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Optimal positions for the release of primitive neonatal reflexes stimulating breastfeeding

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Abstract

Background: Despite widespread skills-teaching, 37% of UK mothers initiating breastfeeding stop by six weeks suggesting a need to reappraise current support strategies. Rooting, sucking and swallowing have been studied extensively but little is known about the role other primitive neonatal reflexes (PNRs) might play to support breastfeeding.
Aims: To describe and compare PNRs observed during feeding, investigating whether certain feeding behaviours and positions, collectively termed Biological Nurturing, (BN) are associated with the release of those reflexes pivotal in establishing successful feeding.
Method: 40 breastfed healthy term mother/baby pairs were recruited using quota sampling to stratify term gestational age. Feeding sessions were videotaped in the first postnatal month, either in hospital or at home.
Findings: 20 PNRs were validated and classified into 4 types (endogenous, motor, rhythmic and anti-gravity) and 2 functional clusters (finding/latching, milk transfer) either stimulating or hindering feeding. Significantly more PNRs were observed as stimulants in semi-reclined postures (BN) than when mothers were upright or side-lying ($p = < 0.0005$).
Discussion: This study is the first to describe a range of semi-reclined maternal postures interacting with neonatal positions, releasing maternal instinctual behaviours and PNRs stimulating breastfeeding. Traditionally the human neonate has been considered a dorsal feeder with pressure needed along the baby's back. Compelling visual data here illustrate that the newborn is an abdominal feeder and, like some other animals, displays anti-gravity reflexes aiding latch. Findings suggest that breastfeeding initiation is innate for both mother and baby, not learned, thus challenging the routine skills-teaching currently central to breastfeeding support.

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1. Background

In 2005, 76% of UK mothers, an unprecedented number, breastfed at birth yet by six weeks 37% had stopped; 90% discontinued before they intended. [1] This steep decline typifies trends for breastfeeding continuance during the past 20 years. [1,2] Positioning and attachment ('P&A') skills-teaching [3] was introduced in 1986 as an aid to initiate and sustain breastfeeding. [4–9] Mothers lie on their sides or sit upright, placing the baby 'tummy to mummy' at breast level; then they attach the baby, positioning nose to nipple, leading in with the chin following mouth gape [4–9]. Recent trials, [10–14] however, demonstrate few benefits associated with this approach. These facts suggest a need to reappraise aspects of current breastfeeding support. This study examined the mechanisms of behaviours and positions collectively termed Biological Nurturing (BN), a new breastfeeding approach.

Building upon Swedish research, [15,16] BN promotes extended baby holding in postures which are different to those taught conventionally. Mothers are encouraged to lean back; babies lie prone in close frontal apposition with maternal body contours. Piloted in prior work, [17,18] BN appeared to release some primitive neonatal reflex-like movements facilitating breastfeeding.

Primitive neonatal reflexes (PNRs) is a collective name given to a group of inborn unconditioned reflex responses, spontaneous behaviours and reactions to endogenous or environmental stimuli [19]. Pioneering doctors [20–25] described over 50 PNRs some of which are used today in well-known assessment instruments to evaluate neurological well-being. Early clinical work indicated that gestational age, neonatal position and behavioural state influence PNR expression. Therefore, to ensure reliability, Prechtl [21] standardised assessment procedures in a landmark study; each PNR is elicited mid-point between feeds, in specified behavioural states and, in one of three neonatal positions: supine, prone or ventral suspension.

Three PNRs rooting, sucking and swallowing have been studied extensively as feeding stimulants [26,27]. Initially, phylogenetic comparisons of 'rooting' included head, cheek, lip and tongue reflexes [19]. A neurological consensus later reduced human rooting to head-turning in response to cheek or lip stimulation [21–25]. Although most lactation experts concur, the earlier 'rooting' PNRs are sometimes documented. For example, Blass and Teicher [28] include such observations in phylogenetic comparisons of suckling as do Als and colleagues [29,30] and Nyqvist et al. [31] focusing primarily upon human preterm feeding. Widstrom et al., [15] and Righard and Alade [16] added hand-to-mouth, stepping and crawling PNRs observed in term infants held in skin-to-skin contact during the first postnatal hour.

