Head Lag in Infants at Risk for Autism: A Preliminary Study

R2K: Research 2012 ~ Early Development, Sensory Integration and Movement

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February 24, 2012

Learning Objectives

1. Discuss the relationship between postural control involving the head during pull-to-sit at 6 months of age in infancy and later social and communication functioning in children at risk for autism.
2. Discuss whether presence of head lag distinguished high risk & low risk infants at 6 months of age.
3. Understand the implications of this research for early intervention.

(Flanagan, Landa, Bhat, & Bauman, in press)

Autism

- A neurodevelopmental disorder defined by qualitatively abnormal social & communicative development as well as repetitive & stereotyped behaviors & interests *(APA, 2000)*
- Multiple etiologies, genetic, environmental *(Herbert, 2005)*
- Heterogeneous phenotype

Background

- 1 in 110 (CDC, 2009)
- Heritable with a recurrence rate of 18.7 % in families having more than one child with ASD (Bailey et al., 1998; Ozonoff et al., 2011).

Background

- Evidence that a diagnosis can be made as early as 14 months (Landa, Holman, & Garrett- Mayer, 2007)
- Research aimed at improving early detection has largely focused on core deficits (social & communication)

(Flanagan, Landa, Bhat, & Bauman, in press)

Motor system as relevant in ASD

Emerging literature indicates that motor system is not typically developing in autism.

Literature: Retrospective studies: Infants later diagnosed with autism

- Deficits in core features (showing, pointing, orienting to name, smiling, eye contact); lack of appropriate gestures and/or expressive postures
- Deficits in motor (posturing, anticipatory postural adaptations, repetitive motor actions, hypoactivity, hypotonia)

(Adrien et al., 1993; Baranek, 1999; Clifford & Dissanayake, 2008; Maestro et al, 2005; Osterling & Dawson, 1994; Osterling et al, 2002)

Literature: Retrospective Studies on Motor Development in Infants with ASD

- Some controversy *(Ozonoff et al., 2008)*
- Atypical/abnormal movement patterns and delayed motor milestones
- Less static and dynamic motor symmetry

(Esposito et al., 2009; Phagava et al., 2007; Teitelbaum et al, 1998)

Recent Prospective Studies of Infant Siblings

- Some prospective studies have found differences in AU sibs compared to LR infants during infancy but features might not predict later diagnosis of ASD
- Limited prospective studies with outcome classifications, and few have identified overt impairment during mid infancy

Prospective Studies of Motor Deficits in High Risk Infants

- AU sibs found to exhibit delay in acquisition of early motor milestones, babbling, and postural stability (Iverson & Wozniak, 2007)
- Zwaigenbaum et al. (2005) reported reduced activity level at 6 months of age in AU sibs later diagnosed with ASD at 24 months based on parent report
- Landa and Garret-Mayer (2006) reported motor delays by 14 months in children later diagnosed with ASD

Motor deficits in older children and adults with autism

- Fine/Gross motor deficits
- Poor postural stability
- Poor postural anticipation
- Praxis deficits
- Gait abnormalities
- Poor motor planning
- Poor movement modulation
- Poor quality of imitation
- Recent meta-analysis found motor deficits pervasive, & more prevalent when using gait & postural stability outcomes

(Damasio & Maurer, 1978; Dowell et al, 2009, Dziuk et al., 2007, Fournier et al., 2010, Hilbert & Lee, 1999; Jansiewicz et al., 2006, Kanner, 1943, Mari et al. 2003, Martineau et al., 2004, Minshew et al., 2004, Molloy, et al., 2003, Noterdaeme et al., 2002, Pierce & Courchesne, 2001, Rinehart et al., 2006, Schmitz et al., 2003, Smith & Bryson, 1994, 2007, Vernazza-Martin et al., 2005, Vilensky et al. 1981)

Relevance of motor impairment in ASD

- Early social and communication skills rooted in infants' spontaneous movement exploration as well as observation and emulation of others' movements (Iverson & Fagan, 2004; Meltzoff & Decety, 2003; Nadel & Butterworth, 1999; Thelen, 2000)
- Milestones in self-produced locomotion facilitate infants' perceptual, cognitive, and socio-emotional development (Adolph et al, 1998, Campos et al, 2000; Gibson, 1988)
- Abnormality in motor system could adversely impact spontaneous exploration, fluent synchronous imitation, and social relatedness

(Flanagan, Landa, Bhat, & Bauman, in press)

