Head Orientation Position during Birth and in Infant Neonatal Period, and Hand Preference at Nineteen Weeks*

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Abstract:

This study of lateral preferences of normal full-term infants found, as predicted, that infants who were delivered from a left occiput antenor or transverse birth position (head turned to the nght) exhibited a neonatal right supine head onentation and a nght-hand preference in visually guided reaching tasks at 19 weeks Contrary to prediction, infants delivered from a right occiput anterior or transverse birth position (head turned to the left) did not exhibit a left-sided preference in either neonatal head position or hand preference Results are discussed in relation to other research which found a right shift in neonates' head orientations and in the distribution of hand preference in the human population The findings suggest further investigation into the relationship between prenatal and postnatal postural asymmetries and the continuing development of laterality.

Article:

The present study is part of an ongoing longitudinal investigation of lateralized preferences of motor patterns in infants and young children (Michel & Goodwin 1979) Prior to the time when infants are capable of reaching hr objects and thus indicating a hand preference, they demonstrate lateral preferences in arm motility (Stubbs & Irwin 1933), hand postures (Cobb, Goodwin, & Saelens 1966), and grasping (Caplan & Kmsbourne 1976) in favor of the right In addition, neonates typical- ly lie with their heads turned to their right (Sating 1979, Turkewitz, Gordon, & Birch 1965) There is some evidence that the side to which the infant prefers to turn the head is related to greater activation of the ipsilateral hand at 12 weeks of age (Coryell & Michel 1978) and to hand preference in later Infancy and childhood (Gesell & Ames 1947, Gesell & Halverson 1942)

Little is known about the antecedent conditions which may affect lateral preferences Radiological studies find that the fetus tends to be with its back toward the mother's left side significantly more often than toward her right (Dunn [cited in Dunn 19761) In this position, the left arm lies posteriorly and its movement is restricted while the right is freer to move (Moss 1929, Wile 1934), thus fetal position has been associated with later hand preference (Kopell 1971, Watson 1924) Churchill, Igna, and Senf (1962) found a relationship between birth position and handedness at 2 years of age as measured by the hand used to pick up and throw a ball Children who were delivered from a left occiput anterior position preferred their right hand, while those delivered right occiput anterior used their left hand.

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The major purpose of this study was to examine the hypotheses that (1) infants delivered from a left occiput anterior or transverse position would exhibit right supine head orientation in the neonatal examination and a right-hand preference at 19 weeks of age, and (2) infants delivered from a right occiput an- tenor or transverse position would exhibit a neonatal head-left orientation and a left-hand preference at 19 weeks of age This age was chosen to examine hand preference because infants are capable of visually guided reaching by 4 months (Bayley 1969, Lederer 1939, Provine & Westerman 1979, White, Castle & Held I964)

Method

Subjects —Subjects were 104 infants (50 females, 54 males) born between April and October 1977 at the Beth Israel Hospital in Boston, Massachusetts They were products of normal pregnancies and deliveries and had normal neonatal examinations Their Apgar scores were 7 or above at 1 and 5 min after birth Attending physicians indicated which mothers could be approached for participation in the study About 10% of the mothers contacted did not agree to participate There were 58 infants from the private service and 46 from the clinic and 39 firstborn and 65 later born Neither factor (private/clinic, first/later born) had an effect on the variables under study

Birth-position assessment —Head position during birth was assessed by the attending physician's recording of the position of the occiput of the fetus during four stages of labor and delivery—at inlet of pelvis, midpelvis, outlet, and restitution (head restitutes to the position in which it entered the pelvis) and as anterior, posterior, or transverse and right or left relative to the mother A column "not noted" was included to increase observer reliability[1] Only infants who were recorded as left occiput anterior or transverse (head turned to their right) or as right occiput anterior or transverse (head turned to their left) during at least two of the four stages were included in the study There were 23 males and 29 females in the left occiput anterior and transverse group and 31 males and 21 females in the right occiput an tenor and transverse group.