1.1. Aim

PNRs develop during fetal life and can be elicited at birth in all healthy term infants suggesting that they might support feeding regardless of method yet little is known about this potential. Therefore, the aim was to explore the contribution of PNRs to infant feeding describing and comparing those observed during BN and in other feeding positions.

1.2. Research questions

- Does BN trigger PNRs as breastfeeding stimulants? If so, can the components and mechanisms of their interactions be described?
- Which PNRs can be described systematically as playing a role in the feeding context?
- What is the nature of this role and does it differ according to feeding method?
- Are the variables controlled in neurological assessment important in the feeding context?

The focus of this paper is the breastfeeding group.

2. Methods

PNRs have been studied using naturalistic qualitative observations made by baby biographers [32,33] and quantitative methodologies used by doctors [21–25]. Either of these approaches offered a suitable theoretical framework for this study. Together, they provided a strong conceptual foundation enabling the systematic examination of previously defined reflexes in the feeding context. In line with recent mixed-methodological innovations, [34,35] a descriptive, comparative quantitative study nested within a qualitative design was selected effectively supporting two methods of data collection. First one feeding session for each mother–baby pair recruited was videotaped during the first postnatal month, in hospital or at home whichever place was more convenient for the mother. The videotapes recorded behaviours as they naturally occurred using an event sampling strategy and continuous real time measurement. Intervention, suggesting positional modifications, only occurred if mothers experienced feeding problems. Then video clips were extracted and structured quantitative observations undertaken.

Definitions for neonatal positions and 14 PNRs observed during the pilot study were predetermined borrowing and building upon those in the neurological and feeding literature. During data cleansing, six other PNRs were observed and defined along with two additional dynamics: maternal postures and neonatal lie, introduced as a component of neonatal position (Table 1).

2.1. Participants and procedures

Cultural practices can influence the expression of PNRs [41]. Therefore, seeking to minimise ethnocentricity, the study was conducted in SE England and Paris, France. Local ethics committees in both countries and NHS Research and Development Committees in England approved the design and procedures. To control for maturational differences, purposeful quota sampling was used to stratify the term birth weeks (37–40+ weeks). Gestational age was determined by calculating the estimated date of delivery from the first day of the mother's last menstrual period and confirmed by the ultrasound scan date recorded in the mother's notes. In case of discrepancy, the ultrasound scan date was used. Recruitment continued until data saturation was reached, that is until any PNRs observed were described and compared in each gestational stratum. As the lead researcher is

