

人际同步对孤独症儿童合作行为的影响及干预促进

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【摘 要】合作是人类行为的核心,也是儿童社会性发展的重要体现。孤独症儿童因神经生理、时间同步以及运动能力等缺陷,导致其在社会交往中合作能力不足。研究发现,人际同步可促进儿童的合作行为。通过人际同步干预,孤独症儿童的联合注意、积极情绪及运动技能等与合作相关的能力获得改善,神经系统得到激活,社会适应能力也有所提高。人际同步干预目前仍在同步机制、感知互动质量等方面存在局限性,未来除了关注同步形式、节奏频率及个体差异等变量对孤独症儿童合作行为的作用机制外,还应关注他们在复杂开放式社交场景中的感知互动质量。

【关 键 词】人际同步;孤独症谱系障碍;合作;联合注意

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合作可以定义为两个或多个个体为了追求共同的目标而联合行动(Hay et al., 2022; Ashley & Tomasello, 1998)。在个体发展中,与他人合作既是行为目的,也是促进社会和认知发展的动力(Yuill et al., 2014)。合作活动中激发的共同目标和意图,促进形成复杂的心理推测、联合注意、合作交流等,这些能力对儿童发展认知和社会交往具有重要意义(Etel & Slaughter, 2019)。

孤独症谱系障碍(Autism Spectrum Disorder, ASD)是一种以社会交往、交流受损和重复刻板行为为特征的神经发育障碍性疾病(American Psychiatric Association 2013),社会交往缺陷是其核心障碍的主要原因(Kruppa et al., 2021)。在感觉运动方面,他们存在运动不协调和运动障碍等现象(Bhat, 2020, 2021; Kaur et al., 2013, 2018);在执行功能方面,他们的注意转换、工作记忆、反应抑制和思维灵活性均较差(Freeman et al., 2017)。这些原发性和并发性损伤共同导致 ASD 儿童合作出现困难(Su

et al., 2022)。

人际同步(Interpersonal Synchrony)指个体在社会交往过程中时间和频率上的协调(Bowsher - Murray et al., 2022; 孙炳海等, 2018),是社会互动中普遍存在的现象。有时需要有意而为之,如握手、举手击掌或共同跳舞(Bowsher - Murray et al., 2022)。有时是自发而成,如同伴间步调一致(Zivotofsky & Hausdorff, 2007)、姿势位置调整(Koul et al., 2023; Gaziv et al., 2017)、身体动作卷入(McNaughton & Redcay, 2020)或面部(嘴部、眼睛、眉毛等)表情流露(Briot et al., 2021)。同步性已被证明与良好的人际互动相关,如增强合作(马昕玥, 崔丽莹, 2022; Hu et al., 2022; Li et al., 2023)和相处融洽(Tomashin et al., 2022; Vacharkulksemsuk & Fredrickson, 2012; Delius & Müller, 2023)。

合作的根本目的是适应社会,并在积极的社会互动中发挥关键作用(Lakin et al., 2003)。而互动同步也被认为是规范社会发展的基础(Feldman,

2007)。正常儿童一般都能自然地组织自己的行为通过人际互动同步实现与他人的合作交流 (Zampella et al., 2020), ASD 儿童由于存在目标理解、社会监控、执行功能及动作预期等缺陷,在自然的社交互动中存在人际同步障碍,导致其与同伴之间的合作变得困难 (Su et al., 2022; Chen et al., 2019; Chita - Tegmark, 2016; Yang & Hofmann, 2016; Somogyi et al., 2013)。探讨人际互动同步及其与社会功能的关系,有助于理解 ASD 儿童非典型性发展对合作的影响因素及作用机制。人际同步过程中,自发地把握社交线索和节奏的能力,可能是社会互惠合作的基础 (Zampella et al., 2020)。因此,从人际同步角度研究分析这一过程中的非典型性可能对了解 ASD 儿童在合作中的互惠损伤提供一个新视角,从而更好地为 ASD 儿童的早期干预训练提供指导与借鉴。

1 孤独症儿童的合作行为

1.1 儿童合作能力的发展

出生第一年开始,儿童就能感知他人的目标,表现出帮助的倾向和明显的合作性 (Slocombe & Seed, 2019)。在早期社会能力发展过程中,联合注意 (Joint Attention) 被视为开启二元互交的重要技能,一般在 8 ~ 12 月龄出现 (Montagut - Asuncion et al., 2022; Beuker et al., 2013)。12 月龄以后,幼儿就能与周围的同伴互动,并出现与同伴之间的协调活动。18 月龄时利他主义的助人行为出现 (Fantasia et al., 2014; Kaartinen et al., 2019)。到 2 岁时,幼儿能在游戏活动中围绕一个共同目标与同伴合作。但此时,他们更关注如何协调自己与他人来实现自己的目的,而不是构建一个共同表征 (Endedijk et al., 2020; Brownell, 2011)。3 岁左右,儿童开始在与同伴互动时动作反应越来越灵敏,并且能更加熟练地完成复杂的合作任务 (Endedijk et al., 2020; Tomasello & Vaish, 2013; Warneken & Tormasello, 2013)。儿童的合作能力会随着年龄的增长而逐渐

发展和完善,这一早期的互动技能让儿童学会平衡自己与同伴的需求,并提高社会交往和适应能力 (Hay et al., 2022)。在儿童后期,他们发展出日益复杂的合作行为,表现为行动和解决问题能力的整合。他们在决定是否与同伴合作时,越来越多地基于自己过去的经验及对同伴行为的预判 (Kaartinen et al., 2019)。儿童合作能力发展示意图见图 1。

