Intrauterine Birth Position Predicts Newborn Supine Head Position Preferences*

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Abstract:
Intrauterine orientation of the fetus before delivery, as judged from head position during birth, was found to be a reliable precursor of the supine head position preference of the neonate. The neonate's head position affected the finger positions of the hands. When the head was oriented right, the right hand was fisted more often than the left and the left hand was open more often than the right. The reverse pattern occurred when the head was oriented left. The neonates did not manifest head position preferences while prone, but the prone position did alter the state of the infant. The neonate's state was also found to be associated with supine head orientation. The results were discussed in relation to the ontogeny of handedness.

Article:
Most infants spend 70-80% of their time with their heads turned toward their right while supine (Gesell, 1938, p. 462). This supine postural preference (SPP) appears by the second day of age (Turkewitz, Gordon, & Birch, 1965) at which time infants are also more responsive to auditory and somesthetic stimuli applied to their right side than to the left (Turkewitz, Moreau, & Birch, 1966). The SPP continues for 3-6 months (Coryell & Michel, 1978; Gesell & Halverson, 1942). After the first month the SPP reliability elicits an asymmetric tonic neck reflex (Coryell & Michel, 1978). During the second month, infants begin to fixate their own hands visually (Gesell & Ames, 1959; White & Held, 1966). That hand which is fixated is the hand extended in the asymmetric tonic neck reflex; Coryell & Michel found that those infants (75% of sample) with a right SPP received significantly more visual experience of their right than of their left hand, while those (13%) with a left SPP received more visual experience of their left hand. Moreover, the amount of visual experience obtained with each hand reliably predicted which hand predominated in visually-elicited reaching at 12 weeks.

Little is known about the antecedent conditions for the infant's head position preference; however, muscle tone and motor system bias, and not lateralized sensitivity and responsiveness, are responsible for the head position preference of infants over 12 hours of age (Turkewitz, 1977). Passage through the birth canal is not responsible for the organization of the infant's head position preference since infants delivered by Caesarean section exhibit the typical head—right posture (Turkewitz & Creighton, in Turkewitz, 1977). However, there is some indication that head position preferences are not present in infants born before term (Turkewitz & Birch, 1971). Turkewitz (1977) has speculated that the head position preference of the newborn may be related to fetal position.

The eventual birth position of the fetus's head is achieved some 3-4 weeks before delivery (Varten, 1945) and is maintained in this position, with restricted mobility, for this entire period (Rydberg, 1965). Steel and Javert (1942) observed that 53% of 763 fetuses were in a left occiput anterior (LOA) or a left occiput transverse (LOT) position before their heads began to descend through the birth canal. The head was in a ROA or ROT position in only 34% of the cases. Since over 95% of infants are born in a vertex position, a majority of infants will be

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* Some of these data were collected as part of a dissertation by Rhoda Goodwin, submitted to Boston University in partial fulfillment of the requirements for the Ph.D. Please send requests for reprints to George F. Michel, Department of Psychiatry, John Enders Research Laboratories, Children,s Hospital Medical Center, 320 Longwood Avenue, Boston, Mass. 02115.

born from the LOT/LOA position. Therefore, position of the infant's head during delivery can be used as an indication of the orientation of the fetus's head during the three weeks before labor.

Since the newborn's general postural preference ("position of comfort") approximates its prenatal posture (Chapple & Davidson, 1941; Dunn, 1975), the present study examines the relation between newborn head position preferences and prenatal posture as indicated by position of the head during birth (birth position). It was hypothesized that newborn infants with a LOT/LOA birth position would exhibit a head—right supine position preference, while ROT/ROA birth position infants would exhibit a head—left supine position preference. Head position preference is likely an aspect of general neurobehavioral organization of newborns; therefore, the effect of state on head position, and the effect of newborn head position on hand fisting were examined.

METHODS

Subjects

Fifty female and 59 male newborn infants born in the maternity ward of the Beth Israel Hospital in Boston were observed. This was a sample of black and white infants from lower- and middle-class backgrounds born between March and August, 1977. There were three criteria for inclusion in the study: a full-term vaginal delivery birth, with a birth weight of 2723-4540 g; a birth record and neonatal examination indicating no neurological or skeletal-muscular anomalies; and the attending obstetrician must have filled out our forms indicating the position of the infant's head during descent. These forms also gave us permission to visit the mother to seek permission to observe her baby.