Table 1 Operational definitions

Breastfeeding	Full (exclusive/almost exclusive) partial (high/medium/low) or token (minimal) [36]
Primitive neonatal Reflexes	Collective terminology defining a group of inborn unconditioned reflex responses, spontaneous behaviours and reactions to endogenous or environmental stimuli developing during foetal life and observed in all normal healthy term neonates at birth. [19–25] For the current study, the words 'PNRs' and 'reflexes' are used interchangeably. PNRs observed were defined operationally by using the standardized descriptions, procedures and techniques of elicitation (illustrated by pictures) in the neurological literature [20–25]
Neonatal position	The relationship between the baby's body and the mother's examining three variables: the degree to which the baby's body was (1) facing, (2) touching and (3) in close apposition with a maternal body contour or part of the environment. Three positions were defined: **Full-BN:** baby's body facing, touching and closely applied to mother's **Partial BN:** gap or angle between the two bodies **Non BN:** only contact between bodies is breast to mouth 
Neonatal lie	The relationship of the long axis of the neonate to that of the mother: three are defined longitudinal, transverse and oblique borrowing from midwifery/obstetrical antenatal terminology. [37]
Neonatal behavioural state	A group of physiological and motor characteristics occurring at the same time indicating levels of arousal including: body, eye and facial movements, breathing pattern and level of response. [38] The six Brazelton and Nugent [24] behavioural states were used: Deep sleep, Light sleep, Drowsy, Quiet alert, Fussy, Crying
Maternal posture	The relationship between the long part of the mother's body and the horizontal axis, defined numerically by approximating the number of degrees in the angle formed at their junction using a protractor. **Full-BN:** degree of recline ≥ 15° to 64° **Partial BN:** degree of recline 0° to 14° (flat or side-lying) **Non BN:** Degree of recline≥65° 
Successful breastfeeding	"Pain-free effective feeding" [[4], p31] using the following validated criteria to evaluate successful milk transfer:[39,40] 1. Presence of rhythmic vigorous age-appropriate sucking with characteristic bursts 2. Visible and/or audible age-appropriate swallowing observed and/or heard 3. Visible ear and/or jaw movement observed during sucking and swallowing 4. Absence of spitting out milk during the feed 5. Increasing frequency and age-appropriate patterns of urine output; pale yellow in colour, characteristic odour 6. Age-appropriate frequency and normal colour patterns of stooling. 7. Pre-post feed observations of nipple shape 8. Baby's lips appear wet after feed 9. Breast appears less full after the feed 10. Baby does not cry post-feed when in mother's arms
Maternal comfort	Assessed through observations scoring the following observable criteria:
Body support	The amount of observed physical support under or around each of 12 maternal body parts from head to feet
Mobility	Observations of whether no hands, one hand or two hands were free, i.e., not holding baby or breast
Pain-free	The mother says that she has no pain (clearly recorded in all the videotapes)
Tension-free	Maternal shoulders appear balanced, not hunched.
'Best' episode	Borrowing from the Brazelton and Nugent concept of 'best performance,' [[24], p10] the episode where the latch was sustained for greater than 1 minute leading to pain-free, effective feeding according to the above definitions of maternal comfort and successful feeding.

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Table 2 Sample characteristics

Sample size	40	100%
Maternal characteristics		
Mean age at videotape ± SD	32 ± 5.16	
First baby	28	70.0%
Caucasian (14 countries)	34	85.0%
African (1 country)	2	5.0%
Caribbean (1 country)	1	2.5%
Asian (3 countries)	3	7.5%
Labour characteristics		
Spontaneous vaginal birth	26	65.0%
Forceps	3	7.5%
Caesarean section	11	27.5%
Neonatal characteristics		
Gender male	24	60.0%
Mean birth weight ± SD	3286 g ± 473 g	
Range birth weight	2200–4410 g	
Gestation (37 weeks)	4	10.0%
Gestation (38 weeks)	8	20.0%
Gestation (39 weeks)	5	12.5%
Gestation (40 + weeks)	23	57.5%
Age at video		
≤7 days old at video	18	45.0%
8–14 days old at video	12	30.0%
15–31 days old at video	10	25.0%

bilingual, English and French-speaking women over 18 were eligible if they had risk-free pregnancies, healthy term infants whose Apgar score was ≥9 at 5 min and agreed, in principle, to have a feeding videotape made in the first postnatal month. During recruitment, mothers received oral and written information about the study and were advised to consider their possible reactions to being filmed including the likelihood of facial recognition. To enable mothers to withdraw at any time, consent was obtained in two phases; the first consent form was signed after videotaping. During a follow-up visit, mothers viewed the video and shared personal experiences; breastfeeding duration was recorded. Mothers then decided whether to have facial blurring and signed the second consent form agreeing that video clips could be used for research and educational purposes. Starting in January 2003 and continuing for 18 months, a convenience sample of 40 mother–baby pairs meeting the inclusion criteria was recruited.