1.2 孤独症儿童的合作表现

ASD 儿童因其社会功能缺陷,无论是与正常发育儿童 (Typically Developing, TD) (Su et al., 2022; Kaartinen et al., 2019) 还是其他类型心智障碍儿童,如唐氏综合征 (Sigman et al., 1999)、发育迟缓 (Liebal et al., 2008)、注意缺陷多动障碍和对立违抗障碍 (Downs & Smith, 2004) 儿童相比,合作表现均较差。

在不同的任务类型中,ASD 儿童的合作表现有所不同,在需要策略性思维的任务,如囚徒困境游戏 (Prisoner's Dilemma Game, PDG) 中 ASD 儿童的合作表现与 TD 儿童无异,但在需要协调动作姿势、联合注意、眼神接触等技能的工具性任务时表现不佳 (李晶,朱莉琪,2014);而在 Sally 和 Hill (2006) 的研究中,虽然 ASD 儿童在不同版本的 PDG 博弈中存在策略转换困难,但 ASD 和 TD 儿童在 PDG 中的合作水平没有显著差异;ASD 儿童在需要动作协调的合作任务中,如同步按键 (Wang, Han et al., 2020)、共同搬运 (李晶,朱莉琪,2014)、合作搭建 (Su et al., 2022)、共同摇椅 (Marsh et al., 2013) 及同步摆动 (Fitzpatrick, 2016) 中表现也存在差异,他们能够表征和计划简单的动作,但在表征复杂程度较高的动作和将高级变量纳入其运动计划时会出现困难 (Cerullo et al., 2021; Fiebach, 2022)。这可能是由于 ASD 群体在合作互动中,更倾向于依赖自发形成的行动计划,而不是考虑同伴的动作线索 (Su et al., 2022)。

此外,ASD 儿童的个体能力水平也会影响合作

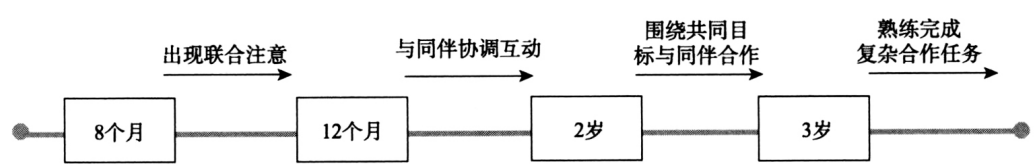


图 1 儿童合作能力发展示意图 (Endedijk et al., 2020; Brownell, 2011; Cerullo et al., 2021)

表现。存在相关学习障碍的 ASD 儿童,合作行为减少 (Colombi et al., 2009; Liebal et al., 2008); 虽然缺乏广泛性认知障碍的 ASD 儿童可能更倾向合作,但他们在决策时比 TD 儿童 (Downs & Smith, 2004; Schmitz et al., 2015) 更少受到公平或道德因素的影响。有研究表明,ASD 儿童的合作表现受其模仿、共同注意及心理理论能力损伤程度的影响 (Kaartin-en et al., 2019; Colombi et al., 2009; Downs & Smith, 2004)。由此可见,ASD 儿童的总体合作表现普遍差于 TD 儿童,但合作表现的差异还受到任务类型及个体能力水平的影响。

2 非典型人际同步对孤独症儿童合作行为的影响

合作要求人们在联合行动时理解和分享对方的目标和意图,时间对齐形式较为松散。而人际同步更注重形式上的行为匹配和时间的一致性 (Bowsher – Murray et al., 2022; Cerullo et al., 2021; Rinott & Tractinsky, 2021)。两者虽在目标意图和时间对齐方面有所区别,但从行为匹配的角度,人际同步可看作是一种合作行为 (胡银莹, 2019; Kruppa et al., 2021; Zhou et al., 2022)。合作行为依赖于广泛的运动和社会能力,如个体的分享表征 (联合注意、认知共情)、行动预测及计划协调能力 (Cerullo et al., 2021),其过程还包括互动同步现象,即合作伙伴行为和时间内彼此协调的动态过程 (Zampella et al., 2020)。生活中大部分合作行为都涉及同伴之间的人际同步,如来回抛球、击鼓、跳舞、划船等。因此,合作的潜在过程可能揭示了人际同步中等效的作用机制 (BowsherMurray et al., 2022),他们之间还存在着关键的能力成分 (图 2)。ASD 儿童因存

在神经生理、时间同步及运动技能等缺陷,在合作任务中出现人际同步障碍,即非典型性人际同步,从而难以调整自身状态与他人灵活互动,影响社会交往 (Cerullo et al., 2021)。通过梳理近年文献,本文将从人际同步的角度分析影响 ASD 儿童合作行为的因素,并总结归纳出 ASD 二元合作中的非典型性人际同步因素分析图 (下页图 3)。

2.1 神经同步异常

在进行合作任务时,合作伙伴需要朝着共同的目标努力,知道对方的意图和决策,以提高他们的整体效益 (Lee et al., 2018)。从神经学角度,与社交相关的脑区,如双侧颞顶联合区和额下回/前额叶皮层,在合作中至关重要 (Tsoi et al., 2016)。在一项计算机合作游戏任务中,通过 fMRI 扫描发现合作时双方中额顶网络的共同激活。同样, Liu 等人 (2017) 在积木合作游戏中同时扫描合作伙伴,发现双方右侧颞上沟的间脑神经同步显著,脑间同步是合作伙伴之间实现实时信息传递的充分条件 (Pan et al., 2021)。

