生物运动及其在社会认知障碍研究中的应用 *

王增建[1] 张得龙[1,2] 何芳芳[1] 梁碧珊[1] 黄瑞旺[1] 刘 鸣[**1]
（[1]华南师范大学心理学院心理应用研究中心，广州，510631）
（[2]广东省中医院放射科，广州，510120）

摘 要 人类对生物运动具有较强的视觉敏感性，即使在视觉线索有限的情况下，仍能提取其中的社会性信息。本文系统梳理了当前生物运动视知觉实验研究涉及的各类社会性信息，并归纳分析社会认知缺陷与生物运动视知觉加工之间的内在联系，以期促进对生物运动视知觉加工心理机制问题的深入探讨。

关键词 生物运动 视知觉加工 社会性信息 社会认知缺陷

1 生物运动社会性信息的视知觉加工

Cutting (1977) 早证实从生物运动光点序列中可提取身份与性别信息，后续研究进一步证实了年龄 (Montepare & Zebrowitz-McArthur, 1988)、情绪 (Dittrich, Troscianko, Lea, & Morgan, 1996) 及意图 (Frith & Frith, 1999) 可以从生物运动中提取。

1.1 身份

身份是最早被证实可从生物运动中提取的社会性信息。视觉经验和运动经验会影响生物运动的身份识别 (Jacobs & Shiffrar, 2005)，其中，自身运动经验的影响更为重要。观察者对与自己有关的生物运动最为熟悉 (Loula, Prasad, Harber, & Shiffrar, 2005)，但这种熟悉受到不同剖面呈现方式的影响 (Daniel, Irene, & Troje, 2006)。近年来研究者开始关注观察者如何从他人角度识别自己的生物运动 (Cook, Johnston, & Heyes, 2011; Prasad & Shiffrar, 2009)。

1.2 性别

观察者通过对比光点人肩膀和臀部的相对结构 (Cutting, Proffitt, & Kozlowski, 1978) 以及侧体摇摆 (Murray, Drought, & Kory, 1964; Murray, Kory, & Sepic, 1970) 进行性别识别。Mather 等 (1994) 认为性别识别更多的是依靠后者，Troje 等人 (2002) 也进一步证实了动力学特征的作用，他们根据行走模式建立的性别分类器，性别区分成绩高于观察者的分类成绩。此外，生物运动的性别识别存在适应后效应 (adaptation aftereffects) (Troje, Sadr, Geyer, & Nakayama, 2006)：观察者注视一个夸张的女性生物运动之后，倾向于将中性生物运动识别为男性，反之将其识别为女性。除了时间因素 (Troje, 2002)，声音信号 (Brooks et al., 2007; Zwan et al., 2009) 在性别识别的适应后效应加工过程中也起到一定的作用。

1.3 情绪

运动是表达情绪的一条重要途径。观察者能够熟练地判断生物运动的情绪 (Dittrich et al., 1996)，即使是局部运动（如手臂敲门）产生的情绪都能够被准确地识别 (Clarke, Bradshaw, Field, Hampson, & Rose, 2005; Pollick, Paterson, Bruderlin, & Sanford, 2001)。影响生物运动情绪识别的因素较为复杂。首先，社交情景能够促进情绪判断 (Clarke et al., 2005)，尤其是恋爱和高兴。其次，性别刻板印象会影响生物运动的情绪识别 (Johnson, McKay, & Pollick, 2011)。再次，生物运动的呈现方式影响情绪识别的准确性 (Atkinson, Dittrich, Gemmell, & Young, 2004; Clarke et al., 2005)。最后，社交障碍影响生物运动的情绪识别能力 (Jones et al., 2011; Murphy, Brady, Fitzgerald, & Troje, 2009)。

1.4 意图

生物运动意图的推测是指根据运动推测他人的

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** 通讯作者：刘鸣。E-mail：lium@scnu.edu.cn

需求、目标和信念等。意图会影响观察者对生物运动的知觉敏感性及神经活动：Neri 等人 (2006) 发现社交情景能够促进对光点人的知觉敏感性；脑磁图研究 (Hirai & Kakigi, 2009) 发现社交情景下的生物运动能够调控双侧枕 - 颞区的神经活动；Centelles 等人 (2011) 采用功能磁共振成像技术，发现社交行为能够诱发行为观察或执行匹配的网络（额下回、前运动区皮层、脑顶叶内沟、右侧顶上回）和心智网络（左侧颞顶联合区、右侧颞上沟前部和前额中回的背侧部分）；眼动记录研究也表明社交行为与非社交行为的视觉空间注意分配以及视觉扫描路径存在差异 (Roché et al., 2013)。

