Title
Consequences of hemispatial neglect on language and social skills development.

Author
Davie, Timothy S.

Publication Date
2012

Independent study project report

Consequences of hemispatial neglect on language and social skills development

Student: **Timothy S. Davie**[1]
ISP Chair: **Doris A. Trauner, MD**[2]
ISP Committee: **Jeanne Townsend, PhD**[2] and **William Perry, PhD**[3]

Introduction

Hemispatial neglect, or inattention to half of one's extra-personal space, is among the sequelae of unilateral brain lesions that occur during ischemic stroke or other neural insult. The affected person may partially or totally ignore visual, auditory, and tactile stimuli contralateral to the lesion. Further, the motivational value of such input is vague. In severe cases, patients may not dress or groom their neglected side, read one side of sentences, or eat food on one side of a tray, even while complaining of hunger. Many affected individuals are anosognostic, meaning that they are unaware of or actively deny their deficit.

Although the anatomical underpinnings for this phenomenon have not yet been fully elucidated, it is clear that the long-held view that hemispatial neglect always denotes a lesion in the parietal lobe is inaccurate. Indeed, damage to any part of a complex anatomic network may be responsible. This network includes the cingulate cortex, posterior parietal cortex, frontal eye fields, striatum, and thalamus. However, data correlating lesion locus to the nature and extent of neglect, particularly in pediatric patients, is scarce.

In adults, lesions of the right hemisphere (RH) are known to produce more severe and longer-lasting neglect than similar lesions in the left hemisphere (LH). This observation was used to hypothesize that the RH may play a more significant role in attending to extra-personal space (Heilman and Van Den Abell 1980, Mesulam 1981, Weintraub and Mesulam 1987). However, more recent data indicates that affected children deviate from this pattern, in that those with a RH or LH lesion exhibit comparable deficits in attending to contralateral extra-personal space (Trauner 2003).

The presence of hemispatial neglect may impact function in a number of ways. If the person is unable to attend to a segment of extra-personal space, they may ignore auditory or visual information coming from that part of space. They miss social cues, facial expressions, and gestures. Thus, it would be reasonable to suspect that hemispatial neglect could impair normal developmental functions in various domains.

To further explore the interplay between lesion locus and childhood development, the current study seeks to determine whether children with hemispatial neglect have deficits in language acquisition, motor skills, and social development. In addition, the relationship between the lesion locus and various developmental consequences (viz., language, social, and motor skill development) will be examined.

Methods

Twenty-seven children (17 females, 10 males) with unilateral stroke of perinatal onset were included in the study. Mean age for children with LH lesions was 3.9 ± 0.85 years, and for those with RH lesions was 4.8 ± 0.78 years ($p < 0.015$). Age range was 2.7 to 5.8 years for those with LH lesions, and 3.2 to 5.8 years for those with RH lesions. All subjects had neuroimaging studies to document a single unilateral lesion. Timing of the lesion to the perinatal period was accomplished by medical record review and acquisition of detailed medical history questionnaires from parents of the children. Children were excluded from the study if they had bilateral or multi-focal lesions, if they were exposed to drugs *in utero*, or if they had a condition that might have caused more global brain damage such as meningitis or hypoxic ischemic encephalopathy.

[1]University of California School of Medicine. Correspondence to tdavie@ucsd.edu
[2]University of California School of Medicine, Dept. of Neurosciences
[3]University of California School of Medicine, Dept. of Psychiatry

From 2004 to 2008, data on language, motor, and social development was collected by Doris Trauner, MD and colleagues. A subset of these data were extracted, organized, and analyzed to address the foregoing questions. Forty-nine videotaped interviews with children aged 2 years 8 months to 5 years 10 months were reviewed. These videotapes were recorded during a battery of experimental tasks that were administered to the children, including tests of neglect, language, and other neuropsychological variables. Nine videotapes were excluded because they involved children with bilateral lesions, or children for whom no other data had been previously collected. Of the remaining 40 interviews, 27 were with children who had suffered perinatal unilateral brain lesions, and 13 were with normally developing control children.

For the purposes of this study, a brief biographical conversation conducted by a previous interviewer was analyzed for each subject. The first 5 minutes of the biographical interview for each child was carefully reviewed and scored.

