心理科学进展 2017, Vol. 25, No. 12, 2063–2074
Advances in Psychological Science DOI: 10.3724/SP.J.1042.2017.02063

个体冲动性对物质滥用与成瘾的影响及脑机制*

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摘 要 冲动性是一多维的概念, 一般指个体缺乏足够预见性或对自身的行为结果缺乏考虑和判断。个体冲动性和物质滥用与成瘾之间存在双重关系, 即个体特质冲动性是物质滥用与成瘾的重要危险因素, 而滥用成瘾性物质又会进一步损害个体的冲动控制功能。本文将论述个体冲动性和物质滥用与成瘾之间的相关性及冲动性增加潜在的神经机制。了解个体的冲动特质和物质滥用与成瘾者冲动性的改变, 研究物质滥用与成瘾者冲动障碍的神经生物学机制, 不仅有助于我们揭示物质滥用与成瘾的发生、发展, 以及脱毒后复发的脑机制, 而且有助于我们探索药物疗法以外的行为干预手段。

关键词 物质成瘾; 抉择冲动性; 运动冲动性

分类号 B845

物质滥用与成瘾被定义为一类慢性复发性脑病, 是精神活性物质与机体相互作用所造成的一种病理性精神/躯体状态。物质成瘾者为了获得某种欣快感或避免因减少/停止使用某种(些)物质导致的躯体/精神痛苦, 不顾不良后果, 强迫性、持续性地寻求和使用这种(些)物质, 不仅严重损害个体健康, 并为家庭和社会带来沉重的负担。纵观中外有关物质滥用与成瘾的研究发现, 认知障碍是物质滥用与成瘾导致的中枢神经系统损伤的结局。个体冲动性属个体的内在性格特质, 高水平的个体冲动性是物质滥用与成瘾的危险因素(如首次使用或从娱乐性滥用到成瘾)。同时, 成瘾性物质的滥用可损害冲动性控制的脑结构与功能, 使得滥用者无法控制自己的觅药/行为, 导致反复滥用或戒断后复吸。

此外, 不同类型的冲动性行为涉及的神经机制尽管有部分重合, 但也有明显差异。其中, 额叶皮层和纹状体功能的异常及脑内单胺能神经递质的异常传递被认为是不同类型冲动性与物质成瘾的神经基础。本文将从个体冲动性及其分类, 个体特质冲动性是物质滥用与成瘾的危险因素, 物质滥用与成瘾增加个体冲动性三个方面详细叙述二者之间的相关性及其神经机制。

1 个体冲动性及其神经基础

1.1 冲动性的定义及评估

大量研究揭示冲动性是一个多层面的概念。但简单地讲, 冲动性的典型特征是个体易做出缺乏足够预见性的决定或对负性结果缺乏足够考虑的行为(Dalley, Everitt, & Robbins, 2011), 包括倾向于做出目光短浅的选择行为, 以及对行为所带来的负性结果不敏感, 或偏爱即刻就能得到的小奖赏而无法等待延迟的大奖赏, 不能抑制已经启动的行为, 以及喜爱冒险、渴望寻求新奇刺激等(Basar et al., 2010; Mitchell, 2004; Reynolds, Ortengren, Richards, & de Wit, 2006)。因此, 冲动性可分为两类: 抉择冲动(decisional impulsivity)和运动冲动(motor impulsivity) (Caprioli et al., 2014; Dalley et al., 2011)。抉择冲动又叫选择冲动(impulsive choice), 指的是不恰当考虑其它的选择和结果就行动, 表现为不能耐受奖赏前所要等待的时间, 为了获得即刻的小奖赏而放弃延迟的大奖赏; 运动冲动又称为行为去抑制(behavioral