Neonatal assessment —Infants were examined on 2 days in a warm (28 5°-31° C), quiet room near the nursery[2] Each was clothed in diaper and shirt and placed supine in the bassinet Head position was assessed by four 2-min conditions During the first minute the examiner held the infant's head to the midline, right or left, during the second minute, the infant's state and positions of head, arms and hands were recorded at 10-sec intervals The session began and ended with a midline condition, right and left conditions were counterbalanced between sessions (M-R-L-M or M-L-R-M) For each starting position, the examiner gently rotated the infant's head The head was held to midline by the examiner’s gently placing fingertips around each of the infant's temples When the head was held to the right or left, the examiner's fingers were around the contralateral temple, and the ipsilateral ear was flat on the mattress The examiner stood out of view of the infant, at the head of the bassinet This procedure was designed to re duce potential biases created by the preassessment position of the infant in the crib.

Head position was coded midline when the nose/chin position was between the right and left nipple line, right when the nose/chin position was to the right of the right nipple line and left when the nose/chIn position was to the left of the left nipple line Coding rehabil ity was determined by two coders on 12 infants for 48 conditions Intercoder reliability for head position was 100% State was coded asleep drowsy, awake, fussing, and crying as adapted from Prechtl (1974) Interobserver agreement was 96% Hand positions were coded in four categones—tightly fisted, loosely fisted, partly open, open (Cobb et al 1966) Interobserver agreement was 88%.

[1] There are no reliability measures of the physicians' judgments of occiput onentation be cause it was too difficult to schedule simultaneous assessments for two physicians As these positions are not difficult to assess, it was decided to use the measures since an occasional error would not systematically bias the hypothesis

[2] Due to scheduling conflicts in the hospital, 23 infants were not reexamined

Nineteen-week hand-preference assessment —At about 19 weeks of age (M = 18 7, SD = 1 5), 76 infants[3] were examined for hand preference with items selected from existing infant scales (Bayley 1969, Lederer 1939) and a plastic building toy Stimuli were a red plastic ring, 9 5 cm in diameter X 35 6 cm in circumference, attached to a 30 5-cm yellow plastic string, two blue plastic nngs with measurements equal to the red ring, two aqua plastic rattles, 14 6 cm in length, with two balls of equal size at either end, two plain, stainless steel teaspoons 14 6 cm in length, a plastic building toy ("construction toy") constructed of red, white, green, and blue square-shaped pieces 9 5 cm long, 15 2 cm at the widest part, and 12 7 cm at the narrowest part, and a piece of white cleansing tissue

Each stimulus was presented 18 cm from the infant for 30 sec The infant was either sitting in a General Motors Infant Love Seat with a detachable "table" (33 cm x 51 cm Plexiglas, covered with white contact paper) or was supine on a white quilt pad

The examination began with the infant in a sitting position The examiner held the red ring to midline, then two blue rings to the right and left sides simultaneously Next, the examiner placed a rattle in a vertical position on the table to the infant's midline, then two identical rattles simultaneously to the infant's right and left Next the examiner placed one rattle in each of the infant's hands and placed the "construction toy" to the midline The examiner then placed a spoon, with the handle toward the infant, first to the midline, and then two identical spoons to the right and left sides simultaneously Next the "construction toy" was placed to midline Finally, with the infant supine, the examiner repeated the presentations of the red and blue rings The examiner then placed a white cleansing tissue over the infant's face for the last stimulus

Before each trial, the examiner turned the infant's head to midline and swung the arms in order to equalize muscle tone (Lederer 1939) Items presented to midline were presented in line with the infant's nose, items presented to the right and left sides were placed in front of either ear Right and left presentations were alternated within and among subjects

The examination was filmed and later analyzed at 2 1/2-sec intervals for hand activity The hand which first responded to the stimulus was scored "approach," "contact," or "grasp " Interobserver agreement was 95% for 12 infants

Neonatal head-position preference and 19- week hand-preference scores were computed by the formula Z = R—L/ √R d- L (Lederer 1939) A positive score of 1 96 or greater indicated a consistently right preference, a positive score of less than 1 96, a right bias, a negative score of less than —1 96, a left bias, and a negative score greater than —1 96, a consistently left preference[4] Infants were examined on 2 days in order to assess the reliability of the neonatal procedure The neonatal head-position preference scores for the two days were significantly correlated, Spearman p = 34, Z = 2 19, N = 81 However, because of the variability between assessments and because 23 infants had one assessment only, it was decided to use the score from 1 of the 2 assessment days in the analyses The scores for the 2 days were not averaged because the average scores would not be statistically comparable to the single scores The day when the infant was in the most quiet and relaxed state was selected on the basis of findings of others that these periods afford the most optimal indicators of an infant's behavior (Korner 1972)[5] The selection was made without knowledge of the infants' birth position or neonatal head-position preference

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[3] It was not possible to reexamine 28 of the infants because 11 of the families had moved 10 had no telephone and did not respond to letters, three refused, and four had illness in the family.