2.2. Data analysis

To extract clips for analysis, the video data were cleansed defining sittings and episodes thus systematising the scope within which PNRs could be examined. Twenty-four hours of footage comprising a total of 93 episodes occurring in 50 sittings were recorded. Each episode was divided into three time periods: pre-feed, latch and ingestion. Then PNRs observed at the three time-points were identified and described followed by interpretations concerning PNR type, function and mothers' comments, where available. Initial associations between the number of PNRs observed and the salient neurological variables were explored. A time-point sampling technique usually implies consistent periods; however that was not the case here. Although some babies fed quickly and

Table 3 Feeding reflexes, type and function

Reflex	Sample		Full BN posture		Partial/non BN posture		Type	Function
	40	100.0%	17	42.5%	23	57.5%		
Hand to mouth [a]	25	62.5%	10	58.8%	15	65.2%	E	1
Finger flex/extend	38	95.0%	17	100.0%	21	91.3%	E	1
Mouth gape	40	100.0%	17	100.0%	23	100.0%	E	1
Tongue dart, lick	24	60.0%	14	82.4%	10	43.5%	E	1
Arm cycle [a]	37	92.5%	15	88.2%	22	95.7%	E	1
Leg cycle [a]	39	97.5%	17	100.0%	22	95.7%	E	1
Foot/hand flex	5	12.5%	2	11.8%	3	13.0%	E	1
Head lift [a]	19	47.5%	13	76.4%	6	26.1%	AG	1
Head right [a]	12	30.0%	9	53.0%	3	13.0%	AG	1
Head bob/nod [a]	26	65.0%	16	94.1%	10	43.5%	AG	1
Root [a]	38	95.0%	17	100.0%	21	91.3%	E,M	1
Placing	17	42.5%	14	82.4%	3	13.0%	M	1
Palmar grasp	40	100.0%	17	100.0%	23	100.0%	M	1,2
Plantar grasp	34	85.0%	17	100.0%	17	73.9%	M	1,2
Babinski toe fan	35	87.5%	16	94.1%	19	82.6%	M	1,2
Step (withdrawal)	31	77.5.0%	17	100.0%	14	60.9%	M	1,2
Crawl	14	35.0%	13	76.5%	1	4.3%	M	1,2
Suck	40	100.0%	17	100.0%	23	100.0%	R	2
Jaw jerk	40	100.0%	17	100.0%	23	100.0%	R	2
Swallow	40	100.0%	17	100.0%	23	100.0%	R	2

Reflex type: E endogenous, M motor, AG anti-gravity, R, rhythmic.
Functional Interpretation: 1. Find/Latch 2. Milk transfer.
[a] PNRs observed as breastfeeding stimulants in full BN postures and barriers in partial and non BN postures.

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Table 4 Maternal posture and baby position at 'best' episode

	Breastfeeding group $n=40$ (100%)					
	Latch n (%)			Ingestion n (%)		
	Full BN	Partial BN	Non BN	Full BN	Partial BN	Non BN
Posture	16 (40%)	2 (5%)	22 (55%)	17 (42.5%)	2 (5%)	21 (52.5%)
Position	14 (35%)	26 (65%)	0 (0%)	30 (75%)	10 (25%)	0 (0%)

effectively, others experienced difficulties, resulting in a varying number of episodes for each mother–baby pair. The concept of "best performance," [[24], p10] with successful breastfeeding as the main outcome measure, was used to select the 'best' feeding episode to examine accuracy and repeatability of the observations. An overview of these extracts was co-viewed with a neonatologist (JMH) to develop procedures.

2.3. Inter-observer test procedures

Three health professionals, a second neonatologist (JHM) an osteopath (TG) and a lactation consultant (PP) examined over 20% of the data selecting clips of the 'best' episode, some at random, from babies exhibiting the most and the least PNRs. A mean and an aggregate internal reliability coefficient were calculated for each pair of observers using an adaptation of the Spearman–Brown formula[42].

3. Results

No mother withdrew and three requested facial blurring. Table 2 summarises sample characteristics. All mother–baby pairs achieved successful feeding during the 'best' episode.

