综述

睡眠时型与技术成瘾的关系及作用机制研究进展

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［摘要］数字化时代，互联网改变了人们的生活方式和昼夜节律，也带来了技术成瘾的全球性问题。众多研究表明睡眠时型与特定技术成瘾（如网络、手机、游戏和社交媒体）显著相关，这使得分析睡眠时型成为了探讨技术成瘾发生、发展和维持的新视角。睡眠时型包括清晨型、中间型和夜晚型，其中夜晚型是个体过度使用和依赖技术的风险因素。目前，有关睡眠时型与技术成瘾的研究多集中在两者的关系方面，鲜少有针对其内在作用机制的分析。基于此，该文从生理因素（如奖赏系统）、心理因素（如抑郁情绪）、个人因素（如性别、年龄、人格特质和睡眠模式）和环境因素（如父母教养风格）等多个角度进行探讨，并采用人-情绪-认知-执行交互模型和进化生命史理论从病因和进化的角度进行分析，对睡眠时型和技术成瘾的关系及其作用机制进行综述。

［关键词］睡眠时型；技术成瘾；奖赏系统；人-情绪-认知-执行交互模型；进化生命史理论
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Progress in relationship between chronotype and technology addiction and its mechanism

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[Abstract] In the era of digitalization, the Internet has changed people's lifestyle and circadian rhythm, and has also brought the global problem of technology addiction. Many studies have shown that chronotype is significantly related to specific technology addiction (such as Internet, smartphones, video games and social media), which makes chronotype become a new perspective to explore the occurrence, development and maintenance of technology addiction. Individuals can be classified into three chronotypes: morning type (M-type), neither type (N-type) and evening type (E-type). Most studies showed that E-type was the risk factor in the onset and maintenance of problematic technology use. At present, most of the prior research focused on the relationship between chronotype and technology addiction, and there were few studies on the mechanism. Based on this situation, this paper discusses physiological factors (such as reward system), psychological factors (such as depression), individual factors (such as gender, age, personality traits and sleep patterns) and environmental factors (such as parental style), analyzes the relationship with Interaction of Person-Affect-Cognition-Execution (I-PACE) model and life history theory from the perspectives of etiology and evolution, and reviews the relationship between chronotype and technology addiction and its mechanism.

[Key words] chronotype; technology addiction; reword system; Interaction of Person-Affect-Cognition-Execution model; life history theory

当前，信息技术已深度嵌入我们的生活，改变着个体的生活方式。第49次《中国互联网络发展状况统计报告》[1]显示，我国互联网普及率达73.0%，网民规模达10.32亿，其中手机网民高达10.29亿。技术的普及和应用在推动社会发展的同时，也满足了个体的个性化需求。但个体对技术的习惯和依赖可能会导致其行为失控，从而损害其情绪健康、工作绩效、人际关系等[2]。GRIFFITHS[3]认为，技术成瘾是涉及

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人机交互的行为成瘾。TUREL 等[4]将技术成瘾定义为非适应性依赖的心理状态，具有突显性、情绪调节、耐受性、戒断、冲突和易复发等特征。作为全球性的成瘾问题，技术成瘾已成为行为成瘾领域的热点话题。

昼夜节律是一种内源性周期波动的生命过程[5]，在个体表达间存在差异，这种差异被称为睡眠时型。睡眠时型一般分为3种，即清晨型、中间型和夜晚型[6]。清晨型个体通常在一日中偏早时间的唤醒水平更高，夜晚型个体则在下午和晚上的唤醒水平更高，中间型处于上述两种情况之间[6]。近年来随着电子产品的普及，其屏幕蓝光可延后个体的昼夜节律，使人群中夜晚型的比例逐年上升[7]。研究[8]显示，夜晚型的倾向与较多的技术使用相关，且使用时长、频率的增加是技术成瘾的重要预测因子。在新型冠状病毒感染流行期间，居家隔离会减少人们的身体活动和日光暴露，增加由社会隔离和工作失序带来的压力，从而影响其对时间流逝的感知。而互联网技术可以提供一个改善社交隔离、缓解焦虑的机会，因此人们在这一时期出现了睡前电子设备使用水平显著上升和昼夜节律延迟的现象[9]。这种改变不仅使个体的睡眠时型倾向于夜晚型，还降低了其睡眠质量，增加精神健康问题的风险。目前，尚未有关于睡眠时型和技术成瘾关系的系统总结。鉴于此，本文通过分析睡眠时型与技术成瘾间的关系，阐述可能影响其关系的生理、心理、个人和环境因素，并试图通过人-情绪-认知-执行交互（Interaction of Person-Affect-Cognition-Execution，I-PACE）模型和进化生命史理论对两者的关系进行理解，以期为降低夜晚型的技术成瘾风险提供参考。