The videotapes were scored in several areas. First, the interviewer had a brief biographical conversation with each child. The first five minutes of this conversation were divided into periods of 30 seconds. During each of these 10 periods, the children were scored on the following: 1) the number of incidences of fleeting eye contact with the interviewer (defined as eye contact lasting less than 1 second), 2) the number of incidences of sustained eye contact with the interviewer (defined as eye contact lasting more than 1 second), 3) the number of times the child smiled in response to social cues, 4) the number of times the child made gestures with their hands, 5) whether the child was actively avoiding interaction with the interviewer, 6) whether the child was actively attending to what the interviewer was saying (defined as paying attention and answering questions appropriately, categorized as consistently, occasionally, rarely, or never), 7) whether the child was cooperative, reluctant/refusing, or fussing/withdrawn, and 8) whether the child used their left, right, or both upper extremities in performing tasks. The later statistical analyses focused on the first 30 seconds scored, as it was felt this best represented the child's functioning, and preceded onset of fatigue or other variable factors specific to the interview.

Following the interview, the children were asked to perform a neglect task. This task was designed by Dr. Trauner and described previously (Trauner, 2003). A corkboard (30 x 45 cm) was placed in front of the child, containing 20 small toys in four categories (cars, cows, boats, and dinosaurs), arranged randomly so that each item was represented on both sides of the board. The examiner sat directly across the table from the child, who was sometimes accompanied by a parent. The child was asked to remove all of the cars they could find on the board, and the order of removal was recorded. Children were classified as having neglect if their scores on the side contralateral to their lesion were >1 points higher than the score on the ipsilateral side (where the worst score would be 5 and the best would be 0).

The examiners were blinded to the neurological status of the child at the time of testing, and the author was blinded to their status during videotape review.

Finally, results of language testing using the Preschool Language Scale-3 (Zimmerman, 1992) were collected for each child. This test measures receptive and expressive language skills and is normed from birth through six years of age.

Data were compiled and analyzed using the Statistical Package for the Social Sciences (SPSS) software suite. In the case of the social measures, significance values were determined using Independent-Samples Kruskal-Wallis Tests. In the case of the language measures, significance values were generated using independent sample t-tests.

Results

Of the 27 children enrolled, 26 were able to complete the neglect test. Of those children with LH lesions, 7 demonstrated contralateral neglect and 9 showed no evidence of neglect on the toy removal task. Four children with RH lesions had evidence of neglect and 6 did not. Thus, approximately 42% of children with either left or right hemisphere lesions demonstrated contralateral neglect.

In comparing children with and without neglect with respect to the social measures, children with neglect were found to exhibit less social smiling. Children with neglect were found to be more cooperative that those without, although the confirmation of this dubious finding would require a larger sample size. See figure 1 for a summary of these results.

Table 1. Comparison of children with and without hemispatial neglect with respect to social measures

		N	Mean	Std. Dev.	P-value
Fleeting eye contact	Neglect	9			0.622
	No neglect	18			
Sustained eye contact	Neglect	9	1.78	1.394	0.160
	No neglect	18	0.94	0.998	
Social smiling	Neglect	9	0.44	0.527	0.019*
	No neglect	18	1.06	0.938	
Gesturing	Neglect	9	0.56	0.527	0.704
	No neglect	18	0.39	0.502	
Avoidance	Neglect	9	0.00	0.000	0.543
	No neglect	18	0.11	0.471	
Attending	Neglect	9	2.89	0.333	0.442
	No neglect	18	2.44	1.097	
Cooperation	Neglect	9	1.78	0.441	0.019*
	No neglect	18	1.44	0.705	

Table 2. Comparison of children with left vs. right-hemisphere lesions with respect to social measures

		N	Mean	Std. Dev.	P-value
Fleeting eye contact	LH	17			0.842
	RH	10			
Sustained eye contact	LH	17	1.06	0.996	0.437
	RH	10	1.50	1.509	
Social smiling	LH	17	1.12	0.857	0.005*
	RH	10	0.40	0.699	
Gesturing	LH	17	0.53	0.514	0.520

	RH	10	0.30	0.483	
Avoidance	LH	17	0.12	0.485	0.508
	RH	10	0.00	0.000	
Attending	LH	17	2.53	0.943	0.467
	RH	10	2.70	0.949	
Cooperation	LH	17	1.53	0.624	0.039*
	RH	10	1.60	0.699	

Table 3. Comparison of children with and without hemispatial neglect with respect to language measures

		N	Mean	Std. Dev.	P-value
ACSS	Neglect	9	88.67	24.213	0.668
	No neglect	15	84.60	20.993	
ECSS	Neglect	9	89.11	21.786	0.928
	No neglect	15	88.33	19.010	
TOTSS	Neglect	9	87.78	25.094	0.851
	No neglect	15	85.87	23.222	