神经递质分泌、脑功能区激活以及脑间同步都影响着 ASD 的人际同步 (赵丽华, 李晶, 2023)。ASD 儿童在观察 – 执行匹配系统 (包括额下回、颞上沟和顶下小叶)、执行功能 (包括前额叶皮层、额中回) 和意图理解 (包括颞顶联合区、颞上沟和前额叶皮质) 的重要区域存在非典型激活,这可能是他们二元互动存在困难的原因 (Todorova et al., 2019; Uratani et al., 2019; Yang & Hofmann, 2016)。多项涉及人际同步的合作任务中,如在摇椅范式 (Marsh et al., 2013)、同步摆荡范式 (Fitzpatrick, 2016)、访谈场景 (Noel et al., 2018) 中, ASD 群体与同伴之间

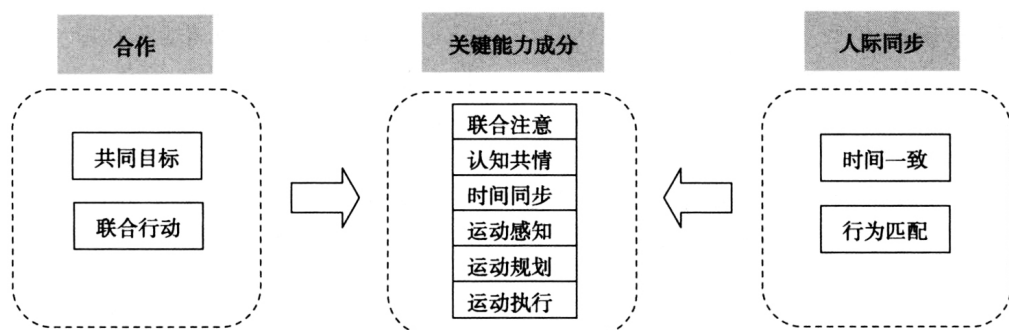


图 2 合作与人际同步共同的关键能力成分

参考: Bowsher – Murray et al., 2022; Cerullo et al., 2021

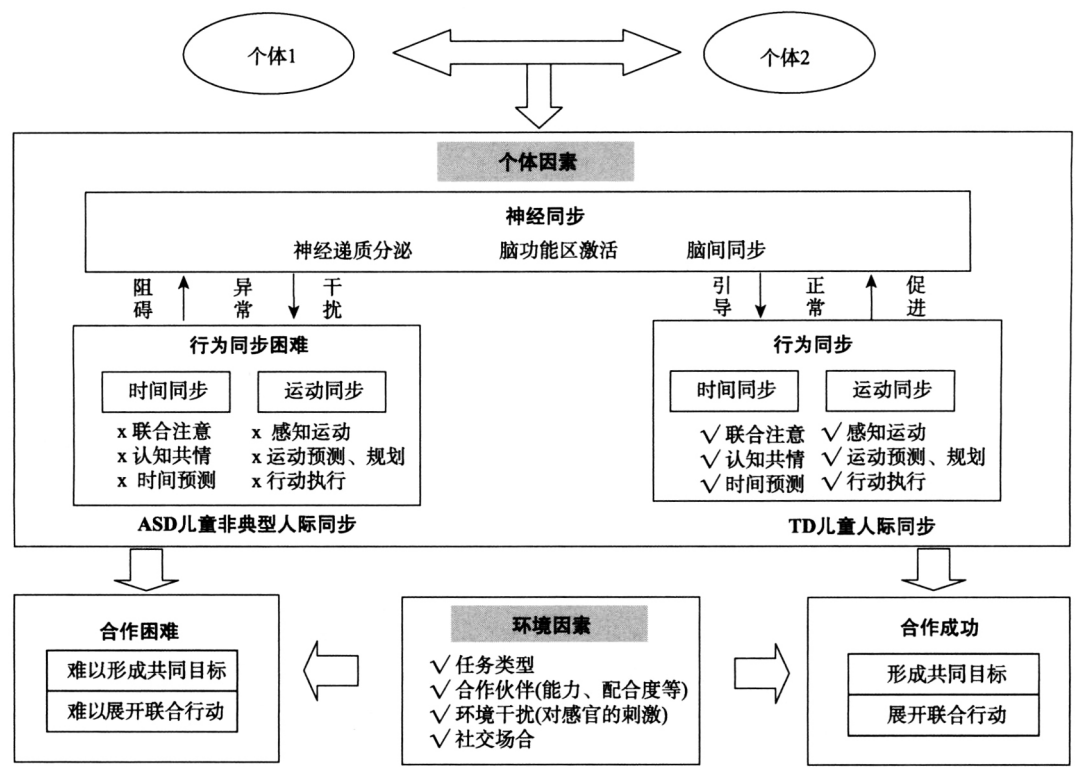


图3 ASD二元合作中的非典型性人际同步因素分析

参考:Bowsher - Murray et al. ,2022;Cerullo et al. ,2021;McNaughton & Redcay,2020。

的同步性均较低,他们的神经激活也存在困难,如非典型偏侧化,前额中下回、颞中上回激活度减弱等(Su et al. ,2020)。然而,也有研究发现在按键合作任务中 ASD 儿童在行为上表现出比 TD 组儿童更低的运动同步性,但在神经水平上却没有观察到显著的组间差异(Kruppa et al. ,2021)。

