). The Developmental Impact of Different Forms of Child Abuse and Neglect. *Developmental Review*, 15, 311-337. <https://doi.org/10.1006/drev.1995.1012>
- Wang, J., Wang, X., Xia, M., Liao, X., Evans, A., & He, Y. (2015). GRETNA: A Graph Theoretical Network Analysis Toolbox for Imaging Connectomics. *Frontiers in Human Neuroscience*, 9, Article 386. <https://doi.org/10.3389/fnhum.2015.00386>
- Weathersby, F. L., King, J. B., Fox, J. C., Loret, A., & Anderson, J. S. (2019). Functional Connectivity of Emotional Well-Being: Overconnectivity between Default and Attentional Networks Is Associated with Attitudes of Anger and Aggression. *Psychiatry Research: Neuroimaging*, 291, 52-62. <https://doi.org/10.1016/j.psychresns.2019.08.001>
- Weissman, D. G., Lambert, H. K., Rodman, A. M., Peverill, M., Sheridan, M. A., & McLaughlin, K. A. (2020). Reduced Hippocampal and Amygdala Volume as a Mechanism Underlying Stress Sensitization to Depression Following Childhood Trauma. *Depression and Anxiety*, 37, 916-925. <https://doi.org/10.1002/da.23062>
- WHO (2022). *Report of the Consultation on Child Abuse Prevention*. https://www.who.int/health-topics/violence-against-children#tab=tab_1
- Wu, X., Lin, P., Yang, J., Song, H., Yang, R., & Yang, J. (2016). Dysfunction of the Cingulo-Opercular Network in First-Episode Medication-Naïve Patients with Major Depressive Disorder. *Journal of Affective Disorders*, 200, 275-283. <https://doi.org/10.1016/j.jad.2016.04.046>
- Yan, C., Wang, X., Zuo, X., & Zang, Y. (2016). DPABI: Data Processing & Analysis for (Resting-State) Brain Imaging. *Neuroinformatics*, 14, 339-351. <https://doi.org/10.1007/s12021-016-9299-4>
- Yang, S., Cheng, Y., Mo, Y., Bai, Y., Shen, Z., Liu, F. et al. (2017). Childhood Maltreatment Is Associated with Gray Matter Volume Abnormalities in Patients with First-Episode Depression. *Psychiatry Research: Neuroimaging*, 268, 27-34. <https://doi.org/10.1016/j.psychresns.2017.07.005>
- Yip, S. W., Lacadie, C. M., Sinha, R., Mayes, L. C., & Potenza, M. N. (2019). Childhood Trauma Moderates Inhibitory Control and Anterior Cingulate Cortex Activation during Stress. *Neuroimage*, 185, 111-118.
- Yu, M., Linn, K. A., Shinohara, R. T., Oathes, D. J., Cook, P. A., Duprat, R. et al. (2019). Childhood Trauma History Is Linked to Abnormal Brain Connectivity in Major Depression. *Proceedings of the National Academy of Sciences*, 116, 8582-8590. <https://doi.org/10.1073/pnas.1900801116>
- Zalesky, A., Fornito, A., & Bullmore, E. T. (2010). Network-Based Statistic: Identifying Differences in Brain Networks. *NeuroImage*, 53, 1197-1207. <https://doi.org/10.1016/j.neuroimage.2010.06.041>
- Zeev-Wolf, M., Levy, J., Goldstein, A., Zagoory-Sharon, O., & Feldman, R. (2019). Chronic Early Stress Impairs Default Mode Network Connectivity in Preadolescents and Their Mothers. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, 4, 72-80. <https://doi.org/10.1016/j.bpsc.2018.09.009>
- Zhong, X., Ming, Q., Dong, D., Sun, X., Cheng, C., Xiong, G. et al. (2020). Childhood Maltreatment Experience Influences Neural Response to Psychosocial Stress in Adults: An fMRI Study. *Frontiers in Psychology*, 10, Article 2961. <https://doi.org/10.3389/fpsyg.2019.02961>
- Zhu, X., Helpman, L., Papini, S., Schneier, F., Markowitz, J. C., Van Meter, P. E. et al. (2017). Altered Resting State Functional Connectivity of Fear and Reward Circuitry in Comorbid PTSD and Major Depression. *Depression and Anxiety*, 34, 641-650. <https://doi.org/10.1002/da.22594>