[4] Results are presented for neonatal head-position preference and hand preference in four categories (consistently nght, nght bias, left bias, consistently left) as a response by these authors to criticisms of literature which reports hand preference as a dichotomous vanable (Annett, Hudson, & Turner 1974)

[5] It was not expected that state would be related to head position, since crying is not related to lateral direction of head turn either on release from a midline position (Turkewitz & Creighton 1975) or in response to sensory stimulation (Turkewitz, Moreau, Davis, & Birch 1969) This study found no relationship between head-position preference and state (asleep/ drowsy, alert, or fussy 'crying) either on day 1, x-'(2) = 2 5, or on day 2, $X^2(2) = 01$

Parent and familial hand preference — Hand preference for parents was assessed using the Briggs and Nebes (1975) adaptation of the Annett (1967) handedness scale Familial left handedness was defined as any left handedness in parents or grandparents

Results

Most (59%) neonates preferred to he with their heads turned to the right, 47 (45%) exhibited a consistently right preference, 15 (14%) a right bias, 20 (19%) a left bias, 17 (16%) a consistently left preference, and five (5%) did not show a preference The direction in which the infant initially turned the head after being held to midline is consistent with the head-position preference for the entire condition, McNemar test for the significance of changes, $x^2(1) =$ — 19 (Siegel 1956) Latency for initial turn was short, 72% turned their heads within 10 sec and 88% within 20 sec There were no differences in latencies to turn right or left, 72% of those who turned right did so within the first 10 sec, and 80% of those who turned left did so within the first 10 sec Pearson product-moment correlations indicate significant correlations between head-position preference for the first and second midline conditions for the first day, $r = 53$, $p < 01$, and for the first and second day of assessment, $r = 45$, $p < 01$ There were no order effects for the midline conditions There were no changes in the head position between assessment days for the individual lateral conditions, McNemar test for significance of changes, x^2 (1) = 57, head held right, $x^2(1) = 08$, head held left The right and left lateral conditions did not bias the direction of the head-position preference score Binomial test indicates that for 1 min following the right and left lateral conditions, infants were likely to lay with their heads in the lateral position to which they were turned and not to turn to the opposite side, right condition, Z = —7 9, $p < 00003$, left condition, Z = —4 8, $p < 00003$.

There is a significant association between birth position (LOA/LOT and ROA/ROT) and neonatal head-position preference, x^2 (3) = 8 24, $p < 05$ (table 1)[6] The relationship is significant for infants delivered LOA/LOT, X^2 (3) = 314, $p < 001$, but not for infants de livered ROA/ ROT, X^2 (3) = 4 88, $p < 20$ Infants delivered LOA/ LOT demonstrate a right neonatal head-position preference Infants delivered ROA/ ROT do not exhibit the expected left bias, their head-position preferences are evenly divided between the right and left There were no differences between males and females in their head-position preferences (table 2).

Analysis of neonatal head position and hand postures showed that when the infant lay with the head to the right, the right hand was more likely to be fisted than the left, and when the head was to the left, the left hand was more often fisted than the right, x^2 (1) = 9 83, $p < 01$ (table 3) Neonates lay primarily with both arms flexed, not in a classical TNR posture with the arm on the side to which the face was turned extended, and the arm on the skull side flexed (Parr, Routh, Byrd, & McMillan 1974, Peeper 1963).

Most (64%) of the 19-week-old infants in dicated a preference for the nght hand m the visually guided reaching tasks, 20 (26%) in dicated a consistently right preference, 29 (38%), a right bias, 14 (22%), a left bias, 11 (14%), a consistently left preference, and two (3%), no preference.

There was an overall relationship between the position of the head during birth and hand preference at 19 weeks of age, x^2 (3) = 14 95, $p < 001$ (table 4)[7] Infants who were delivered from the LOA or LOT position exhibited a right hand preference at 19 weeks of age, $X^2(3) = 16$ 28, $p < 001$, infants delivered.