虽然对生物运动不同维度的社会信息的研究取得了一定成果，但各维度在社会认知发展过程中的作用、不同维度之间的关系 (Brooks et al., 2008; Johnson et al., 2011) 以及加工的神经机制等仍不清晰。而从具有社交缺陷个体探讨生物运动视知觉加工的特点，为揭示生物运动视知觉加工的神经机制提供了可能。

2 生物运动视知觉加工作为社会认知缺陷指标的探索

研究发现自闭症患者、精神分裂症患者、脑白质软化的早产儿和唐氏综合症等群体的社会认知缺陷与生物运动视知觉加工的缺陷存在一定联系。

2.1 自闭症患者生物运动视知觉加工的特点

相对于正常控制组，自闭症儿童和青少年患者对生物运动的知觉敏感性较低 (Annaz, Campbell, Coleman, Milne, & Swettenham, 2012; Kaiser, Delmolino, Tanaka, & Shiffrar, 2010; Lahvis, Falck-Ytter, Rehnberg, & Bölte, 2013)、情绪 (Johnson et al., 2011; Nackaerts et al., 2012) 和意图 (Swettenham et al., 2013) 判断能力较差。自闭症患者加工生物运动的缺陷在生命早期就已出现 (Klin, Lin, Gorrindo, Ramsay, & Jones, 2009)。正常儿童的生物运动知觉敏感性随着年龄增长而增长，但同龄自闭症患者的发展迟缓 (Annaz et al., 2010)。成年自闭症患者对生物运动的敏感性 (Cook & Blakemore, 2010) 及判断生物运动方向的能力 (Murphy et al., 2009) 虽然与正常被试相同，但脑成像研究发现成年自闭症患者使用替代性的脑网络即运动敏感区域和运动选择区域来整合形状和运动信息 (McKay et al., 2012)，而正常成年人使用单一的颞 - 顶连接网络。

2.2 精神分裂症患者生物运动视知觉加工与社会认知缺陷之间的关系

精神分裂症患者具有感知觉和认知功能障碍，他们加工生物运动、整体运动和局部运动的能力受到影响 (Butler et al., 2012; Kim, Park, & Blake, 2011)。Kim 等人 (2013) 通过比较成年精神分裂症患者与正常被试识别生物运动方向、区分生物运动和非生物运动以及心理理论的能力，发现精神分裂症患者识别生物运动方向的准确性低于正常被试，且与心理理论显著相关。大部分精神分裂症患者的以下脑区存在萎缩：顶叶 / 顶 - 颞连接区、颞上沟和额下回、前颞叶，这些脑区的损伤也与生物运动视知觉缺陷有关 (Krakowski et al., 2011; Saygin, 2007)。与精神分裂症患者脑区的萎缩存在左右半球不对称性 (Shenton, Dickey, Frumin, & McCarley, 2001) 相一致，Hastings 等人 (2013) 采用功能磁共振成像技术与心理物理学法发现精神分裂症患者对生物运动的方向识别也存在不对性：检测向左侧平移生物运动比向右侧平移的阈限高，向左侧平移的生物运动优先激活的区域包括双侧背侧前额叶、双侧顶内沟以及右侧楔叶，向右侧平移优先激活的脑区包括双侧缘上回、左侧颞上沟后部/颞中回以及双侧内测额叶皮层。这种方向识别的不对称性与其社会功能相关，但是其具体机制仍不清楚。

2.3 脑白质软化影响生物运动视知觉加工

儿童脑室周围白质软化症是造成早产儿脑瘫的主要原因，患者（13~17 岁）对生物运动的敏感性（判断倒置的光点和干扰点中是否存在一个人）低于同龄的正常青少年 (Pavlova, Sokolov, Staudt, Marconato, Birbaumer, & Krageloh-Mann, 2005)。结构磁共振成像技术和心理物理法研究发现脑白质软化影响了脑结构连接（顶 - 枕叶连接）和功能连接，并进一步影响生物运动的视知觉敏感性 (Pavlova, Sokolov, Birbaumer, & Krageloh-Mann, 2006)，脑磁图的研究支持了这一观点 (Pavlova , Marconato, Sokolov, Braun, Birbaumer, & Krageloh-Mann, 2006)：脑白质软化的早产儿在右侧顶 - 颞区的波峰出现在 290ms，显著晚与正常被试（170ms）。生物运动视知觉的损伤程度与大脑两侧尤其是大脑右侧的顶枕叶脑白质软化的体积有关 (Taylor, Jakobson, Maurer, & Lewis, 2009)。未来研究可进一步探讨脑白质软化的早产儿生物运动的社会性信息（情绪，意图等）的视知觉加工特点，有助于进一步认识对生物运动视知觉加

