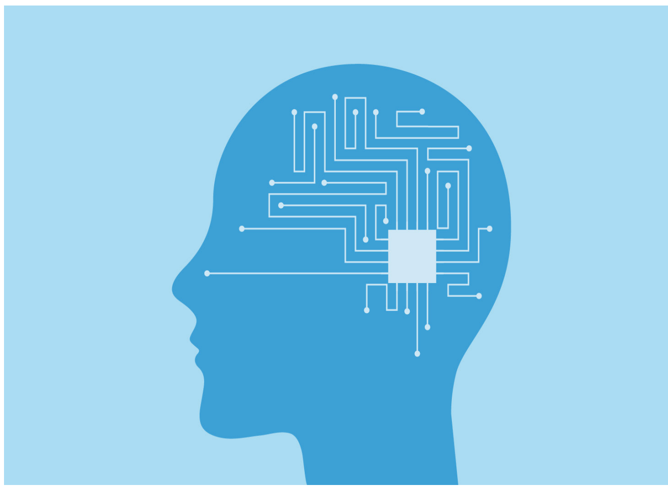
联合国科学顾问委员会：

神经技术

科学顾问委员会

什么是神经技术？



神经技术(Neurotechnology)是一个统称，指任何能够记录或修改人类神经系统神经元活动的技术[1]。其功能主要包括以下三类：(1) 神经成像（监测大脑结构与功能）；(2) 神经调控（影响大脑功能）；(3) 直接脑机接口（Brain–Computer Interfaces, BCIs)[2]。几十年来，神经技术在应对一些最常见的疾病和障碍方面发挥了至关重要的作用。脑深部和神经刺激技术已经可以帮助消除帕金森病和癫痫的症状。[3] 如今，已有超过60万人通过人工耳蜗刺激听觉神经恢复听力。[4] 数十万患有脊髓损伤和神经障碍的人通过脑机接口恢复了行动能力和肢体运动。[5] 数十年来，神经技术在应对某些最普遍的疾病和障碍中发挥了关键作用。深部脑刺激和神经刺激已帮助消除帕金森病和癫痫的症状[3]。目前，超过60万人通过人工耳蜗（Cochlear Implants）刺激听觉神经恢复了听力[4]。数十万脊髓损伤和神经障碍患者通过脑机接口重新获得了行动能力和肢体控制[5]。

其重要性何在？

神经技术的进步，尤其是脑机接口领域，正逐渐从医疗应用转向更广泛的日常生活场景。这些技术的普及引发了伦理、人权和安全方面的重大关切。

最新进展有哪些？

近年来的突破使脑机接口从简单的感觉和运动功能控制转向更高层次的认知能力[6]。当前技术已能实现人类与人工智能（AI）的协同合作，使大脑与AI系统相互响应并共同演化。

2024年初，Neuralink成功将一款AI驱动的设备植入人类患者体内，使其仅凭思维即可控制计算机程序[7]。支持Neuralink的中国研究团队同时宣布，正在开发完全无线版本的技术，以降低风险并提升可及性[8]。

2021年，加州理工学院的研究人员公布了一项超声波技术，能够“读取”大脑活动并预测心理反应。这种非侵入性方法可能彻底改变脑成像技术，显著提升阿尔茨海默病和癫痫等神经系统疾病的诊疗水平。此外，该技术还可能实现通过脑信号控制虚拟或增强现实场景[9]。

更精细、低侵入性工具的开发使该领域变得更安全且更易普及。例如：Synchron公司的“Stentrode”通过血管输送电极，无需开颅手术即可完成植入[10]；Precision Neuroscience的“柔性电极阵列”利用数千个微型电极捕捉脑活动[11]；光学接口技术的进展可能最终消除手术植入的需求[12]。

神经技术不仅是脑疾病和损伤患者康复治疗的常规手段，还正快速拓展至非医疗领域。随着无线非侵入技术的成熟，脑机接口可能很快成为日常可穿戴设备的一部分，用于健康监测、提升工作效率或增强虚拟现实体验[13]。未来，它甚至可能融入大量人群的日常决策，或将个体连接起来实现集体行动[14]。

存在哪些风险?