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[6] The significant relationship is found also when the consistently right and consistently left categories only are compared, $x^2(1) = 584$, $p < 02$, when all nght preferences and all left preferences are compared, $x^2(1) = 583$,< 02, and when a mean score is used for head-position preference for day 1 and day 2 for 81 infants, $x^2(3) = 8$ 57, $p < 05$

[7] The significant relationship is found also when the consistently right and consistently left categones only are compared, $x^2(1) = 562$, $p < 02$, and when all right preferences and all left preferences are compared, $x^2(1) = 7$ 8, $p < 01$

TABLE 1

BIRTH POSITION AND NEONATAL HEAD-POSITION PREFERENCE (N = 99)

BIRTH POSITION	NEONATAL HEAD POSITION				
	Consistently Right	Right Bias	Left Bias	Consistently Left	χ^{2a}
LOA/LOT	29	8	8	4	31 4 ($p < 001$)
ROA/ROT	18	7	12	13	4 88 ($p < 20$)

[a] $df = 3$ overall, $\chi^2(3) = 8\ 24$, $p < 05$

TABLE 2

BIRTH POSITION AND NEONATAL HEAD-POSITION PREFERENCE ACCORDING TO SEX

	NEONATAL HEAD-POSITION PREFERENCE			
	Consistentlv Right	Right Bias	Left Bias	Consistently Left
Males				
LOA/LOT	13	1	5	1
ROA/ROT	10	5	4	10
Females				
LOA/LOT	16	7	3	3
ROA/ROT	8	2	8	3

TABLE 3

RELATION OF ASYMMETRIC HAND POSTURES TO HEAD POSITION DURING NEONATAL ASSESSMENT

ASYMMETRIC HAND POSTURES	NEONATAL HEAD POSITION	
	Head to the Right	Head to the Left
Right fisted, left open	34	10
Right open, left fisted	12	19

NOTE.—Overall $\chi^2(1) = 9\ 83$ $p < 01$

TABLE 4

BIRTH POSITION AND INFANT HANDEDNESS AT 19 WEEKS (N = 74)

BIRTH POSITION	INFANT HANDEDNESS			
	Consistently Right	Right Bias	Left Bias	Consistently Left
LOA/LOT	17	15	3	4
ROA/ROT	3	14	11	7

NOTE —Overall $\chi^2(3) = 14.95$, $p < .001$

TABLE 5

RELATION OF BIRTH POSITION AND HAND PREFERENCE AT 19 WEEKS BY SEX

BIRTH POSITION	INFANT HANDEDNESS			
	Consistently Right	Right Bias	Left Bias	Consistently Left
Males				
LOA/LOT	8	7	0	3
ROA/ROT	1	7	5	6
Females				
LOA/LOT	9	8	3	1
ROA/ROT	2	7	6	1

ROA/ROT are as likely to have a right as a left hand preference at 19 weeks There were no sex differences in the overall distribution of hand preference, but there were more males than females with hand preferences which were consistently left, $x^2(1) = 4.5$, $p < .05$ (table 5).

There was an overall relationship between neonatal head-position preference and 19-week hand preference, $x^2(9) = 17.1$, $p < .05$ (table 6) Infants with a right neonatal head position (consistently right and right bias combined) demonstrated a right-hand preference at 19 weeks, $N = 49$, $x^2(3) = 16.72$, $p < .001$ There were no significant differences in the distribution of hand preferences for infants with left neonatal head-position preferences However, six of eight infants with consistently left head-orientation preferences showed a left-hand-use preference.

The correspondence in direction of lateral preferences of neonatal head-position prefer-

TABLE 6

NEONATAL HEAD-POSITION PREFERENCE AND HAND PREFERENCE AT 19 WEEKS (N = 71)

HEAD-POSITION PREFERENCE	INFANT HANDEDNESS				
	Consistently Right	Right Bias	Left Bias	Consistently Left	
Consistently right	11	16	3	3	$\chi^2(3) = 16.72$, $p < .001$
Right bias	1	8	4	3	
Left bias	6	2	4	2	$\chi^2(3) = 2.01$ $p < .50$
Consistently left	1	1	3	3	

NOTE —Overall $\chi^2(9) = 17.1$, $p < .05$

ences and hand preference at I9 weeks is related to the position of the infant's head at birth, x^2 (1) = 544, $p < .02$ (table 7) Of the 36 infants whose head and hand preferences were right, 22 (61%) were delivered from the LOA/LOT position, of the 12 infants whose head and hand preferences were left, 10 (83%) were delivered from the ROA/ROT position Of the 23 infants whose hand preferences at 19 weeks were contralateral to their neonatal head-position preference, 11 were delivered ROA/ ROT and 12 LOA/ LOT.