Of the approximately 900 infants born during this period, slightly over 300 met these criteria. Of these, many were lost both because of scheduling conflicts and the refusal of about 15% of the mothers to give permission for the observations. To avoid possible spurious correlations due to relatively frequent occurrence of LOT/LOA birth positions and head-right position preferences in the general population, we selected more ROT/ROA infants than would have occurred in a random sample. Of the 109 infants observed, we predicted a head- right preference for 53% and a head-left preference for 47%.

Procedure

The infant's birth position was determined by its occiput position (anterior, posterior, transverse, right, left) relative to the mother at four phases during delivery (at inlet, midpelvis, outlet, and after restitution). To increase validity, the physician was provided with the opportunity of checking "not noted" for each phase of delivery. There are some births in which the obstetrician is not able to note occiput position at certain phases of the delivery (e.g., mother reaches delivery room after infant's head has reached midpelvis). Therefore, each infant's birth position was designated by a record of occiput position for at least two of the four phases of delivery that included a specification of a left or right orientation. Using these records, we generated a dichotomous prediction about the left-right orientation of head position preference.

Occiput position during delivery is routinely assessed, though not routinely recorded, by the attending physician. Therefore, there is some room for error in both the observation of occiput position and the recording of the position on our checklist (typically made after delivery). We accepted the possibility of some error in the birth position data (i.e., we have no independent measures of the physicians' reliability or validity in assessing occiput position), because it was likely that such errors would be random and not favor our hypotheses.

The newborn's posture was observed during 16-50 hr postpartum . The infant was moved in the crib from the nursery to a quiet, warm (28-31°C) room in the nursery ward. Blankets, clothing, and diapers were removed, and the infant placed in a supine position. The head was held gently in midline position for one minute. Then, the head was released and state, head, and digit positions were recorded on a checklist every six seconds for one minute. These intervals were timed by a tone generator providing a "beep" in an earphone worn by the observer. After this observation, the head was held gently with the left ear flat on the mattress for one minute. Again, postures and state were recorded every six seconds for the following minute. Finally, the head was held with the

right ear flat on the mattress for one minute, and state and postures recorded during the minute following release. The order of starting head positions (midline, left, right) was alternated among infants in a counterbalanced design. Chi-square analysis revealed no significant association of the order of starting position with birth position predictions, sex, or birth order.

Immediately thereafter, the infant was held (supported by both hands with the area between thumb and forefinger supporting the infant's shoulders and the remaining fingers holding the head; the infant's toes touched the mattress and its hips were supported by the observer's forearms) in a prone position with head in midline for one minute. Then, the infant was placed prone on the crib's mattress with the head in midline. State, head, and digit positions were recorded as above. As above, the infant was also held in the prone position with head turned to the left (chin in line with left shoulder) and subsequently to the right. Again, the order of starting position while prone was altered in a counterbalanced design. Half of the infants went through the prone-position procedures first.

Infant state was recorded in five categories adapted from Prechtl (1974). The categories were crying, fussing, alert/awake, drowsy, asleep. Head position while supine was recorded in three categories: head—right position, defined as nose/chin to right of right nipple with right ear touching mattress; head—left position, defined similarly for left nipple; midline position, defined as nose/chin position between right and left nipples.

Head position while prone was recorded as: head—right, occiput oriented over or beyond left scapula; head—left, occiput oriented over or beyond right scapula; midline position, occiput between scapulae. Positions of the digits of the hands were described using three categories adapted from Cobb, Goodwin, and Saelens (1966). Fisted was defined as three of four fingers flexed at the second joint, with finger tips resting on the palm. Open was defined as three of four finger tips not touching the palm. The hand position was recorded as moving when three of four fingers were in motion.

All categories had an interrater reliability greater than .90 as measured with a preliminary sample of twelve newborn infants.

RESULTS

Newborn Head Position Preferences

Head position data were analyzed separately for the supine and prone conditions. The three observation periods in each condition were combined to yield a total of thirty 6-sec intervals. Head position preference for each infant was indexed using the formula $(R - L)/\sqrt{R + L}$, where R = number of intervals the head is turned right and L = number of intervals turned left. Positive scores indicate a right-turn and negative scores a left-turn orientation. Since this formula yields a Z score, scores of ±1.96 or greater were considered as describing a significant preference.

As Table 1 shows, significantly more infants orientated right and had significant head—right preferences while supine. Of the 52 infants who showed no significant head preference while supine, 67% had head position scores greater than zero and 33% had scores less than zero, a reliable difference ($p = .0089$, binomial test). There were no significant differences while prone.