收稿日期: 2017-03-22
* 国家自然科学基金项目(81471353), 国家重大科学研究计划(973 计划)项目(2015CB553500)资助。
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disinhibition), 指的是不能及时中断已经开始的反应, 且过早反应的发生率较高(Caprioli et al., 2014; Dalley et al., 2011)。目前有多种评估冲动性的方法, 主要分为问卷和行为学测试评估两类。问卷评估主要包括 Barratt 冲动量表(Barratt Impulsivity Scale, BIS) (Barratt et al., 1994), UPPS-P 冲动行为量表(UPPS-P Impulsive Behavior Scale, IBS) (Cyders, Flory, Rainer, & Smith, 2009)、Kirby 货币选择问卷调查(Kirby's Monetary Choice Questionnaire, MCQ) (Dombrovski et al., 2011)、Kirby 试验(Kirby test) (Kirby & Petry, 2004)等。行为学测试评估, 根据冲动性分为两类。评估抉择冲动常用赌博任务(Iowa Gambling Task, IGT) (Bechara, 2003)、延迟折扣任务(delay discounting task, DDT) (Ainslie, 1975)等。评估运动冲动常用 5 孔选择序列反应任务(5-choice serial reaction time task, 5-CSRTT) (Robbins, 2002)、信号停止反应任务(stop-signal reaction time, SSRT) (Logan, 1994)、Go/No-go 任务(de Wit, Enggasser, & Richards, 2002)等。上述问卷和行为学评估方法均可用来评估人的冲动性; 在动物模型中, 主要用延迟折扣任务来评估抉择冲动性, 用 5-CSRTT、SSRT 和 Go/No-go 任务来评估运动冲动性。

1.2 冲动性相关的神经递质

多数研究发现, 与冲动性相关神经递质主要是单胺类神经递质, 包括多巴胺(Dopaming, DA)、五羟色胺(serotonin, 5-HT)和去甲肾上腺素(norepinephrine, NA)等。

药理学干预多巴胺受体对抉择冲动行为的影响是比较复杂的。一些研究显示, 系统给予多巴胺 D1 或 D2 受体的拮抗剂均影响个体的抉择冲动水平(Wade, de Wit, & Richards, 2000); 另一些研究则发现该干预没有明显影响个体的抉择冲动水平(Acheson & de Wit, 2008; Hamidovic, Kang, & de Wit, 2008)。类似地, 系统给予 L-DOPA 增加了个体对即刻小奖赏的偏爱, 而安非他明和多巴胺重摄取抑制剂却降低了个体对即刻小奖赏的偏爱(Isles, Humby, & Wilkinson, 2003; Pine, Shiner, Seymour, & Dolan, 2010; van Gaalen, van Koten, Schoffelmeer, & Vanderschuren, 2006)。这种相互矛盾的现象可能与给药前个体抉择冲动水平的差异有关(Buckholtz et al., 2010)。相关脑区的研究发现, 眶额叶皮层(orbitofrontal cortex, OFC)给予 D1 受体的拮抗剂增加了大鼠的抉择冲动性(Zeeb, Floresco, & Winstanley, 2010), 而内侧前额叶皮层(medial prefrontal cortex, mPFC)或伏核(nucleus accumbens, NAc), 激动 D1 受体也促进了冲动抉择(Loos et al., 2010; Pezze, Dalley, & Robbins, 2007), 提示不同脑区的多巴胺受体激活在抉择冲动性中的作用也不一致。

在评估运动冲动性的 5CSRTT 模型中, 系统给予 D1 受体拮抗剂抑制了大鼠的过早反应, NAcC, NAcS 和 OFC 内微注射 D1 受体拮抗剂均抑制了动物的过早反应(Pattij, Janssen, Vanderschuren, Schoffelmeer, & van Gaalen, 2007; Winstanley et al., 2010), 说明不同脑区的 D1 受体拮抗均能抑制过早反应。系统给予 D2 受体拮抗剂对过早反应无明显影响(Besson et al., 2010), 但在局部脑区 DA 受体干预的研究发现, NAcC 中 D2 受体的拮抗抑制了大鼠的过早反应, NAcS 中 D2 受体的拮抗则增加动物的过早反应(Besson et al., 2010), 这提示 NAcC 和 NAcS 中的 D2 受体在调节运动冲动性中的作用可能是相反的。此外, 在 SSRT 任务中, 拮抗背内侧纹状体的 D2 受体, 大鼠对停止信号的反应时延长, 即反应抑制受损; 而拮抗该脑区 D1 受体则增加了反应抑制(Eagle et al., 2011)。支持该结果的进一步研究发现, 人服用 D2 受体激动剂类药物, 能够改善他们在 SSRT 中的冲动行为(Nandam et al., 2013)。以上的研究表明 DA 受体在运动冲动中也发挥着重要的作用。