1 睡眠时型与技术成瘾的关系

目前，技术成瘾主要包括网络成瘾（如社交媒体成瘾、网络游戏成瘾、网络购物成瘾、网络色情成瘾、网络赌博成瘾等）和手机成瘾2个方面。而有关睡眠时型与技术成瘾的研究多集中在社交媒体成瘾、网络游戏成瘾等网络成瘾和手机成瘾[10-11]。通过文献检索，我们对睡眠时型与技术成瘾间的关系进行整理并阐述如下。

1.1 睡眠时型与网络成瘾的关系

网络成瘾包括2种类型，即广泛性网络成瘾和特异性网络成瘾；前者是指个体在互联网上无目的地使用不同应用程序且花费过多时间，后者涉及对特定应用程序（如游戏、社交、购物、色情等）的成瘾[12]。有研究[13-17]表明，夜晚型与广泛性网络成瘾呈显著正相关。与清晨型、中间型相比，夜晚型个体的网络成瘾得分更高[18]。在网络成瘾群体中，网络成瘾高危组个体的夜晚型占比亦较高[13]。在调整了性别、年龄、人格、父母学历、睡眠质量等变量后，夜晚型这一睡眠时型仍可显著预测出更高的网络成瘾水平[17,19-20]。同时，也有研究者获得了不同睡眠时型个体的网络成瘾水平不存在显著差异的结果，这可能与该研究所选样本相关；有沉重学业压力的韩国中学生，其在线娱乐时间几乎被学习和补课占据，导致网络成瘾水平在不同睡眠时型中的差异不显著[21]。

然而，有关夜晚型与特异性网络成瘾的研究主要集中在与社交媒体成瘾、网络游戏成瘾方面。有研究[22-25]表明，夜晚型与社交媒体成瘾、社交媒体使用强度和使用侵入性均呈显著正相关。针对Facebook的研究[23]结果显示，夜晚型个体使用目的更为多元，用户体验更加积极，也更具参与性；且纵向研究[22,24]表明，个体夜晚型的偏好程度可以正向预测其2个月后社交媒体成瘾水平，在调整了年龄、性别、人格、睡眠时间后，夜晚型仍是Facebook成瘾、使用强度和侵入性的重要预测因子。作为另一种特异性网络成瘾，网络游戏成瘾的相关研究主要偏向于儿童和青少年群体。有研究发现，参与网络游戏的频率和时间更多、养成睡前玩游戏习惯的儿童会越倾向于夜晚型[26]；夜晚型的青少年玩家也会花费更多的时间在电脑游戏上[27-28]。也有研究[29-31]证实夜晚型与网络游戏成瘾呈显著正相关，且在调整了性别、年龄和人格后，夜晚型仍能显著预测个体的网络游戏成瘾水平。

1.2 睡眠时型与手机成瘾的关系

横向研究[27,32-35]表明，夜晚型与手机成瘾呈显著正相关。在使用逐步回归模型调整了性别、年龄、人格、睡眠时长等因素后，研究发现睡眠时型仍是手机成瘾的独立预测因子[32-33,36]。纵向研究[34,37]则表明，手机成瘾可以预测个体之后的睡眠时型。交叉滞后模型的结果显示，手机成瘾可以单向预测个体1年后偏晚的睡眠时型，反之则无预测作用[34]。一项使用潜变量混合增长模型对大学生开展为期2年的追踪

研究[37]的结果显示，与低问题性手机使用水平（低水平）发展轨迹组和中等问题性手机使用水平（中等水平）发展轨迹组相比，高问题性手机使用水平（高水平）发展轨迹组的个体中清晨型显著较少、夜晚型显著较多；在调整了性别、健康状态和睡眠质量等协变量后，多元逻辑回归结果显示具有中等水平、高水平发展轨迹的个体的睡眠时型更偏向于夜晚型，这表明长期的问题性手机使用可作为个体昼夜节律紊乱的预测因素。