TABLE 1
Newborn Head Position Preferences

	Percent orienting		
	Right	Left	p (Binomial Test)
Supine	75	25	.0001
Prone	54	45	.2236
	Percent with significant		
	Right preference	Left preference	p (Binomial test)
Supine	43	9	.0001
Prone	14	8	.1539

The correlation between supine and prone head position indices was not significant (Pearson r = 0.11, df = 107, p > .10), and a treatment by subjects analysis of variance revealed a significant difference between supine and prone head position indices (F(1, 108) = 5.8, p < .05), suggesting that supine and prone head positions are influenced by different factors.

Birth Position, Sex, and Birth Order as Related to Head Position

Birth order information was dichotomized simply into firstborn and later-born categories. Less than 10% of the mothers of the 66 later-born infants in the sample had had more than two previous deliveries. Occiput position of the infant's head during delivery was used to dichotomize the infants into two groups representing a predicted newborn head—right preference or head—left preference.

The influences of birth position, sex, and birth order on the infant's supine head position preference score were examined using a multiple linear regression model (BMDO3R, 1964). The infant's head position index was the dependent variable and birth position prediction, sex of infant, its birth order category, and the various interactions among these variables were each represented using a dummy coding technique.

The partial correlation coefficient for the relation of birth position to newborn supine head position preference was .52 (see Table 2) with a t value of 5.2 (p < .001) The partial correlation coefficient for the sex of the infant (-0.24) was also significant (t = 2.1, p = .05). Neither birth order nor any of the interactions were significantly related to supine head position preference.

TABLE 2
Mean (SD) Head Position Score

Birth position prediction		Sex	
Right	Left	Male	Female
2.3 (±2.1)	0.4 (±2.6)	0.9 (±2.7)	2.1 (±2.1)

TABLE 3
Categorical Distribution of Supine Head Position Preferences of Newborn Infants

Birth Position Prediction	Preference (z) score index		
	Significantly right	Between +1.95 and −1.95	Significantly Left
Right	35	21	2
Left	12	31	8

Multilinear regression analysis of the infants' head position indices while prone revealed no significant effects of birth position, sex, birth order, or their interactions.

Table 3 shows the distribution of infants according to birth position prediction and the nature of their observed supine head position scores. Of the 47 infants with a significant head—right preference, 35 (75%) were predicted by their birth position to have a head—right preference. This association is significant ($x^2 = 9.2$, $p < .01$) even when the expected values are adjusted to account for the slightly unequal distribution of head—right and head—left birth position predictions in the sample. Of the 10 infants with significant head—left preferences, 80% were predicted by their birth position to have a head-left preference ($p = .055$, binomial). Of those who showed neither a significant head—right nor head—left preference, 17 had scored less than zero. Twelve of the 17 infants (71%) with nonsignificant head position scored less than zero were predicted by birth position to have a head—left preference ($p = .072$, binomial).

Head Position and Asymmetrical Hand Positions

Newborn infants are more likely ($x^2 = 8.2$, $p < .005$) to have their hand in simultaneously symmetrical positions (56% of the time) than in asymmetrical positions (44%). While there is no association between head position (left vs. right) and whether the hands are in symmetrical or asymmetrical positions ($x^2 = 2.5$, $p > .10$), head position does affect the pattern of asymmetry of hand position. When the hands are in asymmetrical positions (Table 4), the right hand is more likely to be fisted when the head is oriented right, and the left hand is more likely to be fisted when the head is oriented left ($x^2 = 4.5$, $p < .05$, $c = .21$). Similarly, when the head is oriented right, the left hand is more likely to be open and when the head is oriented left, the right hand is more likely to be open ($x^2 = 9.3$,$p < .01$, $c = .30$). There is no significant association between head orientation and left- and right-hand finger movement ($x^2 = 3.35$, $.07 > p > .06$, $c = .22$).

TABLE 4
Percentage of Time Right and Left Hand Alone was Fisted, Open, or Moving, Relative to Right–Left Head Orientation

Hand Position	*Head Orientation*	
	Head–Right	*Head–Left*
Right hand fisted	60	38
Left hand fisted	40	62
Right hand open	40	72
Left hand open	60	28
Right hand moving	62	41
Left hand moving	38	59

Asymmetrical hand positions examined independently of head position reveals a different pattern. The right hand is fisted 41% of the time that the left is not fisted (open or moving), and the left hand is fisted 40% of the time that the right is not fisted. Therefore, the association between head—right and fisted right-hand is not because they are both predominant asymmetries. Similarly, the right hand is open 31% of the time that the left is not, and the left hand is open 29% of the time that the right is not. Thus, the difference between the right and left asymmetrical hand positions depends on the infant's head position and is not a characteristic difference between the hands.