脑间同步被视为探讨 ASD 群体非典型性人际同步的重要途径。一项研究在社会互动情境下考察 ASD 儿童与其父母之间的脑际沟通,发现 ASD 儿童在与父母进行合作互动时,额叶皮层的人际神经同步性要高于单独和非互动行为。此外,神经同步性和合作任务表现均受到儿童孤独症症状严重程度的影响,即孤独症症状较重的儿童在合作过程中表现出与父母较低的动作合作水平和神经同步性(Wang,Han et al. ,2020)。自然情境下,在 ASD 青少年对话交谈时,对其颞顶头皮位置进行脑间神经活动测量,发现社交越困难的被试神经同步水平越低(Key et al. ,2022)。神经生理异常,导致合作伙伴之间难以对环境有相似的感知,并在分享表征中出现困难,从而可能在合作中出现人际同步困难

(Cerullo et al. ,2021)。

2.2 时间同步困难

人际同步视角所描述的合作模式普遍存在于现实生活的互动同步中。合作中常常要求行动在时间上的同步,但运动的形式却不同(Sebanz et al. ,2006)。例如共同舞蹈、打击乐合奏、一起搬运等。TD 儿童在合作时一般会根据对方发送的协调信号,及时预判和调整自己的行为配合他人,并让他人更好配合自己。然而,Cerullo 等人(2021)的文献综述中显示有 12 项实证研究表明 ASD 群体在时间同步上存在不同程度的损伤,影响他们在合作任务中的沟通、协调和社会行为表现。还有研究表明,人际同步水平与孤独症症状程度负相关,就是说孤独症症状越重人际同步水平越低(Murat Baldwin et al. ,2022)。影响孤独症儿童时间同步的因素主要有以下几方面:

联合注意发展受损是 ASD 儿童时间同步困难的重要表现,这一损伤阻碍了其社交技能和语言能力的发展。有研究发现 ASD 学龄前儿童的运动同步能力低于对照组,且 ASD 学龄前儿童表现出自发

性社会摇摆的能力低于对照组 (Fitzpatrick et al., 2013)。同样,ASD 青少年在运动同步任务上的表现也比控制组差 (Fitzpatrick, 2016)。运动同步早期功能障碍可能导致 ASD 儿童在与照顾者建立情感联系、语言学习和联合注意力等方面存在困难 (Fitzpatrick et al., 2017)。在同步模仿任务中,ASD 儿童通过追随他人的注视来参与其发起的联合注意的能力比试图让他人看来发起联合注意的自发驱动能力更弱 (Mundy & Newell, 2007),这可能是由于在社会交往中,ASD 儿童体验到的联合注意比 TD 更少,因此更没有动力发起与其他人的共同关注 (Fiebach, 2022)。联合注意受损导致 ASD 群体难以在社交活动中开启人际同步以及协调合作行为。

认知共情 (cognitive empathy) 是理解他人想法和感受,对他人的心理状态进行推理的过程,需要涉及包括观点采择和心理理论在内的复杂的认知能力 (Mazza et al., 2014; Tholen et al., 2020)。ASD 群体不善于考虑他人不同的观点,因而常常做出一些不恰当的反应 (Mao et al., 2023; Eigsti & Irvine, 2021),难以与同伴实现时间同步。ASD 群体的联合意向性和自我意向性均存在异常,联合意向性困难包括难以通过深入思考和计划来感知合作者的意图,自我意向性困难使他们难以将自己视为群体成员并采纳群体的观点 (Salice & Henriksen, 2020)。在一项即兴镜像游戏中,ASD 儿童与同伴同步的时间更少,尤其是在处于跟随者角色时,他们难以理解领导者的意图,与其保持同步 (Brezis et al., 2017)。ASD 儿童在识别他人面部表情和自身面部表情的表达方面也存在障碍,这导致其在沟通交往时难以理解他人意图,在表达时也会出现一些怪异、呆板的现象 (Briot et al., 2021; Mazzoni et al., 2020)。总之,认知共情障碍使 ASD 儿童难以根据同伴表现调整自己的行为,让自身的感知和行为达成一致,实现顺利合作。

ASD 群体还存在时间和动作序列预测障碍 (Cerullo et al., 2021)。ASD 成人在领导者—追随者合作游戏中,表现出时间预测和感知同步方面困难 (Murat Baldwin et al., 2022)。有研究让 ASD 儿童完成两项合作任务。第一项有明确目标。第二项没有明确目标,需要根据合作伙伴的运动特征预

测目标。结果显示,在目标明确的任务中 ASD 与 TD 儿童的动作没有显著差异,但当他们需要依靠对方运动特征来推断对方运动时,ASD 比 TD 儿童表现出更大的异步性 (Fulceri et al., 2018)。一项研究要求儿童分别在独奏和社交情景下表演简单和复杂的节奏动作,结果显示 ASD 儿童在所有节奏的动作中都比 TD 对照组有更多的变化和更慢的动作 (Kaur et al., 2018)。动作时机的协调技巧是舒适社交的基础,ASD 群体因存在时间和动作序列预测障碍,当他们在需要运动线索来预测他人行动时,时间同步就会变得困难,从而合作中出现人际同步迟缓或中断 (Cerullo et al., 2021)。

2.3 非典型性运动同步

人际同步依赖于同伴行为在时间和形式上的一致性,ASD 儿童在运动能力上的损伤影响了这种一致性。感觉运动控制、执行功能和意图理解能力较差以及社交情景中较差的视动能力和肢体协调能力,导致其出现非典型性人际运动同步,并在各类合作活动中存在困难 (Bhat, 2020, 2021; Fitzpatrick et al., 2017; Freeman et al., 2017; Kaur et al., 2018)。综合近年文献,ASD 儿童的非典型运动同步主要体现在以下三方面:

首先,ASD 儿童在听觉、视觉和运动感觉输入等感觉运动方面存在非典型整合,这影响其在个体间和个体内的同步性,进而阻碍他们的合作互动行为 (McNaughton & Redcay, 2020; Murat Baldwin et al., 2022)。ASD 群体在运动同步方面的感知困难,还与他们对他人运动有较低的敏感度和注意力有关,如在一项考察 ASD 青少年自发运动 (目标不在互动意识范围内) 和有意运动 (互动目标明确) 的研究中,被试肩并肩坐在椅子上摇晃,在自发运动条件下,被试按照自己的节奏摆动;在有意运动条件下,被试以对方为参照,按相同或相反的方式摇摆,与对照组相比,ASD 儿童在自发运动和有意运动中均表现较差 (Fitzpatrick, 2016)。这表明 ASD 儿童在有意识整合自身与外界感觉信息时出现困难,并导致人际协调障碍。

其次,ASD 群体运动预期和规划能力存在高度不稳定性 (Gonzalez et al., 2013),如在一些探讨 ASD 群体合作抓取任务的研究中,发现 ASD 群体未

能在动作结束时营造一个舒适的姿势状态,为同伴的后续合作提供便利(Jovanovic & Schwarzer,2017; Scharoun & Bryden,2014,2016)。ASD 群体能力状态不同,在合作中规划自己动作来给予同伴舒适状态的表现也不同(Cerullo et al.,2021)。人际协调障碍可能与无法利用社会信息预测他人行为有关,而 ASD 群体存在潜在的预测编码缺陷现象(Liang et al.,2022; von der Lühse et al.,2016)。一项研究考察 ASD 和 TD 儿童在不同操作抓取任务(单手、双手和小组合作)中的运动规划能力,被试要求通过以上三种任务形式将一个垂直的圆柱体从桌子移到不同高度的架子上,结果显示没有组间差异。原因可能是该研究只考察了任务的空间方面,而没有考察时间方面,ASD 儿童在运动规划的时间方面有可能存在差异(Ansuini et al.,2018),从而导致其无法预测和规划自己的行为来与他人保持同步。

最后,在运动执行方面,ASD 群体中有 50% ~ 100% 存在粗大和精细动作不协调、平衡能力差、动作笨拙等现象(张鑫,2021),运动障碍是他们最常见临床表现之一(熊才运等,2020)。在关节活动、拍手、姿势摇摆和钟摆摇摆等节律性动作任务中,ASD 群体较少与测试者同步(Bhat,2020,2021; Fitzpatrick et al.,2017; Kaur et al.,2018; Patten et al.,2014)。ASD 儿童在轮流任务中也存在困难,在来回交谈中,ASD 儿童表现出更长的话轮转换间隔和更低的时间灵活性,这表明 ASD 儿童的反应抑制和执行功能较差(Cerullo et al.,2021; Ochi et al.,2019)。此外,模仿新颖的动作和动作序列也被证明在早期孤独症中存在特异性损伤(Rogers et al.,2003)。这一损伤导致 ASD 儿童在动作执行过程中往往存在偏差而难以在社交中保持同步。

TD 儿童随着年龄的增长,能够协调自己与同伴确定共同目标,形成人际同步,联合开展共同行动,进而形成合作闭环,顺利完成合作任务。然而,ASD 儿童在信息输入、整合和输出等环节存在异常,从而在合作时出现人际同步障碍,导致难以形成个体间的合作闭环(McNaughton & Redcay,2020)。根据上述分析,本文制作 ASD 二元合作中的非典型性人际同步因素分析图(图3)(Bowsher - Murray et al.,2022; Cerullo et al.,2021; McNaughton &

Redcay,2020)进一步厘清各因素对合作的影响。ASD 儿童的非典型人际同步不仅在大脑神经中发现,还表现在认知行为方面。神经和行为同步往往同时发生,且两者密切相关。有研究表明,神经同步引导且先于行为同步,神经同步还常常通过行为同步表现出来(Kruppa et al.,2021; Nam et al.,2020; Pan et al.,2021)。因此,从个体因素角度,一方面先天的神经生理(如神经递质分泌、脑功能区激活、脑间同步)异常导致 ASD 儿童在行为上难以实现同步与合作;另一方面认知行为的缺陷也致使 ASD 儿童难以在正常的社交环境中完善和发展大脑神经(Bowsher - Murray et al.,2022)。TD 儿童在合作任务中能够通过联合注意、认知共情确定共同目标,并协调时间及行为动作进行联合行动,顺利完成合作任务。而 ASD 儿童因存在先天的神经生理异常导致共同注意和认知共情障碍,在合作中难以明确合作对象,也难以与同伴在共同目标上达成一致。在人际同步的关键成分:时间同步和运动同步等方面 ASD 儿童也存在障碍,导致其难以与同伴顺利开展联合行动。此外,从环境因素角度,任务类型(李晶,朱莉琪,2014)、合作伙伴的能力及配合度(Zampella et al.,2020)、环境干扰及社交场合(Bowsher - Murray et al.,2022)也有可能影响 ASD 儿童的合作表现。ASD 儿童的非典型性人际同步可能是影响其合作的主要因素,改善人际同步能力,对其合作能力的提升具有重要意义。