Literature: Relevance of Postural Control

- Postural control in infancy associated with self-exploratory behavior, spontaneous motility, symmetry and hand function.
- Abnormality in postural control in early infancy "disrupts the development of adequate motor behavior and sensorimotor interaction, which can result in faulty perception-action cycle, thus influencing later social and cognitive development (De Groot, 2000, p. 65).
- Motor skills reflect adequacy of developing nervous system prior to emergence of language skills and may prove mechanism for predicting later impairment in infants at risk for autism…

(Flanagan, Landa, Bhat, & Bauman, in press)

Early Postural Control

- Poor postural control during pull to sit (traction response) documented in infants with developmental disabilities (CP, low birth weight) and shown to be predictor of developmental disability (Barbosa, Campbell, Smith, & Berbaum, 2005; Samsom et al., 2002; Samsom, Sie, & de Groot, 2002)
- Few studies on earliest markers in autism have assessed postural control

(Flanagan, Landa, Bhat, & Bauman, in press)

Literature: Quality of Movement in Infants at High Risk for ASD

- No longitudinal studies have reported motor deficits in infants later diagnosed with ASD.
- Standardized motor assessments may not be sensitive enough at 6 months of age
- Quality of movement based on videos found to be marker of integrity of nervous system during the first several weeks of life and a predictor of cerebral palsy (Ferrari, Cioni, & Prechtl, 1990).
- Quality of movement may provide better indicator of integrity of developing nervous system and provide valuable information on how infants later diagnosed with ASD interact with environment (Ferrari et al., 1990; Miller & Roid, 1994; Phagava et al, 2008; Wolf et al., 2002).

Problem Statement

- Motor skills are first observable behaviors of developing nervous system prior to emergence of language skills.
- Difficulties with movement may limit infants' active exploration and interaction with people and objects and subsequent development of foundational play and social occupations

(Flanagan, Landa, Bhat, & Bauman, in press)

Aims of Study

- 1) Examine relationship between head lag at 6 months of age and later diagnosis of ASD in high risk infants (AU sibs)
- 2) Examine whether presence of head lag distinguished AU sibs & LR controls at 6 months of age

(Flanagan, Landa, Bhat, & Bauman, in press)

Method: Participants

- Sample 1: 40 AU sibs
- Sample 2: 20 AU sibs & 21 LR infants with no family history of ASDs
- Rationale for AU sibs:
  - High genetic risk for autism and a milder set of impairments (language, social=BAP)

(Flanagan, Landa, Bhat, & Bauman, in press)

Assessments in Sample 1

- Completed at 6, 14, 18, 24, 30, and 36 month visits
  - Not all children assessed at each data point
- Outcome assessment completed at 30 or 36 months
- Based on outcome assessment, children sorted into 3 groups: (1) ASD; (2) Social/Communication Delay, and (3) No language/social delay (Non-delay).

(Flanagan, Landa, Bhat, & Bauman, in press)

Assessments

- **Autism Diagnostic Observation Schedule**
- **Mullen Scales of Early Development (MSEL)**
- Clinical judgment

(Flanagan, Landa, Bhat, & Bauman, in press)

Measure of Motor Functioning in both Samples

- **Clinical judgment of head lag scored from videotapes of task item on GM Scale** (MSEL)

(Flanagan, Landa, Bhat, & Bauman, in press)

Sample 1: Group Differences in Demographics

	ASD (n=10)	Social/Communicatio n Delay (n=13)	Non-Delay (n=17)	
	Frequency (%) or *M (SD)*	Frequency (%) or *M (SD)*	Frequency (%) or *M (SD)*	*p*
Age	6.12 (0.45)	6.68 (1.38)	6.83 (1.02)	.250
Gender, male	10 (100)	8 (62)	5 (29)	.001
Race, Cauc.	7 (70)	12 (92)	14 (82)	0.43
SES	58.00 (10.29)	*52.23 (14.29)	*53.58 (7.84)	.470

Note. All comparisons were made using Fisher Exact tests except for age and SES, for which ANOVA was used. *M*=mean; *SD*=standard deviation; SES= socioeconomic status. *Not all participants in this group had SES data available.

(Flanagan, Landa, Bhat, & Bauman, in press)

Sample 2: Group Differences in Demographics

	High Risk (n=20)	Low Risk (n=21)	
	Frequency (%) or *M (SD)*	Frequency (%) or *M (SD)*	*p*
Age	6.30 (0.29)	6.61 (0.43)	.01
Gender, male	11 (55)	14 (67)	0.444
Race, Cauc.	18 (90)	19 (90)	1.000
SES	*54.58 (7.33)	57.64 (7.32)	.201

[illegible] Comparisons were made using *t* Test for age and [illegible] SES, a Chi-Square for gender, and a Fisher's for ethnicity because the expected cell count was <5. *M*=mean, *SD*=standard deviation, SES= socioeconomic status. *Not all participants in the group had SES data available.