State and Head Position

State characteristics varied significantly ($x^2 = 163.5$, $df = 4$, $p < .001$) with respect to prone or supine position (Table 5). Infants sleep more and cry less when in a prone position. While supine, infants exhibited a significant ($x^2 = 57.3$, $df = 4$, $p < .001$) but weak ($c = .16$) association between head position and state (Table 5). When drowsy or asleep, the head orients left more than when alert or disturbed. There is no association ($x^2 = 7.13$, $df = 4$,$p > .12$) between head position and state while the infant is prone.

TABLE 5
Percentage of Time Infants Spent in Different State for Supine versus Prone Conditions, and for Left versus Right Supine Head position

	Infant State				
	Asleep	*Drowsy*	*Alert/Awake*	*Fussing*	*Crying*
Prone condition	28	15	36	13	8
Supine Condition	15	21	33	15	16
Head–right supine	13	17	34	16	20
Head–left supine	19	27	29	13	12

DISCUSSION

Prenatal intrauterine orientation of the fetus, as estimated from birth position information, is clearly associated with the newborn infant's supine head position preference. This supports the Dunn (1975) and Turkewitz (1977) arguments for an in utero influence on postnatal posture. It is not known whether the association results from the influence of prenatal postural orientation on the organization of postnatal postural preferences, or whether they both reflect a single underlying cause. However, obstetrical study (Rydberg, 1965) supports the view that orientation of the fetus during the last weeks before delivery results from the mechanics of shape and volume of the uterus, pelvis, fetus, and its head. As amnionic fluid decreases and the fetus grows, mechanical pressure will shift the fetus to a cephalic presentation and the shape of the head will lead to vertex position. The left—right orientation of the head may result from the asymmetric location of muscles. For example, the left and posterior section of the upper part of the pelvic space is occupied by the rectosigmoid, resulting in an asymmetrical obstruction of the space. Obviously, such factors make certain orientations of the fetus's head more probable without precluding the occurrence of other orientations. Therefore, though the head position preference of the newborn appears to be governed by conditions intrinsic to itself, the position of the fetus seems to be governed by its shape and the anatomical structure of its mother's pelvis and uterus (however, see Gardner, Lewkowicz, & Turkewitz, 1977).

Intrauterine orientation was not associated with prone head position orientation. Perhaps the prone condition requires a coordination of trunk, limbs, and head movements for orientation beyond what can be manifested during the observation time used. It is possible, however, that infants have no head position preferences while prone.

Since intrauterine pressure and the birth process contribute to an asymmetrical molding of the newborn's head (Rydberg, 1965), it might be argued that supine head position preference results from head asymmetry combined with poor muscle tonus or coordination of neck muscles.. This would also explain the association between birth position and head position preference, since LOT/LOA orientation is likely to result in left occiput protuberance while ROT/ROA leads to right occiput protuberance.

Many infants moved from an extreme head—left placement to a head—right position to achieve a significant preference index score. It is unlikely that the asymmetries of the head would allow, physically, the rolling of the head from a flat position over a protuberance to another flat position. Finally, Bauermeister (1977), in a study of the relation between head asymmetries and the preferred head positions of eighteen newborn infants, found no evidence for a physical explanation of head position preference.

Birth order did not affect the newborn's head position preference. It may be that severe prenatal and birth condition stress would affect newborn head position preferences, but it is unlikely that the typical complications associated with primiparity (longer labor, more use of instruments, etc.) affect head position preference.

The observed influence of the sex of the infant on the supine head position preference may reflect the effects of circumcision on activity level. Most of the males in the study were uncircumcized or observed before being circumcized; however, several were observed 24 hours after circumcision.

Brackbill, Douthill, and West (1973) found that prone placement was associated with lower behavioral and physiological arousal and more sleep time as compared with supine placement. A similar association between state and supine versus prone position was observed in the present study. Moreover, there was an association between head position and state. Whether state change is a mediator or consequence of head position is as yet unknown.

Earlier, Cobb, Goodwin, and Saelins (1966) suggested that the asymmetrical fisting of the newborn's hands could be an early indication of handedness status. That is, a right hand more often fisted than the left indicated right- handedness. Our observation that the prevalent head—right orientation of the infant results in more frequent fisting of the right hand and opening of the left warrants the conclusion that head position must be considered when examining the occurrence of early lateralized differences in hand activities.