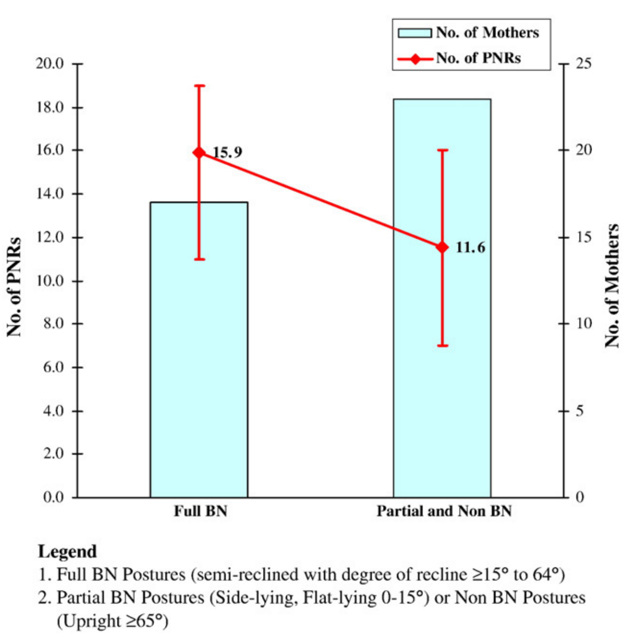

Figure 1 Maternal postures and primitive neonatal reflexes 'best' performance episode.

Breastfeeding continuance was 100% at six postnatal weeks (87.5% ($n=35$) fully and 12.5% partially).

Twenty PNRs were described, identifying four types—endogenous, motor, anti-gravity and rhythmic. These were clustered into two functional groups—finding/latching and milk transfer (Table 3). The mean observer-to-observer correlation was 0.82 and the aggregate inter-rater reliability score was 0.93. There was no association apparent between the presence and number of PNRs and gestational age, age at video, neonatal behavioural state and ethnicity.

During the 'best' episode, just over half of the mothers ($n=21$) were upright (non BN postures) with two in partial BN postures (one flat lying, one side-lying); the remainder ($n=17$) were in full BN semi-reclined postures. All babies were in either full or partial BN positions (Table 4). The mean number of PNRs observed when mothers were in partial and non BN postures was 11.6 compared to 15.9 when they were in full BN postures (Fig. 1). A significantly greater number of PNRs was observed aiding latch and sustaining feeding when mothers were in full BN postures ($p=<0.0005$ level (two-tailed unmatched t test; $t=5.42$, $df=38$). Although the total duration of feeding observations was greater in the full BN postural mothers (mean = 23′54″) compared to the non and partial BN mothers (mean = 23′11″), this time difference was not significant. Interactions between full BN postures and positions, identified as the main components, were witnessed to be associated with PNR release as breastfeeding stimulants. When mothers encountering problems changed to full BN postures, gulping and gagging diminished, the baby often became the active agent controlling the feed, aided by the different types of PNRs.

4. Discussion

This study, to our knowledge, is the first to describe a significant impact of maternal postures upon breastfeeding. In addition, whilst previous studies have looked at the role of rooting, sucking and swallowing, the current study maps a further 17 PNRs in the feeding context. Results build upon Peiper's [19] work, neurological assessment procedures [20–24], phylogenetic comparisons [27,28] and postures observed in a Swedish research [15,16]. Our findings develop further our understanding of the neurobehavioural contribution of PNRs to breastfeeding from birth to four weeks.

The mixed methods approach is a main feature of the study as it could be argued that without the event sampling technique undertaken in qualitative observations, the range of maternal postures releasing neonatal reflex activity may not have been observed. Therein also lay the study's limitations as neither causal nor predictive relationships can be

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unequivocally established. For example, the statistical tests applied showed high inter-observer agreement but this was only a first pass of the data examining the feasibility that those PNRs observed had a feeding role within the confines of descriptive work. Likewise, the cultural diversity of the sample is not representative and the high rate of breastfeeding duration needs to be interpreted with caution. The quota sampling technique was used to ensure that PNRs could be described across term gestations, the convenience sample was small, designed to tease out the components of BN and, to show if and how they interacted. It was not designed to examine relationships, significance or effect.

Discussion of observations of the four PNR types can help to clarify their role.