除多巴胺系统外, 个体冲动性与脑内 5-HT 及其受体也显著相关。用转基因或药理干预的方法破坏 5-HT 转运体的功能或给予其替代品增加突触间隙 5-HT 的水平, 动物在 5CSRTT 中的过早反应会减少(Baarendse & Vanderschuren, 2012; Carli & Samanin, 1992; Homberg et al., 2007), 而降低脑内 5-HT 的水平则产生相反的作用(Carli & Samanin, 2000; Harrison, Everitt & Robbins, 1997; Winstanley et al., 2004a)。激动 5-HT 1A 受体(Carli & Samanin, 2000)或拮抗 5-HT 2C 受体均能增加大鼠的过早反应, 而 5-HT 2A 受体的激动或 5-HT 2C 受体的拮抗剂(系统给药或脑区局部给药)均降低其过早反应(Fletcher, Tampakeras, Sinyard, & Higgins, 2007; Talpos, Wilkinson, & Robbins, 2006; Winstanley et al., 2003)。以上结果提示, 5-HT 2A 和 2C 受体之间可能在运动冲动中发挥着相反的作用。

关于个体冲动性与其中枢 NA 及其受体关系的研究报导有, NA 重摄取抑制剂可减少大鼠对即刻小奖赏的偏爱(Robinson et al., 2008)和 5CSSRT 中的过早反应(Economidou, Theobald, Robbins, Everitt, & Dalley, 2012)。系统或脑区(OFC 或背侧前边缘叶, dPL)给予 NA 重摄取抑制剂降低了对停止信号的反应时, 而系统或 dPL 给予 NA α-2A 受体的激动剂 guanfacine 则可延长个体对停止信号的反应时(Bari, Eagle, Mar, Robinson, & Robbins, 2009; Bari et al., 2011; Chamberlain et al., 2006, 2007; Robinson et al., 2008), 提示 NA 也参与调节了反应抑制。

1.3　冲动性相关的脑区

参与冲动性的主要脑区目前仍不完全清楚。一些研究揭示, 腹内侧前额叶皮层(ventromedial prefrontal cortex, vmPFC)、背外侧前额叶皮层(dorsolateral prefrontal cortex, dlFPC), 以及后扣带回皮层(posterior cingulate cortex, PCC)的激活程度与个体对奖赏价值的折扣相关(Kalenscher et al., 2005; Kim, Hwang, & Lee, 2008; Sripada, Gonzalez, Luan Phan, & Liberzon, 2011)。低频经颅磁共振刺激破坏左侧 lPFC 的功能, 能增加个体对即刻小奖赏的选择, 即抉择冲动水平增高(Figner et al., 2010)。vmPFC 及内侧眶额叶皮层(medial orbitofrontal cortex, mOFC)损伤的病人对奖赏价值的折扣升高(Sellitto, Ciaramelli, & di Pellegrino, 2010)。利用核磁共振成像技术(magnetic resonance imaging, MRI)发现 lOFC 的血氧饱和度水平 BOLD (bold oxygen level dependent)信号的增强与选择延迟大奖赏显著相关(Boettiger et al., 2007)。然而, 在动物实验中, 损毁 vmPFC 并没有影响抉择冲动性(Cardinal et al., 2001), 而 OFC 亚区的损毁对抉择冲动的影响也不一致。mOFC 损毁增加了大鼠对延迟大奖赏的偏爱, 而 lOFC 损毁则降低了大鼠对延迟大奖赏的偏爱(Mar, Walker, Theobald, Eagle, & Robbins, 2011)。此外, NAcC, 海马(hippocampe, Hip)及基底外侧杏仁核(basolateral amygdala, BLA)也在抉择冲动中发挥重要作用, 损毁这些脑区均会增加大鼠对即刻小奖赏的偏爱, 即抉择冲动水平升高(Cardinal et al., 2001; Cheung & Cardinal, 2005; Winstanley et al., 2004b)。在抉择冲动过程中, Peters and Buchel 认为不同的神经网络参与编码了抉择的不同方面：一个是价值评估网络(反映个体对奖赏价值的编码), 主要包括 vmPFC, mOFC, NAcC 和 PCC, 一个是认知控制网络(反映决策冲突及认知控制), 主要由 ACC 和 lPFC 组成, 一个是预期网络(反映抉择过程中对奖赏的预期, 情绪等), 主要由内侧颞叶, vmPFC 和 PCC 组成(Peters & Büchel, 2011)。