There were no associations between familial left handedness and neonatal head-position preference, x^2 (1) = 24, or between familial left handedness and infant hand preference, x^2 (1) = 29 There were only 13 left- handed parents, only one infant had both parents who were left handed.

Discussion

This study has demonstrated that infants delivered from the LOA or LOT position show the predicted right neonatal head-position preference and right-hand preference at 19 weeks, but infants delivered from the ROA or ROT position do not show the predicted left preference in either their neonatal head-position preference or their hand preference.

The results are in accord, in a general sense, with studies of newborn head-turning preferences (Saling 1979, Turkewitz & Creighton 1975, Turkewitz et al 1965) and studies of newborn head turning to nonaversive and aversive sensory stimulation (Liederman & Kinsbourne 1980, Turkewitz et al 1969) , although we found more incidences of left head turning than previously reported This finding is probably due to an oversampling of the ROA/ ROT population in order to have an equal sample of infants delivered LOA/LOT and ROA/ ROT The finding of an association between LOA/ LOT position and handedness is in accord with the findings of Churchill et al (1962) , the lack of association of ROA/ ROT birth position and left handedness is contrary to their findings The discrepancy could be real and due to the variable nature of the lateral preferences associated with a left-turned fetal head position, or it could be due to the relatively small number of infants in the consistently right and the consistently left groups For example, of the 11 left-handed infants, seven (64%) were delivered ROA/ ROT, of the 20 right-handed children, only three (15%) were delivered ROA/ ROT.

Little is known about the relationships between prenatal and postnatal postures or the causes of asymmetrical postures Although it has been found by radiographic technique (Dunn 1976) that the position of the fetus prior to delivery corresponds to the neonatal "position of comfort" (Chapple & Davidson 1941), the relationship between prenatal and postnatal head positions has not been explored Future investigations with ultrasound may be able to illuminate this relationship by a fine analysis of fetal head positions during several stages of pregnancy Taylor (1976) has suggested that a cause for intrauterine asymmetry could be the torsion of the uterus to the right (in most pregnancies) which causes the bladder to be displaced to the right This displacement leaves more room on the left side for the left occiput position of the fetal head when it is anterior or transverse It is also possible that the fetus has a preference for lying to one side and maintains that position for a significant amount of time during the gestation period Perhaps infants delivered LOA/LOT remain more consistently in that position prenatally than infants delivered ROA/ ROT remain ROA/ ROT prenatally, and this difference ac counts for the consistency of lateral (head and hand) preferences to the right for infants delivered LOA/ LOT but not for infants delivered ROA/ ROT Gardner, Lewkowicz, and Turke witz (1977) found that with increasing con ceptual age, premature infants spend more time with their heads to the right than left, and they concluded that the postural asymmetry is related both to factors intrinsic to the developing fetus and to the intrauterine environment.

Although others (Coryell & Michel 1978, Gesell & Ames 1947) have associated head pose

TABLE 7

RELATION OF ASYMMETRY OF NEONATAL HEAD-POSITION PREFERENCE AND HAND PREFERENCE AT 19 WEEKS TO BIRTH POSITION

BIRTH POSITION	DIRECTION OF LATERAL PREFERENCE OF HEAD AND HAND		
	Both Right	Both Left	One Right/ One Left
LOA/LOT	22	2	12
ROA/ROT	14	10	11

tion and early hand activation or later hand use, this study found a significant relationship between right neonatal head-position preference and right handedness only, and not between left neonatal head-position preference and left handedness One problem with the present analysis is that there were very few infants with neonatal head-position preferences which were "consistently left", there were only eight in that category, but 33 in the "consistently right" category Infants with neonatal head-position preferences biased" either to the right or left showed hand preferences which were about evenly divided between right and left, therefore, it may be in the "consistently right" and "consistently left" groups that the differences may emerge However, there are too few subjects in the ' consistently left" group to make a meaningful statement at present.

Further investigation of prenatal postures, premature infants, and infants who have had different labor and delivery experiences than those examined in the present study (e g , Caesarean section) are important in order to understand more fully the development of lateral preferences.

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