3 人际同步干预对孤独症儿童合作行为的干预促进

人际同步对 TD 儿童的合作行为有促进作用(马昕玥,崔丽莹,2022; Jackson et al.,2018),近年来,不少研究开始探讨人际同步干预对 ASD 儿童社会功能的改善作用。有学者认为互动同步干预可能比传统的干预更有效(Landa et al.,2011),传统干预方式从认知角度教 ASD 儿童理解他人的意图和想法,需卷入大量认知资源,难度较高。而人际同步干预只需关注模仿与同步,学习时社交和认知负担较少(张鑫,2021)。还有研究表明,基于人际同步的干预模式可在治疗初期帮助儿童与治疗师之间建立良好信任关系(Dvir et al.,2020)。因相关实证研究较少,目前尚未有人际同步干预促进孤独

症儿童合作行为的直接证据。通过梳理文献,总结人际同步干预对 ASD 儿童合作相关能力的促进作用如下:

3.1 促进神经系统激活

ASD 群体在与他人进行人际同步活动时,存在神经系统激活的现象,如 ASD 儿童在成年同伴引导下进行同步伸展或全身摇摆运动时,顶下小叶区域出现高激活(Su et al., 2020, 2021)。有研究在社会互动情境下考察 ASD 儿童与父母之间的脑际沟通,使用基于 fNIRS 的超扫描技术在两人按键任务中同时测量他们的前额叶,发现 ASD 儿童在与父母进行同步合作时,其额叶皮层的人际神经同步性要高于单独和非互动时(Wang, Han et al., 2020)。此外,同步水平还受 ASD 儿童孤独症症状程度的影响,即症状较重的 ASD 儿童在合作过程中表现出与父母较低的动作同步水平和神经同步性。在一项涉及人际同步的对话实验中,ASD 儿童在与他人互动时大脑神经同步显著增强(Key et al., 2022)。有研究表明,ASD 群体人际运动同步(如姿势、注视和手势的协调)表现更好时会伴随着大脑神经同步的增加,以及社交功能的改善(Zampella et al., 2020)。神经系统激活增加了神经生理同步的可能性,有助于合作伙伴之间的协调互动,进而改善合作表现。

3.2 提升联合注意能力

ASD 儿童对单一物体保持注意的能力受到抑制,导致联合注意活动对他们来说尤其困难(Cabibihan et al., 2013)。在一项节奏音乐干预中,发现节奏的提示和调整与社交技能相关,节奏调节干预后,ASD 群体与同伴一起以调整后的节奏拍击时表现出更少的非同步性,此外,他们还表现出更大的联合注意和互动参与(Yoo & Kim, 2018)。Landa 等人(2011)考察 ASD 儿童在人际同步与不同步条件下开展综合干预课程的效果,发现两组被试虽然组间差异没有达到统计学意义,但同步组在联合注意和积极情绪的启动都有增加。在 ASD 儿童与机器人同步交互过程中,机器人指向特定物体,ASD 儿童更容易跟随机器人的注视方向。随着能力的提升,他们还能发起引导机器人注意力的行为(Kozima et al., 2007)。So 等人(2020)在 ASD 儿童与机器人的戏剧实验中,让干预组儿童观看 3 部

机器人戏剧表演,并让他们与机器人、人类实验员一起进行角色扮演,与对照组相比,干预组在联合注意启动和功能性游戏行为方面有显著改善。一些针对 ASD 儿童运动模仿能力的干预措施已被证明对其语言、游戏技能和联合注意有影响(Edwards, 2014)。人际同步干预通过节奏的支架作用,改善 ASD 儿童联合注意能力,从而为后续社交技能的提升创造一个时间窗口。

3.3 激发积极情绪体验

人际同步能使 TD 儿童心情愉悦,并产生积极情绪(Galbusera et al., 2019)。对于 TD 儿童来说,与他人互动同步会产生有益的体验,并增强奖赏性大脑区域的神经活动(Berridge & Kringelbach, 2015)。ASD 儿童在社会交往中的愉悦感,也有助于增加社会动机,并促进社会信息加工的神经系统发展。这种奖赏加工机制反过来帮助编码和巩固对社会经验的积极记忆,并影响更多相关社会功能的大脑神经系统发展(Greene et al., 2019)。在 ASD 群体中,也发现以舞蹈、音乐和游戏形式的人际同步干预可激发积极情绪,从而带来人际交往中合作行为的改善(Basso et al., 2021; Landa et al., 2011)。在一项基于动作镜像的舞蹈干预中,ASD 群体幸福感、身体意识、自我-他人意识均有所改善,社交技能也有所提高(Koch et al., 2015)。愉悦的社交体验是社会动机的基础,也是干预可持续推进的重要保障。ASD 群体普遍存在情绪障碍(Oakley et al., 2021),情绪往往是 ASD 儿童成长中最主要的关注点。人际同步干预激发的积极情绪体验,有助于 ASD 儿童形成稳定情绪和积极的生活态度。

3.4 改善感知运动能力

感觉运动同步在儿童的社会交往中起着至关重要的作用(Monier & Droit-Volet, 2019)。从个体发展角度,婴儿与照料者之间感觉运动同步,对其后期社会能力的获得具有深远影响(Feldman, 2007)。对于 TD 儿童,感觉运动同步能增强其与陌生同伴的有意沟通,并促进合作与人际协调(Rabinowitch & Meltzoff, 2017)。对于 ASD 群体,感觉运动同步能力也被认为是提升社交互动和合作行为的重要基础(Su et al., 2022)。在一项以音乐节奏为同步条件的实验中 ASD 儿童经过 20 周的干预,

与治疗师的身体同步性显著提高 (Dvir et al., 2020)。在单边同步实验中,ASD 群体在以跟随者身份调整自己的动作以适应对方(领导者)的动作时,感知同步能力对其合作行为产生积极影响 (Koehne, Hatri et al., 2016)。节律性听觉输入有助于改善 ASD 儿童感觉运动功能,即提供一个可预测的结构来稳定运动模式变化,并促进运动规划内部模型的发展 (Hardy & Lagasse, 2013)。