反应抑制的控制和大脑额叶及基底神经节功能联系的完整性密不可分。功能影像学的研究表明额叶的腹侧部分和基底神经节之间的神经环路调节了 SSRT 的行为表现(Aron, Robbins, & Poldrack, 2004)。右侧额下回脑损伤的患者反应抑制功能显著受损(Aron, Fletcher, Bullmore, Sahakian, & Robbins, 2003)。右侧的额下回很可能是通过丘脑底核(subthalamic nucleus, STN)控制了纹状体的相关亚区, 从而调节了 SSRT 任务中对停止信号的反应(Aron & Poldrack, 2006)。Go/No-Go 任务也存在类似的调节模式(Aron & Poldrack, 2005; Iversen & Mishkin, 1970; Rubia et al., 2001)。此外, 损毁边缘下皮层(infralimbic, IL)和 ACC 增加了大鼠在 5CSRTT 中的过早反应, 而损毁 mPFC、顶叶、lPFC 均不影响大鼠的过早反应(Chudasama et al., 2003; Muir, Everitt, & Robbins, 1996; Passetti, Chudasama, & Robbins, 2002)。与 SSRT 类似, STN 的损毁也抑制了大鼠的过早反应(Baunez & Robbins, 1997)。这些结果提示外侧及下部额叶与纹状体形成的神经通路参与调节运动冲动性。

2　个体特质冲动性和物质滥用与成瘾

2.1　个体特质冲动性

在一个群体中, 个体的冲动水平并不是一致的, 差异比较大。其中, 有冲动水平较高的, 也有冲动水平较低的, 这两种特质的冲动性是生理状态下的表型, 反映不同群体的性格特质, 统称特质冲动性。研究发现特质冲动性表型在群体中是稳定存在的(Diergaarde et al., 2008; Kolokotroni, Rodgers, & Harrison, 2014; Loos et al., 2010)。

2.2　个体特质冲动性是药物滥用与成瘾的危险因素

大量研究表明, 特质抉择冲动性和特质运动冲动性均是促进物质滥用与成瘾发生、发展的危险因素之一。研究表明, 在大学生群体中, 较早开始饮酒和吸烟的青少年抉择冲动水平显著增高(Audrain-McGovern et al., 2009; Kollins, 2003);

有物质滥用家族史的青壮年抉择冲动水平异常增高，且其酒精或其它物质滥用的概率显著增加，提示高水平抉择冲动性的个体未来发展为酒精或其它物质的滥用的可能性增加(Acheson, Vincent, Sorocco, & Lovallo, 2011)。此外，用自身给药模型模拟人物质滥用与成瘾过程的动物实验表明，在成瘾性物质获得过程中，先天性高抉择冲动水平的大鼠饮酒、摄取尼古丁、可卡因及甲基苯丙胺的频率更高，量更大；在戒断期，对成瘾性物质的觅药动机更强，更难消退；在情景线索诱导的重建期，高抉择冲动水平的大鼠对得到该成瘾性物质的渴望更强烈(Anker, Perry, Gliddon, & Carroll, 2009; Diergaarde et al., 2008; Kayir, Semenova, & Markou, 2014; Marusich & Bardo, 2009; Perry, Larson, German, Madden, & Carroll, 2005; Perry, Nelson, Anderson, Morgan, & Carroll, 2007; Poulos, Le, & Parker, 1995)，提示高抉择冲动水平是物质滥用与成瘾的重要危险因素。在评估运动冲动性的动物模型中发现，对停止信号的反应时长的个体更容易发展为可卡因或甲基苯丙胺物质成瘾的人群(Ersche et al., 2012)；过早反应率高的大鼠在习得可卡因自身给药时，得到可卡因的针数增多，且更容易发展为强迫性觅药行为(Belin et al., 2008)，这些结果提示高水平的运动冲动性也是物质成瘾的危险因素之一。另外，有研究发现，高运动冲动水平的大鼠对天然奖赏蔗糖的应答增强，蔗糖的摄入量显著高于低运动冲动水平大鼠；在情景线索诱导的重建中，高运动冲动水平的大鼠蔗糖重建成功的比例要显著高于低运动冲动水平的大鼠，提示高运动冲动性可能是对奖赏相关刺激的应答增强，从而增加成瘾性物质的期使用的风险(Diergaarde, Pattij, Nawijn, Schoffelmeer, & de Vries, 2009)。