随看神经技术日益融入人类生活，其伦理与实践问题逐渐凸显：

• **隐私、知情同意与人权：** 神经技术收集高度敏感的神经数据，可能成为黑客攻击或滥用的目标[15]。用户隐私和知情同意问题至关重要，因为这些信息可能被用于操纵行为或思想[16]。若大规模应用，还可能催生监控社会和威权治理模式[17]。“神经营销”（Neuromarketing）利用脑数据识别用户偏好，正成为企业的常用工具[18]。神经技术可能导致大规模人权侵害的风险正引发担忧[19]。

• **人类能动性：** 部分脑机接口用户报告称，其行为自主感发生改变，甚至认为某些动作并非由自身主导[20]。这引发了长期的法律与伦理问题——例如，若某人扣动扳机后声称是脑机接口而非其个人所为，责任应如何界定？当脑机接口用于群体协同行动时，能动性与问责问题将更为复杂。

• **安全性：** 士兵可能通过计算机增强感官、反应速度或耐力，从而引发“增强军备竞赛”的风险[21]。连接无人武器系统的“赛博格士兵”（Cyborg Soldiers）已非科幻概念[22]。增强型战争还可能挑战现有国际人道法的适用性[23]。

• **不平等问题：** 目前神经技术的研发能力几乎全部集中在全球北方[24]。长期来看，这可能导致“增强社会”与“未增强社会”的分化，加剧全球不平等[25]。

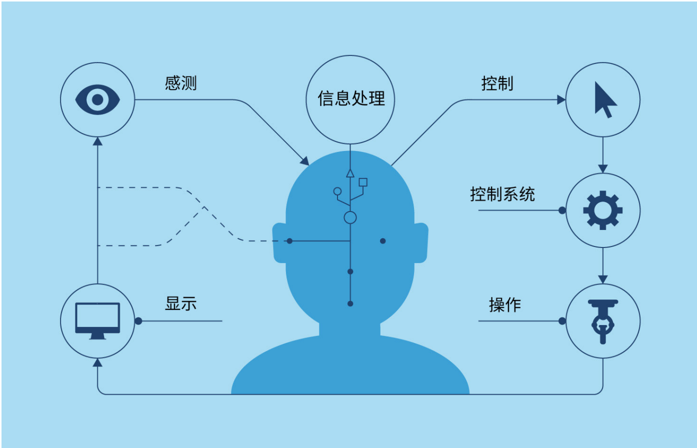
有何影响?

截至目前，神经技术的监管几乎完全由各国政府或区域性组织负责。[26] 缺乏国际公认的规范可能加剧一些风险，特别是在所谓“增强竞赛”方面，同时也可能在世界多地放任危险用途的蔓延。在此背景下，联合国已采取若干重要举措，其中包括教科文组织的《普遍生物伦理和人权宣言》，为神经技术的安全与公平发展提供了规范框架。[27] 联合国人权理事会也开始关注神经技术可能带来的人权影响，设立了一个顾问委员会，并呼吁开展相关研究。[28] 虽然这些举措是必要的，但恐怕仍不足以应对神经技术发展带来的日益严峻的风险。

应考虑哪些因素?

• **神经技术的伦理研究与公平发展：** 随着神经技术影响的日益扩大，或许需要制定更具体的研究与开发规则和/或监管机制。[23] 尤其是关于脑机接口，必须有明确的规则和对知情同意的保障。[24] 确保公平获取神经技术带来的益处，也应成为优先事项。

• **全球数据保护标准：** 欧盟和美国现有的数据保护框架中已包含部分适用于神经技术的条款。[25] 然而，随着使用的日益广泛，有必要重新审视全球数据保护规范与标准，以应对其独特的风险。对各国、地区及国际标准和立法进行全面盘点，重点聚焦于其有效性与保护措施，将是下一步的有益举措。



• **监管者、私营部门、使用者与科学家之间的对话平台：** 制定可行的神经技术保障措施，需要上述各方开展有意义的协商。尤其在神经技术应用日益超出医疗领域的当下，汇聚监管、商业及科学领域的专家至关重要。

• **更深入理解全球安全风险：** 神经技术在军事领域的潜在影响尚处于初步了解阶段。可在主要的区域和国际安全治理机构中开展关于人类增强相关法律与实践问题的专题讨论。

为确保发展中地区公平获得神经技术进步成果，全球南方需要来自全球北方的支持，包括知识转移、科研基础设施投资和能力建设项目。建立区域研究中心、伦理治理框架和人才培养计划，将有助于在应对伦理与安全挑战的同时推动创新。

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