鉴于睡眠时型受基因遗传的直接影响[38-39]，现有研究多倾向于将睡眠时型概念化为驱动技术成瘾的风险因素。目前，横向研究的结果展现出一种趋势，即夜晚型是技术成瘾的风险因素；相比于清晨型和中间型，夜晚型与网络成瘾、手机成瘾水平呈显著正相关，且夜晚型可以预测网络成瘾和手机成瘾水平。纵向研究则发现，夜晚型无法单向预测个体未来一段时间的手机成瘾水平，反之可以预测[34,37]，这与横向研究结果不一致。相关文献总结见表1。对于睡眠时型与技术成瘾的关系，横向研究方法限制了因果关系的解释力，而纵向研究的证据相对较少。因此，结合横向和纵向研究我们推测，该两者之间可能存在一种双向因果关系，但仍需要进一步的研究加以分析。

表1　睡眠时型与技术成瘾关系的文献总结

Tab 1　Literature summary of the relationship between chronotype and technology addiction

Technology addiction	Literature	Basic information of subjects (age/year; male proportion)	Measure		Comment (when individuals are more inclined to evening type)
			Chronotype	Addiction	
Internet addiction	LIN et al., 2013[14]	2 731 college students (19.40±3.60; 52.4%)	MES	YBOCS-IU	↑ Compulsive Internet use
	RANDLER et al., 2014[17]	616 college students (20.81±1.97; 27.9%)	CSM	IA Scale	↑ Internet addiction
	KANG et al., 2015[13]	325 adults (20–49; 48.9%)	MEQ	YIAS	↑ Incidence of Internet addiction
	OH et al., 2016[15]	2 632 college students (19.16±0.91; 48.9%)	CSM	KIAT	↑ Internet addiction
	XU et al., 2018[19]	3 572 college students① (freshmen and juniors; 34.5%)	MES	IAT	↑ Internet addiction ↑ Incidence of Internet addiction
	CHUNG et al., 2020[21]	765 adolescents (15.07±1.36; 60.9%)	MES	YIAS	No significant difference in Internet addiction between different chronotypes
	KOO et al., 2021[18]	8 565 high-school students (16.77±0.85; 52.1%)	MEQ	IAPS	↑ Internet addiction
	PRZEPIORKA et al., 2021[16]	398 college students (20.37±2.29; 28.9%)	CSM	IAT	↑ Problematic Internet use mental disorder ↑ Problematic Internet use time management disorder
	YI et al., 2021[20]	7 457 college students① [≤17 (15.1%), 18 (64.6%) and ≥19 (20.2%); 53.5%]	MEQ	IAT	↑ Internet addiction
Social media addiction	LIN et al., 2021[25]	1 791 young adults (27.2±10.1; 30.1%)	rMEQ	BSMAS	↑ Problematic social media use
	BLACHNIO et al., 2015[22]	633 Facebook users (20.78±4.80; 35.9%)	CSM	FBI Scale; FIQ	↑ Intensity and frequency of Facebook usage ↑ Facebook intrusion
	HORZUM et al., 2022[24]	981 college students (20.82±2.39; 26.9%)	CSM	FAS	↑ Facebook addiction
Internet gaming addiction	VOLLMER et al., 2014[31]	741 adolescents (12.89±1.05; 60.2%)	CSM	CGAS	↑ Computer game usage time ↑ Computer game addiction
	KÜÇÜKTURAN et al., 2022[30]	922 high-school students (16.0±1.04; 42.7%)	CSM	CASfA	↑ Computer game addiction
	DAĞ et al., 2022[29]	109 children (9.20±1.45; 49.5%)	CCTQ	CASfC	↑ Computer game addiction ↑ "Can not give up playing games" subscale scores ↑ "Neglecting responsibilities because of computer games" subscale scores