综上，个体特质抉择冲动性使其不考虑物质滥用与成瘾所带来的负性后果，而个体特质运动冲动性使个体对滥用成瘾性物质的控制能力降低。这就使得个体特质冲动性成为物质滥用与成瘾发生及发展的重要危险因素。

2.3 个体特质冲动性的神经机制

现有的研究提示，个体冲动水平的异常与脑内多巴胺能系统的异常改变相关。Volkow 及其团队发现慢性可卡因、甲基苯丙胺及酒精成瘾的人纹状体多巴胺 D2/3 受体减少，进一步，若给予使多巴胺 D2/3 受体结合降低的诱发电位，则非物质成瘾的健康被试表现出对哌甲酯(精神兴奋药)强烈的“喜爱” (Volkow, Fowler, Wang, & Goldstein, 2002)。Nader 团队的研究也发现纹状体多巴胺 D2/3 受体可应度增高的猴子接触新奇物体的速度较慢，符合他们新奇-抵抗的特征，而那些纹状体多巴胺 D2/3 受体可应度低的猴子学习新物体所需的潜伏期更短，并展现出高冲动的行为(Czoty, Gage, & Nader, 2010)。另外, 2007 年的一项研究发现高冲动水平的大鼠腹侧纹状体多巴胺受体 D2/3 受体对多巴胺的可应度下降，而且，D2/3 受体可应度下降的大鼠更易习得可卡因的强化(Dalley et al., 2007)。同样地，甲基苯丙胺成瘾的人冲动评分更高，其纹状体 D2/3 受体的可应度也显著低于健康被试，且与冲动水平显著相关(Lee et al., 2009)，以上结果均提示伏核的 D2 受体在个体特质冲动性中的重要作用。进一步, Flagel 及其团队于 2016 年发现，相对于对新奇环境反应增高的大鼠，高反应的个体伏核核心部(nucleus accumbens core, NAcC)D2 mRNA 水平更低且 D2 启动子与组蛋白 H3K9me3 的结合更强，提示个体特质冲动性可能是 NAcC 后天基因修饰改变造成的(Flagel et al., 2016)。除了 DA D2/3 受体外，研究还发现 mPFCDA D1/5 受体的转录水平与大鼠的抉择冲动水平显著正相关，提示个体特质冲动性 mPFC 内多巴胺受体也存在异常(Loos, & Pattij, et al., 2010)。

目前，关于生理状态下个体特质冲动性的脑网络研究还很少，有少量的研究表明，参与冲动的额叶皮层环路的异常可能与高冲动性相关(Ding et al., 2014)。个体特质冲动性的相关脑环路和脑网络尚需进一步探究。

3 物质滥用与成瘾和个体冲动性

3.1 物质滥用与成瘾增加个体冲动性

纵观中外物质滥用与成瘾的相关研究一致地发现，无论是单一的物质滥用与成瘾，还是多种物质混合的滥用与成瘾，个体都会出现不同程度的冲动水平的升高。研究表明可卡因、吗啡、海洛因等成瘾后，人或动物的抉择冲动水平显著升高 (Harvey-Lewis, Perdrizet, & Franklin, 2012; Karakula et al., 2016; Li, Zuo, Yu, Ping, & Cui, 2015; Stoltman, Woodcock, Lister, Lundahl, &