Table 4. Comparison of children with and without hemispatial neglect with respect to language measures

		N	Mean	Std. Dev.	P-value
ACSS	LH	15	80.67	21.283	0.115
	RH	9	95.22	20.675	
ECSS	LH	15	83.80	19.192	0.122
	RH	9	96.67	18.615	
TOTSS	LH	15	81.13	23.658	0.145
	RH	9	95.67	21.166	

It was found that children with neglect and children with right-sided lesions exhibit less social smiling. In order to determine whether it affected social smiling independently, tests of between-subjects effects were run, and in both cases, significance was determined (P = 0.002).

Discussion

Hemispatial neglect can be a debilitating condition in adults. The complications of neglect during early brain development are not known. The presence of such neglect early in life could interfere with learning, social awareness, and motor development. The current study sought to elucidate two previously unexplored questions: 1) whether significant deficits in language and social skills exist in perinatal stroke survivors with persistent contralateral neglect, and 2) the nature of the neglect produced by lesions in various loci.~40% of our subjects exhibited neglect on a toy removal task. There was no difference in the incidence of neglect based on the side of the lesion. Importantly, our results indicate that the presence of neglect does not adversely affect language function. Furthermore, similar to results of previous studies, language ability did not differ based on

the side of the lesion (Ballantyne et al., 2007; Bates et al., 1997). In contrast, the presence of neglect appeared to have a significant impact on a specific social measure in that children with neglect exhibited significantly less social smiling than children without neglect. In addition, children with left-sided lesions appear to do more social smiling than children with RH lesions, regardless of the presence or absence of neglect. This observation corroborates previously reported findings that babies with right-hemisphere lesions have reduced positive facial expression (Reilly et al. 1995). Our results also agree with previous findings that children with right-hemisphere lesions are more prone to negative temperament (Nass 1987). Finally, we replicated a previous finding that there is no difference in the incidence of hemispatial neglect in children with right or left-sided lesions (Trauner 2003). These results suggest that the RH may not be dominant for spatial attention early in brain development.

Taken together, these findings indicate that hemispatial neglect may be a sequel of early focal brain injury to either the right or left hemisphere, but the presence of neglect does not signify more problems with language development. Social skills may be adversely affected by neglect, however. These results suggest that care should be taken to identify possible hemispatial neglect in peri-natal stroke survivors, and that early intervention may be warranted to improve attention to social cues.

References

Ballantyne A, Spilkin A, Trauner D. Language outcome after perinatal stroke: Does side matter? Child Neuropsychology 13:494-509, 2007.

Bates, E., Thal, D., Trauner, D., Fenson, J., Aram, D., Eisele, J., Nass, R. From first words to grammar in children with focal brain injury. Developmental Neuropsychology 13:275-343, 1997.

Heilman KM, Van Den Abell T. (1980) Right hemisphere dominance for attention: the mechanism underlying hemispheric asymmetries of inattention (neglect). Neurol 30:327–30.

Mesulam M-M. (1981) A cortical network for directed attention and unilateral neglect. Ann Neurol 10:309–25.

Mesulam M.-Marsel, "Chapter 27. Aphasia, Memory Loss, and Other Focal Cerebral Disorders" (Chapter). Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL, Loscalzo J: Harrison's Principles of Internal Medicine, 17th Edition: http://www.accessmedicine.com/content.aspx?aID=2886863.

Nass R. Koch D. (1987) Temperament Differences in Toddlers With Early Unilateral Right- and Left-Brain Damage. Dev. Neuropsych. 1987, 3(2), 93-99.

Reilly JS, Stiles J, Larsen J, Trauner D. (1995) Affective facial expression in infants with focal brain damage. Neuropsychologia. 1995 Jan;33(1):83-99. PMID 7731543.

Trauner D. (2003) Hemispatial neglect in young children with early unilateral brain damage. Dev Med & Child Neuro 45:160–166

Weintraub S, Mesulam M-M. (1987) Right cerebral dominance in spatial attention: further evidence based on ipsilateral neglect. Arch Neurol 44:621–5.

Zimmerman, I. L., Steiner, V. G., & Pond, R. E. (1992). PLS-3: Preschool Language Scale-3. San Antonio, TX : The Psychological Corporation.

Sincerely,

Doris A. Trauner M.D.
Professor, Departments of Neurosciences and Pediatrics