工与社会认知缺陷的关系。

此外，具有社会认知缺陷的先天性疾病如威廉斯氏综合征（Williams Syndrome）、唐氏综合症（Down Syndrome）、X 染色体易损综合征（Fragile X Syndrome）等群体也存在生物运动视知觉加工缺陷。但关于这些群体的相关研究较少，且没有统一的结论 (Hippolyte, Barisnikov, Van der Linden, & Detraux, 2009; Jordan, Reiss, Hoffman, & Landau, 2002; Reiss, Hoffman, & Landau, 2005)。其原因除了被试的差异（IQ 水平、疾病的严重程度等），还与实验方法如实验刺激和任务的差异有关，使得研究者无法确定生物运动的视知觉加缺陷与社会认知缺陷之间的关系。因此，生物运动知觉加工能力能否作为社会认知能力的标记 (Pavlova, 2011) 仍需后续研究证实。

3 总结与展望

生物运动知觉加工是一个复杂的心理活动过程，其包含社会交往所需要的各类信息。目前，生物运动社会性信息知觉加工的研究较少，研究者可以结合不同数据挖掘方法，如多变量模式分析方法 (James et al., 2001)，进一步探讨不同社会性信息加工的神经机制。另外，生物运动视知觉加工缺陷与社会认知缺陷之间的关系没有统一的结论，未来的研究应该进一步结合纵向研究范式 (Annaz et al., 2010) 探讨二者之间的关系。

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Biological Motion and Its Application in the Study of Social Cognitive Impairments

Wang Zengjian [1], *Zhang Delong* [1,2], *He Fangfang* [1], *Liang Bishan*[1], *Huang Ruiwang* [1], *Liu Ming* [1]

([1]Center for the Study of Applied Psychology, Key Laboratory of Mental Health and Cognitive Science of Guangdong Province, School of Psychology, South China Normal University, Guangzhou, 510631)

([2]Department of Radiology, Guangdong Province Hospital of Traditional Chinese Medicine, Guangzhou, 510120)

Abstract Human beings are remarkably sensitive to recognizing the motion of biological entities in complex visual scenes, even when it is depicted with a handful of point-lights attached to the head and major joints. A number of studies demonstrated that biological motion contains not only form and motion information, but also include many sorts of socially relevant information about an agent such as identity, gender, emotions, intentions and so on. One could recognize the biological motion as him or his friends without face and other familiar cues, the visual experience of observing others' action and the movement experience executed by participant himself or herself could influence the identity perception abislity. Kinematic not structural cues have an effect on the perception of identity of the biological motion, but which aspects of the kinematics of human gait are responsible for person identification are still required to explore. Motion information alone could make one to distinguish anger, happiness, surprise or other mental states automatically, social context would improve the ability of emotion perception of biological motion and different display conditions will also influence the processing progress, for example the inversion display will decrease the emotion perception. Eye movements revealed a spontaneous, fast and durable bias of overt visual-spatial attention favor for the perception of social motion and a different visual scanpath for social compared to non-social human biological motion. These findings constitute a basis for the investigation of a 'social intention' bias in perception of human biological motion. The other interesting thing is observer could estimate whether the biological motion walkers are walking backward or forward to the observer, but the perception was affected by facing bias. The observer could also change his or her behavior in social interaction according to the social information, but concrete content of each dimension and their relationship between each other are still under exploring. On the other hand, action cognition is very important to social cognition for human being and animals. There has been many researches have confirmed that there is an inner connection between visual biological motion processing and deficits in social cognition. Individuals with autistic spectrum disorders always have social cognition impairments, but there are contradictory conclusion between young children,adolescents and adults with autism on their performance of biological motion pilot task. Brain imaging data revealed a decreasing brain activity in the superior temporal sulcus which is very important in the processing of biological motion. The perception of biological motion is also affected in the people with schizophrenia.Down syndrome and other genetic conditions with distinct profiles of social cognitive impairments, whether biological motion processing is intact in these disorders are essential to proclaim the hypothesis that intact biological motion processing may be considered a fundamental basis for preserved social cognition. But Williams syndrome individuals exhibit intact or even enhanced social skills, and they are reported to be unimpaired on biological motion tasks. Future research should shed light on functional brain mechanisms associated with impairments in social information derived from biological motion, in order to provide more evidence whether biological motion could be a hallmark of social cognition and whether it could be applied in the diagnosis and treatment.

Key words point-light displays of biological motion, visual perception, social relevant information, social cognitive impairments