Greenwald, 2015; 严万森, 张冉冉, 刘苏姣, 2016); 同样地, 酒精依赖患者较健康被试其更加偏爱即刻小奖赏, 对延迟大奖赏的折扣率更高(Petry, 2001; Rubio et al., 2007)。以上结果提示物质滥用与成瘾引起了个体抉择冲动性的异常升高。在 SSRT 任务中, 物质滥用与成瘾的个体对停止信号的反应时明显增加(Ersche et al., 2012; Fillmore & Rush, 2002; Liu, Heitz, & Bradberry, 2009; Monterosso, Aron, Cordova, Xu, & London, 2005), Go/No-go 任务的错误率也显著增加(Lane, Moeller, Steinberg, Buzby, & Kosten, 2007; Verdejo-García, Perales, & Pérez-García, 2007)。然而, 在 5CSRTT 中, 经历苯丙胺, 海洛因或可卡因自身给药的大鼠, 即使延长其戒断时间, 过早反应并没有发生改变(Dalley et al., 2005), 但将高冲动大鼠的数据单独统计, 则发现其可卡因自身给药的经历反而降低了运动冲动性(Caprioli et al., 2013)。综上, 在某种程度上, 物质滥用与成瘾引起的个体抉择冲动性的改变与运动冲动性并不完全一致。

3.2　物质滥用与成瘾影响个体冲动性的神经机制

物质成瘾一般会使成瘾者的大脑产生结构及功能的变化, 从而产生冲动行为的改变。脑成像的研究表明, 物质滥用与成瘾者的大脑额叶及基底神经节功能失调, 例如, 多种物质混合成瘾者双侧 PFC 的灰质及可卡因成瘾者 ACC、岛叶和上颞叶的灰质密度均显著低于健康对照组(Franklin et al., 2002; Liu, Matochik, Cadet, & London, 1998), 滥用酒精的个体其 mPFC 和 OFC 的灰质体积显著减少, 且 OFC 与 mPFC 的灰质体积与个体的冲动水平显著负相关(相关系数分别为 $r = -0.527$, $r = -0.406$) (Asensio et al., 2016; Tanabe et al., 2009)。此外, 即使经历了成瘾性物质的长期戒断, 脑灰质的损伤仍然存在(Fein et al., 2006)。除了灰质密度的损伤外, 物质滥用与成瘾者在执行冲动相关任务时, 一些脑区也表现出明显的异常, 例如, 酒精依赖的患者在执行延迟任务时, 腹侧纹状体的激活程度显著低于健康对照(Beck et al., 2009; Bjork, Smith, Chen, & Hommer, 2012), 纹状体和 dlPFC 的功能连接度显著降低(Park et al., 2010); 可卡因滥用者在对 Nogo 信号作出反应时, 不管最终是否成功地抑制了对 Nogo 反应的行为, ACC 的激活程度都比健康对照组低, 若抑制失败, 则上述现象更为明显(Kaufman, Ross, Stein, & Garavan, 2003); 酒精依赖个体执行 SSRT 时, lPFC 的激活程度降低(Li, Luo, Yan, Bergquist, & Sinha, 2009); 此外, 随着近些年来静息态脑功能连接度研究的发展, 研究发现酒精依赖个体默认网络、左侧抉择网络和显著网络内的功能联系明显高于健康对照(Zhu, Cortes, Mathur, Tomasi, & Momenan, 2017); 与健康对照组比, 网络游戏成瘾者的奖赏网络(豆状核)的兴奋性提高, 执行控制网络(前扣带回、额叶和顶叶)兴奋性的降低与冲动性的增高密切相关(Wang et al., 2017)。以上的结果均提示长期滥用成瘾性物质, 物质成瘾者脑结构、功能以及脑网络均会产生不可逆的改变, 尤其是执行控制网络兴奋性的降低, 使得物质成瘾者的冲动性增加。