Continued Tab

Technology addiction	Literature	Basic information of subjects (age/year; male proportion)	Measure		Comment (when individuals are more inclined to evening type)
			Chronotype	Addiction	
Smartphone addiction	TODA et al., 2015[27]	182 college students (male: 21.70±2.60, female: 21.0±2.1; 67.0%)	MEQ	MPDQ	↑ Smartphone dependence
	RANDLER et al., 2016[36]	342 younger adolescents (13.39±1.77; 51.5%); 208 older adolescents (17.07±4.28; 29.8%)	CSM	SAPS for younger adolescents; SAS-SV for older adolescents	↑ Smartphone addiction
	DEMIRHAN et al., 2016[33]	902 college students (20.42±1.90; 27.0%)	CSM	MPPUS	↑ Problematic mobile phone usage
	RANDJELOVIC et al., 2021[35]	77 college students① (20–22; both genders)	MEQ	SAS-SV	↑ Problematic smartphone use
	BAĞCI et al., 2022[32]	346 college students (19.60±2.56; 32.7%)	CSM	SAS-SF	↑ Smartphone addiction
	KANG et al., 2020[34]	Baseline: 940 college students (19.10±0.90; 36.8%) One-year follow-up: 902 college students (19.10±0.90; 36.5%)	rMEQ	MPIQ	↑ Mobile phone involvement ↑ Mobile phone addiction behaviors
	LI et al., 2022[37]	999 college students (18.80±1.20; 37.7%)	MEQ	SQAPMPU	↑ Score trajectories of problematic mobile phone use

Note: ① represents that no age or gender information was included in the original literature, so we use relevant information to supplement. ↑ represents a significant positive correlation. MEQ/MES—Morningness-Eveningness Questionnaire/Scale; rMEQ—reduced Morningness-Eveningness Questionnaire; CSM—Composite Scale of Morningness; CCTQ—Children's Chronotype Questionnaire; YBOCS-IU—Yale-Brown Obsessive Compulsive Scale for Internet Use; IA Scale—Internet Addiction Scale; YIAS—Young's Internet Addiction Scale; IAT—Internet Addiction Test; KIAT—Korean version of the Internet Addiction Test; IAPS—Internet Addiction Proneness Scale for Youth; BSMAS—Bergen Social Media Addiction Scale; FBI Scale—Facebook Intensity Scale; FIQ—Facebook Intrusion Questionnaire; FAS—Facebook Addiction Scale; CGAS—Computer Game Addiction Scale; CASfA—Computer Game Addiction Scale for Adolescents; CASfC—Computer Game Addiction Scale for Children; MPDQ—Mobile Phone Dependence Questionnaire; SAPS—Smartphone Addiction Proneness Scale; SAS-SV—Smartphone Addiction Scale-Short Version; SAS-SF—Smartphone Addiction Scale-Short Form; MPPUS—Mobile Phone Problem Usage Scale; MPIQ—Mobile Phone Involvement Questionnaire; SQAPMPU—Self-rating Questionnaire for Adolescent Problematic Mobile Phone Use.

2 睡眠时型与技术成瘾关系的作用机制

当前，相关研究仅集中在睡眠时型与技术成瘾的关系上，较少针对其中的内在机制进行探索[14-16,25]。近年来，神经科学研究发现技术成瘾与物质成瘾的病理路径趋同[40-41]。我们推测，是否可从睡眠时型与物质成瘾的研究中进行借鉴，寻找睡眠时型与技术成瘾关系的影响因素。基于此，如下从生理、心理、个人和环境这4个方面，对两者关系的作用机制进行分析。

2.1 生理因素

在研究睡眠时型与技术成瘾关系的生理影响因素中，奖赏通路是其具有代表性的因素之一。BYRNE等[42]发现，在奖励线索的背景下奖赏通路是能够引导动机、行为和愉悦情绪的神经网络，是成瘾的重要生物基础。有研究[38-39]显示，与睡眠时型相对应的昼夜节律基因（如*Clock*、*Per1*、*Per2*）的多态性表达会影响关键奖赏中枢活动和多巴胺能活动。与清晨型相比，夜晚型与奖励中枢中更高的多巴胺受体可用性相关，存在更强的奖赏敏感性[43]，在奖赏通路核心区域（如内侧前额叶、腹侧纹状体）中表现出更强的奖赏反应性[42]，且在涉及认知控制的脑区中默认网络功能连接性更弱[44]。脑科学研究表明，技术成瘾个体的参与认知控制、奖励处理的大脑皮层及皮层下区域可发生灰质体积、脑区间功能连接水平的显著改变[40-41,45-46]，总体表现出多巴胺奖赏系统的激活和执行控制网络的失效[47]。综上，夜晚型个体可能拥有一个成瘾易感性较高的奖赏系统，对技术使用可能存在更高的奖赏敏感性、奖赏反应性和更低效的认知控制，从而可促进其成瘾行为的形成和维持；同时，