The present study not only confirms the earlier observations of Turkewitz and his colleagues and identifies a developmental precursor of head position preference, but it also bears on certain notions concerning the development of handedness. Several investigators have argued that intrauterine position affects hand preference (Churchill, Igna, & Senf, 1962; Gesell & Ames, 1950; Kopell, 1971; Moss, 1929). It is conceivable that birth position is associated with later handedness through the effects of prenatal postural orientations on neonatal head position preferences.

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REFERENCES

Bauermeister, M. Head posture and head turning in the human neonate. Project report of the Joint Program in Neonatology, Beth Israel Hospital, Boston, Massachusetts, July, 1977.

Brackbill, Y., Douthill, T. C., & West, H. Neonatal posture: Psychophysiological effects. *Journal of Pediatrics,1*973, *82*, 82-84.

Chapple, C., & Davidson, D. A study of 1he relationship between fetal position and certain congenital deformities. *Journal of Pediatrics,1*941. /8, 483-491.

Churchill, J., Igna, E., & Senf, R. The association of position at birth and handedness. *Pediatrics,1*962, *29*, 307-309.

Cobb, K., Goodwin, R., & Saelens, E. Spontaneous hand positions of newborn infants. *Journal of Genetic Psychology,1*968, */08,* 225-237.

Coryell, J., & Michel, G. F. How supine postural preferences of infants can contribute towards the development of handedness. *Infant Behavior and Development,1*978, *1*, 245-257. Dunn, P. M. Congenital postural deformities. *British Medical Bulletin,1*975, *32*, 71-72. Gardner, J., Lewkowicz, D., & Turkewitz, G. Development of postural asymmetry in premature human infants. *Developmental Psychobiology,1*977, */0,* 47¹-480.

Gesell, A. The tonic neck reflex in the human infant. *Journal of Pediatrics,* 1938, /3, 455-464. Gesell, A., & Ames, L. B. Tonic-neck-reflex and symmetro-tonic behavior. *Journal of Pediatrics,* 1950,*36,1*65-¹76.

Gesell, A., & Halverson, H. The daily maturation of infant behavior: A cinema study of postures, movements, and laterality. *Journal of Genetic Psychology,* 1942, *61,* 3-32.

Kopell, H. Letter to the editor. *Scientific American,* 1971, *224,* 9.

Moss, F. A. *Applications of psychology.* Cambridge, Mass.: Harvard Univ. Press,1929.

Prechtl, H. F. R. The behavioral states of the newborn infant (a review). *Brain Research,1*974, *76,* 185-2¹2.

Rydberg, E. Mechanism of labor in cephalic presentation. In J. P. Greenhill (Ed.), *Obstetrics (13th* ed.). Philadelphia, Pa.: Saunders,1965.
Steel, K. B., & Javert, C. T. Mechanism of labor for transverse positions of the vertex. *Surgical Gynecology and Obstetrics,1*942, 75, 477-480.
Turkewitz, G. The development of lateral differences in the human infant. In S. Hamad, R. W. Doty, L. Goldstein, J. Jaynes, & G. Krauthamer (Eds.), *Lateralization in the nervous system.* New York: Academic Press,1977.
Turkewitz, G., & Birch, H. G. Neurobehavioral organization of the human newborn. In J. Hellmuth (Ed.), *Exceptional infant (Vol.* 2). New York: Brunner/Mazel,197¹.
Turkewitz, G., & Creighton, S. Changes in lateral differentiation of head posture in the human neonate. *Developmental Psychobiology,1*974, *8,* 85-89.
Turkewitz, G., Gordon, E. W., & Birch, H. G. Head turning in the human neonate: Spontaneous patterns. *Journal of Genetic Psychology,* 1965, */07,* 143-¹58.
Turkewitz, G., Moreau, T., & Birch, H. G. Head position and receptor organization in the human neonate. *Journal of Experimental Psychology,1*966, *4,* 169-177.
Vartan, C. K. Behavior of the fetus in utero with special reference to the incidence of breech presentation at term. *Journal of Obstetrics and Gynecology* (Brit.) 1945, *52,* 4¹7-434.
White, B. L., & Held, R. Plasticity of sensorimotor development in the human infant. In J. F. Rosenblith and W. Allinsmith (Eds.), *The causes of behavior* (2nd. ed.). Boston: Allyn & Bacon,1966.