在神经递质受体水平, 研究发现慢性可卡因、甲基苯丙胺及酒精成瘾的个体纹状体多巴胺 D2/3 受体减少(Volkow et al., 1993; Volkow, et al., 2002); 在物质成瘾的人群中发现, 纹状体 D2 受体的可应度减少(Volkow, Fowler, Wang, Baler, & Telang, 2009)。

3.3　个体冲动性预测复吸

目前治疗物质成瘾最棘手的问题是脱毒后的复吸, 即物质成瘾患者脱毒后数月甚至数年内, 一旦遭受一些内、外界的刺激, 如成瘾物质、先前用药环境、应激等便会诱发其再次用药的心理渴求和/或用药行为(Childress, McLellan, Ehrman, & O'Brien, 1988; Childress et al., 1999; O'Brien, Childress, McLellan, & Thomas, 1992)。例如, 酒精依赖的患者戒断治疗后一个月内的复饮率在 40%~60%之间, 一年后会高达 70%~80% (Annis, Sklar, & Moser, 1998; Dawson, Goldstein, & Grant, 2007)。研究发现, 复饮的酒依赖患者与未复饮的患者相比, 其冒险行为评分更高(Bowden-Jones, McPhillips, Rogers, Hutton, & Joyce, 2005; de Wiled, Verdejo-García, Sabbe, Hulstijn, & Dom, 2013), 提示酒精依赖患者异常的冲动性可作为酒精依赖早期复饮的预测指标。另外, 有研究报道与酒精戒断患者比, 复饮患者中脑边缘奖赏系统的脑体积更小(Cardenas et al., 2011), 边缘奖赏网络同步性的降低和执行控制网络同步性的升高是长期戒断的酒精滥用患者的特征(Camchong, Stenger, & Fein, 2013); 此外, 海马后部与后扣带回环路功能连接度的增高可以提高可卡因戒断者

对用药环境的反应, 从而引起复吸(Adinoff et al., 2015), 时间折扣任务中纹状体壳核与后岛叶功能连接度的降低是可卡因复吸的危险因素之一(McHugh et al., 2013), 这些结果均提示脑结构和脑网络功能连接度可作为预期物质滥用患者的复饮/复吸的指标。这就提示我们, 脑结构和功能的变化具有作为预期物质成瘾者预后的生物标志物的潜力, 这将有助于临床上对脱瘾治疗后的物质滥用成瘾者复吸的危险性预期, 以期适时予以干预, 降低脱毒后的复吸率。

4 小结与展望

综上, 冲动性作为个体的性格特质, 本身可成为物质滥用与成瘾发生的危险因素。同时, 成瘾性物质的滥用也可引起一些与冲动性相关的脑结构、功能及脑网络的异常, 进一步损害了个体冲动的控制能力, 二者之间存在着双重的关系。

目前, 对冲动性相关的神经递质及脑网络的认识还有待于进一步的认识。未来, 对于特质冲动性的个体, 研究相关基因层面的差异是必要的, 该方面的研究可以更好的将环境因素和基因因素区分开来。另外, 鉴于目前神经科学领域对人类脑影像学研究的迅速进展, 显然需要进一步阐明物质成瘾者存在的异常冲动性所涉及的脑网络机制。这些都有助于我们更好的理解物质滥用与成瘾的危险/易感因素及脑机制, 防治物质滥用, 以及成瘾者脱毒后的复吸。

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The effect and brain mechanism of individual impulsivity on drug abuse and addiction

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Abstract: Impulsivity is a multidimensional concept, which is generally defined as lack of foresight or consideration and judgment of actions. There is a double relationship between impulsivity and substance abuse, namely that trait impulsivity is an important risk factor for substance abuse and addiction, and the individual impulsivity could be damaged by abusing the addictive substances. The relationship between impulsivity and substance abuse, as well as its underlying neural mechanisms will be discussed in this review. Reorganization of previous research literatures on the trait-like impulsivity, or its alteration caused by substance abuse, and understanding of the neurobiological mechanisms implicated in this process, not only help us reveal the nature of occurrence, development and recurrence of substance abuse after abstinence, but also help us explore the behavioral intervention means other than drug therapies.

Key words: substance abuse and addiction; decisional impulsivity; motor impulsivity