与奖赏系统相关的功能改变可能也是睡眠时型与技术成瘾关联的重要生物基础。

2.2　心理因素

在研究睡眠时型与技术成瘾关系的心理影响因素中，抑郁是其最受关注的因素之一。相关研究[15-16]表明，抑郁在夜晚型与网络成瘾之间起到了中介作用。夜晚型个体具有较低的未来时间洞察力，更倾向使用非适应性的情绪调节策略，而这些特点会加剧个体的负性体验，被认为是夜晚型与抑郁关联的行为机制[5]。与夜晚型个体的低情绪调节能力相关的脑机制改变，如较高的情绪加工脑区激活水平、较低的默认网络功能连接强度等，被认为是夜晚型与抑郁关联的神经基础[5,48-49]。且抑郁的严重程度与技术成瘾相关[50-51]。夜晚型个体具有生理和心理上的抑郁易感性，该类人群会将技术使用作为一种回避和调节抑郁情绪的策略，当技术使用为其提供了持续的奖励（如满足感、沉浸感）时，个体就会从正常技术使用过渡为技术成瘾。

2.3　个人因素

2.3.1　性别与年龄　睡眠时型与技术成瘾间的关联强度可能存在性别和年龄的差异。有研究表明，男性更偏向于夜晚型且更易沉迷于网络、游戏、社交媒体，女性则更偏向于清晨型和手机成瘾[13-14,17,24,27,30-32,36]，产生差异的原因可能包括高睾酮水平的性激素影响[52]、网络使用动机[17]以及父母对男孩持更放纵的教养风格[53]，但也有研究[14,20,28,35]发现了与之相反或无性别差异的结果。对于年龄方面，年轻人比成年人、老年人更偏向夜晚型且存在更多的技术使用问题[6,22,54-55]，年纪小的孩子比年长的孩子存在更多的网络游戏成瘾风险[31]和手机成瘾风险[56]。

2.3.2　人格特质　人格是个体稳定的心理特质。不同睡眠时型的个体存在特定的人格特质，使得技术成瘾也存在个体差异。元分析表明，清晨型与高尽责性、低神经质存在中等的相关性，夜晚型与低尽责性、高外向性和开放性存在中等的相关性[57]。而高尽责性和宜人性是技术使用过程中的保护因素，高神经质是促进技术成瘾的风险因素[58-61]。综上，夜晚型更偏向于低尽责性，该较为不利的人格特质增加了个体发展为技术成瘾的可能；且尽责性是与自我调节技能相关的特质，低尽责性意味着自我调节能力较低[62]，偏向即时满足，从而易导致技术成瘾[10,63]。

2.3.3　睡眠模式　研究表明，睡眠质量和失眠症状在夜晚型与社交媒体成瘾之间起到中介作用[25]，不利的睡眠模式可能在其中产生重要影响。睡前，人们的感觉更为放松，暴露在屏幕蓝光中的时间较长，从而延迟了个体的昼夜节律[64]。且密切的夜晚人机互动会导致长期的社交时差，在夜晚型个体中产生睡眠债务，甚至导致慢性睡眠剥夺[65]。而这也会在神经层面上增强夜晚型个体的奖励回路敏感性和冲动性，增加技术成瘾的发生风险[39]。

2.4　环境因素

家庭环境是青少年最为亲密的社会环境。在睡眠时型与技术成瘾关系研究中，父母教养风格是最受关注的环境影响因素。有研究[14]表明，父母教养风格可在睡眠时型和强迫性网络使用间发挥调节作用。父母对青少年的监督、与之交流形成的良好亲子关系是睡眠和技术成瘾的主要保护因素[66]，而缺乏父母支持和监督的青少年可能无法控制自己的就寝时间和日常安排，从而有更高的风险发展为夜晚型和网络成瘾[67]。研究发现，不良教养风格（如侵入性控制、自主性限制等）往往会塑造出焦虑型、回避型依恋的孩子[68]；该类子女易产生逆反心理、激发亲子冲突，常会通过使用网络和手机来抵抗和回避父母，以寻求补偿与替代性的社会支持[10]。