(Flanagan, Landa, Bhat, & Bauman, in press)

Presence of Head Lag at 6 mos in Sample 1: AU sibs

- 40 infants: ASD (n=10); Social/Communication Delay (n=13); Non-Delay (n=17)
- Presence or absence of head lag strongly associated with outcome diagnostic classification of ASD (fisher's exact test p=.002)
- 90% in ASD group (n=9) had head lag
- Only 1/10 in ASD group did not have head lag but had rigidity and tremulousness movements

(Flanagan, Landa, Bhat, & Bauman, in press)

Presence of Head Lag at 6 mos in Sample 1: AU sibs

- 54% of infants with Social/Communication Delay exhibited head lag at 6 mo of age
- 35 % of Non-Delay group exhibited head lag
- All AU sibs with HL scored at least 1.5 SD below MSEL mean scores between 6-36 months

(Flanagan, Landa, Bhat, & Bauman, in press)

Presence of motor deficits at 6 mos in Sample 2: HR vs LR

- Significant difference between AU sibs and LR groups was found for presence of head lag (χ=5.57, p value =.018).
- 75% (n=15) of AU sibs, but only 33% (n=7) LR infants exhibited head lag

(Flanagan, Landa, Bhat, & Bauman, in press)

Discussion

- Increased proportion of infants with outcome grouping with head lag compared to non-delay group
- Significant relationships between head lag at 6 months of age and later diagnosis
- Motor impairment appears to be part of the genetic liability for ASD

(Flanagan, Landa, Bhat, & Bauman, in press)

Discussion

- Head lag: may indicate low tone, poor postural stability, impaired sensory processing and/or difficulty with postural anticipatory activity
- These explanations are plausible, considering prior reports of deficits in anticipatory control in older children with autism (Martineau et al., 2004) and in the integration of sensory input (Minshew et al., 2004; Molloy et al, 2003).

(Flanagan, Landa, Bhat, & Bauman, in press)

Discussion

- Deficits in anticipatory control in autism may be due to impaired development and use of sensorimotor representations (Schmitz et al, 2003; Schmitz & Assaiante, 2008)
- Reduced self-generated exploratory behavior (Pierce & Courchesne, 2001) may affect formation of sensorimotor representations
- Self-generated actions and sensorimotor representations are linked to understanding of others' actions and intentions (Schmitz et al, 2003; Schmitz & Assaiante, 2008; Sommerville, Woodward, and Needham, 2005)

(Flanagan, Landa, Bhat, & Bauman, in press)

Summary Review

- Importance of early developing motor skills for cognitive, language, and social development highlights need for research focusing on the relationship between early aspects of movement
- Early motor delays in conjunction with other alterations in development may serve as early indicators of neurodevelopmental disruption

(Flanagan, Landa, Bhat, & Bauman, in press)

Implications for Early Intervention

- Development of AU sibs should be monitored from at least 6 months of age.
- Early motor impairment in AU sibs may be a useful red flag for later impairment and certainly signals the need for assessment by a motor expert.
- Early intervention may facilitate better outcomes in motor, social, and communicative development.

(Flanagan, Landa, Bhat, & Bauman, in press)

Assessment Should Include:

- Fine and gross motor development
- Head lag when pulled to sit
- Hypotonicity
- Passivity
- Eye contact
- Reciprocal social smile paired with eye contact
- Sustained attention in adult initiated interaction
- Response to name
- Babbling

(Flanagan, Landa, Bhat, & Bauman, in press)

Limitations of Studies

- Small sample size
- Lack of comparison group(s)
- Further examination of sensorimotor and related factors in more systematic method (arousal level, motivation, sensory processing difficulties) should be addressed in future research
- Need further systematic assessment of subtle motor abnormalities

(Flanagan, Landa, Bhat, & Bauman, in press)

References

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- Flanagan, J. E., Landa, R., Bhat, A., & Bauman, M. (in press). Head lag in infants at risk for autism: A preliminary study. *American Journal of Occupational Therapy.*

Acknowledgements

- Families who participated
- REACH staff, especially Ashley Faherty and Dr. Alison Marvin
- Barbara Demchick, MS, OTR/L (ScD cand) and Douglene Jackson, MS, OTR/L (PhD cand) (coders for IRR)
- Funding agencies: NIMH, Cure Autism Now, and Karma Foundation

Thank you!