在运动技能方面, Srinivasan 等人 (2015) 通过考察节奏(以人际同步为基础的音乐节律游戏)、机器人(与机器人互动的多肢体模仿和同步游戏)和对照组(精细运动桌面游戏)三种干预方式对 ASD 儿童模仿、人际同步和总体运动表现的影响,发现在运动能力测验中节奏组和机器人组身体协调能力有所改善,而对照组在精细手部控制方面有所改善。研究者通过对 ASD 群体以人际动作模仿和同步为主的舞蹈、动作干预,发现在近泛化水平上,与对照组相比,同步组在全身模仿、同步运动、互惠对话方面均有增强 (Koehne, Hatri et al., 2016)。人际同步干预通过改善 ASD 儿童的身体协调及节奏感知,进而增强运动技能。

在运动模仿方面, Marsh 等人 (2013) 的研究表明,与正常发育儿童相比, ASD 儿童与父母在摇椅运动中不同步,并提出人际运动同步和模仿可能是 ASD 儿童社会认知干预的目标。一项研究显示, 14 名 5~9 岁 ASD 儿童经过为期 6 周的声束模仿同步干预后,模仿准确性和社会关注的持续时间方面取得了显著的改善 (Forti et al., 2020)。Landa 等人 (2011) 在 ASD 学步儿 (21~33 个月) 中补充以社会同步行为为目标的综合干预课程,发现人际同步组干预后与眼神接触配对相关的模仿行为增加,这一技能被泛化到不熟悉的情境中,并在后续活动中得以维持。运动模仿能力是 ASD 儿童进行社交学习与合作互动的重要基础。

3.5 提高推理及共情能力

还有证据表明,人际同步干预对 ASD 群体的推理及共情能力有一定的促进作用。Koehne 和 Behrends 等人 (2016) 的研究发现,对于社会认知能力受损的 ASD 群体,通过同步干预,促进了他们的情绪推理和共情感受(对他人感受的情绪反应)。有

研究者对 ASD 儿童进行会谈干预,发现二元交互能力增强后,ASD 儿童可将这项技能泛化到更复杂的社交活动中,并与治疗师进行共享活动,表现出人际同步的特征 (Bertamini et al., 2021)。在运用镜像和人际同步技术对 ASD 群体的干预中,发现虽然 ASD 群体的共情能力没有显著变化,但情绪推理、同步性和运动互惠性显著增加 (Koehne, Behrends et al., 2016; Mastrominico et al., 2018)。ASD 儿童与机器人互动同步干预的研究显示,人际同步在一定程度上提高了 ASD 儿童的情感共情能力 (Giannopulu et al., 2020)。推理及共情能力的提升有助于 ASD 群体在合作中考虑对方的意图和感受,进而协调和规划自己的行动,更好完成合作任务。

综上,我们发现人际同步干预不仅能增加 ASD 儿童积极情绪体验,还对合作与人际同步过程中的关键能力成分——联合注意、运动感知等能力有促进作用,同时对推理及共情能力也有改善作用,这种促进作用还体现在神经系统方面的激活。根据 ASD 二元合作中的非典型性人际同步因素分析 (图 3),神经同步与行为同步相互影响与促进,人际同步干预试图通过行为同步训练,来改善神经同步及其相关的社会功能,进而提升整体社交能力。因此,在儿童大脑发育的黄金期,通过早期人际同步干预,可以在一定程度上改善大脑神经网络以及行为问题,让 ASD 儿童尽早在社会交往中开启正常的合作互动模式。目前虽未有直接的实证研究证明 ASD 儿童人际同步干预与合作行为的相互作用关系,但人际同步干预在一定程度上促进了合作相关能力发展,人际同步干预促进 ASD 儿童合作行为具有一定可行性。未来的实证研究应在此方面做进一步探讨,并细致剖析可能影响研究效果的变量因素,从而更好地了解人际同步促进孤独症儿童合作行为背后的核心机制。

4 总结与展望

本文通过论述普通儿童及 ASD 儿童合作能力的发展及表现,发现 ASD 儿童虽然在一些需要策略性思维的合作任务中表现与正常儿童无异 (李晶, 朱莉琪, 2014; Downs & Smith, 2004; Sally & Hill, 2006),但因其社会功能缺陷,普遍存在合作能力不足的现象 (Su et al., 2022; Wang, Li et al., 2020; Jahr

et al., 2000; Kaartinen et al., 2019)。影响 ASD 儿童合作中的非典型性人际同步主要有:神经生理异常导致其难以与他人进行良好脑间同步;时间同步困难导致其难以协调时机与他人保持同步;运动能力不足导致其难以与他人形成行为运动同步。一些研究开始尝试用人际同步干预来改善 ASD 儿童社会功能缺陷。综合以往文献,已有证据表明人际同步干预能帮助 ASD 儿童激活神经系统、提升联合注意、增加积极情绪体验及增强运动感知能力,这为人际同步干预促进其合作能力的发展提供可行性。目前已有学者提出将人际同步作为 ASD 儿童早期诊断标识 (McNaughton & Redcay, 2020; Zampella et al., 2020), 人际同步也可能成为 ASD 儿童早期干预的手段, 未来研究应从以下方面做进一步的探讨:

首先,合作是一个由复杂能力成分共同作用的多层次过程。该领域研究的实践意义在于将协调能力作为早期治疗的目标,对 ASD 儿童的社会化具有重要意义 (Cerullo et al., 2021)。有研究表明,除了社会功能的核心障碍外,ASD 与 TD 群体中还在注意力 (Hedger et al., 2020)、时间感知 (Allman & Falter, 2015)、感知处理 (Meilleur et al., 2020) 等方面存在差异。因此,要系统了解 ASD 儿童合作中的人际同步特征,未来的研究还需要全面了解多个潜在过程运作的功能差异,且考虑各因素在多大程度上影响 ASD 儿童的合作行为。虽然人际同步能力在一定程度上会影响 ASD 儿童的合作表现,但这种表现差异也有可能是互动类型引起的,如有效沟通程度 (Crompton, Ropar et al., 2020)、共享经验感受 (Crompton, Sharp et al., 2020),也许这些因素对 ASD 儿童与同伴建立合作和情感联系更为重要。未来的研究应考虑社会互动中对 ASD 儿童合作行为更广泛的相关影响因素。最近也有研究表明,多动症 (Gvirts Problovski et al., 2021)、精神分裂症 (Dean et al., 2021) 群体的合作中也存在非典型人际同步的现象,人际同步缺陷这个潜在因素可能会因疾病而异,未来研究还需厘清各因素在不同条件下的作用机制,为 ASD 儿童早期干预方案提供更准确的指导意见。

其次,ASD 儿童因行为刻板,逻辑推理不足及

心理灵活性差 (Su et al., 2022),在静态和低水平的社交情景中,人际同步干预能给他们带来一定的舒适性,并有一定效果,但在动态和高水平的社交情境中,他们较容易表现出对社会信息的异常加工 (Chawarska et al., 2012)。人际同步通过简单地遵循指示来同步动作,可能不足以有效地支持 ASD 儿童后续的社会参与。因此基于同步性的干预可能需要包括更复杂的开放式社交场景,互动同步性可能与感知互动质量更相关 (Manders et al., 2021)。有研究者认为,多感官集成,即来自不同感官(如听觉、视觉)的信息的组合,对于具有内在噪声的个体与动态的外部环境成功交互至关重要 (Noel et al., 2018, 2017; Alais & Burr, 2004)。还有学者提出通过自然会话模式,考察 ASD 儿童头部、手部和躯干等身体部位的同步性,预测其社会合作能力 (Zampella et al., 2020)。未来的研究应更多关注基于自然情景的互动同步,以及要考虑 ASD 儿童处于“最近发展区”的能力范围,从简单情景的指令同步到复杂开放社交场景的多元感知互动,为 ASD 儿童的阶梯式人际同步干预提供理论指导。

最后,目前研究主要采用运动同步干预的形式,并伴有一定的旋律或节奏 (Forti et al., 2020)。人际同步干预效果受同步形式、节奏频率等外部线索影响,例如在手拍游戏中,自发同步性的增加与联合注意反应能力的提高相关,而在敲击任务中,有意同步性的增加与联合注意启动能力的提高相关 (McNaughton & Redcay, 2020; Fitzpatrick et al., 2017);研究表明 ASD 儿童的运动频率和同步率之间存在正相关关系 (Fitzpatrick et al., 2017),治疗师与 ASD 儿童之间的相互调节适应在以中高频率为特征的节律模式中表现得更好,即每秒 2 次或更多次的重复节律时,他们之间的同步水平更高 (Dvir et al., 2020)。干预效果还受 ASD 儿童个体能力水平的影响,如认知水平较高、早期互动缺陷较少的 ASD 儿童干预后表现出更好的表达性语言和游戏技能的习得 (Zachor & Itzhak, 2010);高功能孤独症儿童在同步合作活动中表现更好 (Fiebich, 2022);认知共情好的 ASD 儿童在人际同步中表现更佳 (Koehne, Hatri et al., 2016)。目前,人际同步干预还存在结果不一致的现象。一些研究发现人

际同步对其社交能力和亲社会行为有促进作用 (Koehne, Behrends et al., 2016; Landa et al., 2011; Srinivasan et al., 2015), 如 ASD 儿童 4 岁左右时与父母同步行为预测其 1 年后的联合注意技能和长达 16 年的语言技能 (Siller & Sigman, 2002)。但也有研究发现人际同步未能对 ASD 儿童的核心障碍带来改善, 如接受以鼓励社会同步性干预课程的幼儿与对照组比, 在联合注意或共同情感方面没有显著提升 (Landa et al., 2011)。未来的研究应探讨同步形式、节奏频率以及个体间差异的相互作用机制, 从而提高干预的效果, 进而为开展更有效的更有针对性的临床干预训练提供借鉴和指导。

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The Impact of Interpersonal Synchronization on Autistic Children's Cooperative Behavior and Its Intervention Promotion

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Abstract: As the foundation of human behavior, cooperation is a crucial aspect of children's social development. However, children with autism are not cooperative in social interactions because of impairments in their motor skills, neurophysiology, and temporal synchronization. Interpersonal synchronization has been found to improve children's cooperative behavior. Interpersonal synchronous intervention improves cooperative skills of autistic children which relate to cooperation, such as joint attention, pleasant emotion, and motor competence. Meanwhile, it activates the neural system, finally enhances their social adaptation. In the future, research should be done to evaluate the quality of autistic children's interactions in complex, open – ended social scenarios, beside focusing on the influence of elements such as synchronization form, rhythm frequency, and individual characteristics that influence their cooperative behaviors.

Key words: interpersonal synchronization; autism spectrum disorder (ASD); cooperation; joint attention