3　睡眠时型与技术成瘾关系的理论理解

基于上述分析，我们尝试使用I-PACE模型和进化生命史理论，从病因和进化的角度对睡眠时型与技术成瘾的关系进行理论分析。

3.1　夜晚型发展和维持技术成瘾的病理过程

BRAND等[69]于2016年提出I-PACE模型，用以解释特定网络使用障碍发展和维持的过程。该团队认为，特定网络使用障碍是易感性因素、调节或中介因素、执行功能因素相互作用的结果。根据I-PACE，睡眠时型及其相关的奖赏系统、人格特质、父母教养风格等均为技术成瘾的易感性因素，这些因素可能增加个体的冲动应对策略、对内外部刺激的抑郁反应等

调节或中介因素的程度，再结合自我调节等执行控制能力的下降，从而可使夜晚型个体更易发展和维持技术成瘾行为。在特定技术使用障碍的早期阶段，夜晚型个体在不断延后的睡眠时间里通过网络和手机体验到的满足感会导致正强化，从而加强夜晚型与技术使用间的关联。随着技术使用向着失控和强迫性发展，夜晚型个体可能会经历人际冲突、抑郁焦虑等负面状况，进而通过网络和手机体验到的补偿感会继续维持其技术成瘾行为。

3.2 夜晚型倾向选择技术成瘾的进化视角

进化生命史理论认为，个体分配有限资源的倾向可反映其特有的生命史策略（life history strategy，LHS）。对于成长于恶劣环境的个体而言，其对未来的预期不佳，认为长期投入的风险较大，而将未来收益折现是资源利用最大化的方式，因此该类个体强调短期效应，倾向于即时满足，称为快策略者[70]。从进化视角来讲，夜晚型是一种快策略的表达，这可能与人类祖先使用火向夜间环境扩张相关。黑暗带来的适应性挑战选择了那些更加冲动、偏执以及社交性较高的人，且黑暗导致的能见度降低也更利于隐藏身份，从而可降低个体抑制不良行为的可能性，增加冲动行事的风险[71]。因此，危险且隐秘的夜间活动所选择和塑造的夜晚型个体会更加冲动，倾向于感觉寻求，看重短期效应[6]。对于快策略的夜晚型个体，成瘾行为是其为了获得即时满足的选择。沉迷于技术会减少长期投资，获得更多即时的回报和享受，这对快策略个体来说具有一定的进化适应性意义。

4 总结与展望

回顾现有横向研究可以发现，夜晚型个体具有更高的技术成瘾水平和技术成瘾风险，且夜晚型倾向还是个体技术成瘾重要且独特的预测因子。纵向研究结果表明个体的技术成瘾问题会增加未来夜晚型倾向的可能性，但反之个体的睡眠时型无法预测之后的技术成瘾。从上述两类研究获得的结果发现，睡眠时型与技术成瘾或存在双向因果关系。

在生理和心理层面上，夜晚型个体具有成瘾易感性更高的奖赏系统和抑郁易感性更高的情绪状态，这可能会增加其技术成瘾的风险。在个人和环境层面上，睡眠时型与技术成瘾的关系存在年龄和性别差异，年轻男性是高风险人群。此外，具有低尽责性的人格特质、不利的睡眠模式、接受了控制和忽视的教养风格特点的夜晚型个体可能更易技术成瘾。为了更加深入和全面地理解睡眠时型与技术成瘾的关系，我们使用 I-PACE 模型对夜晚型个体技术成瘾的发生、发展和维持过程进行理论解释，还从进化的新视角发现采用快策略的夜晚型个体选择技术成瘾是具有功能意义和进化适应性的。

综合上述研究我们发现，睡眠时型与技术成瘾关系相互促进，但由于该两者的关系证据多来自问卷调查，其结果或局限了对两者因果关系的推断。未来，或可考虑使用更客观的“数字时型”来衡量个体的内源性睡眠时型和技术使用水平[64]，增加前瞻性队列研究以进一步确定两者之间的因果关系；同时，借鉴睡眠时型与物质成瘾研究领域的方向和方法，以丰富睡眠时型与技术成瘾的内在机制研究，从而可以对具有可塑性的影响因素进行干预，降低技术成瘾的可能性。

利益冲突声明/Conflict of Interests

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