4.1. Endogenous reflexes

Endogenous reflexes often seemed to be released by thin air. Peiper [19] termed this phenomenon a 'vacuum' incentive or response without apparent stimulus. Endogenous PNRs were observed in the pre-feeding context as hunger cues or surprisingly, at inter-episode intervals when mothers put their babies down thinking that hunger was satiated. These latter behaviours appeared to indicate a need to 'comfort suck' or be in arms corroborating work by Blass and Teicher [28] highlighting the multi-functional nature of suckling.

Matthiesen et al. [43] observed neonatal 'hand massage' during the first postnatal hour prior to sucking. Correlating with high maternal oxytocin release, their data suggest that this innate kneading may prepare lactation like some animals do, using their paws or heads [20,28]. In the current study, head bobbing and finger flexion/extension were observed prior to latch during the first postnatal month. Although no blood samples were taken, strong nipple erection was observed suggesting replication and developing further the Matthiesen et al. [43] findings.

Brazelton and Nugent [24] describe the hand-to-mouth reflex as both an organisational aid and a self-comforting activity. Here, hand-to-mouth was observed to trigger mouth gape, rooting and sucking as pre-feeding cues or during latch, substantiating findings by Widstrom et al. [30] However, contrary to their findings, sequences were not well defined; the order of PNRs was unpredictable in the current study, appearing to change according to contemporaneous need, making each episode unique.

4.2. Motor PNRs

Consistent with neurological procedures, [21–25] when mothers leaned back the baby's feet tops brushed against the maternal body surface triggering placing; brushing of the foot sole released stepping, sometimes termed the withdrawal reflex. Together with crawling movements these PNRs appeared to propel the baby upwards. However, babies often needed help from their mothers to find the breast. During BN, few mothers held babies in arms applying pressure on the baby's back. Instead, mothers' bodies provided a foundation, their arms the boundaries, their fingers stroking guidance, triggering and channelling the number and type of PNR needed to help the baby latch and feed. Surprisingly, this individualised choreography revealed emerging sequential patterns of instinctual maternal behaviours. Having provided the necessary degree of slope and body space containing the food, there was a characteristic pause; mothers waited, and then holding the baby in ways mimicking the neurologically-defined position of ventral suspension [21–25], mothers orientated the baby on their body, setting off variable chains of reflex reactions enabling motility. During BN mothers appeared to trigger instinctively the right reflex at the right time.

A strong foot-to-mouth association at latch was noted. Mothers had hands free and spontaneously stroked their baby's feet triggering the Babinski reflex and toe grasping, releasing lip and tongue reflexes simultaneously. This foot-to-mouth connection was not as apparent when mothers sat upright, possibly because mothers' hands often supported both the baby and breast; babies' legs and feet were often exposed to thin air which also may have muted the brushing required to stimulate the reflexes.

4.3. Rhythmic PNRs

Sucking and swallowing occur in patterns of rhythmic bursts [20–27]. Here, the jaw jerk reflex also had a rhythm. Prechtl [[21], p18] details how to elicit the jaw jerk: "a short sharp tap delivered to the chin" releases a "quick contraction of the masseteric muscles lifting the chin". Interestingly, this procedure may explain why lactation experts suggest attaching the baby to the breast 'leading in with the chin' and assessing cheek and ear movement during suckling. These observations offer neurobehavioural explanations to substantiate 'P&A' skills-teaching techniques and current lactation assessments [3–8,39,40]

When mothers were in full BN postures however, babies lay on top. The assessment of chin position became unnecessary as gravity ensured a close fit between maternal breast and neonatal facial tissue. Aided by gravity even a receding baby chin taps rhythmically against the mother's breast promoting deep suckling and releasing the cadenced Masseter ear/jaw movements indicating successful milk transfer.

4.4. The mechanisms of biological nurturing

Understanding the reflex mechanisms was not straightforward as close analysis of the videotaped data revealed that PNRs did not always help. Sometimes the reflexes appeared as a hindrance. In other words, the same reflexes could act as feeding stimulants observed as finding behaviours enabling latch and milk transfer or as barriers, inhibiting attachment and successful breastfeeding. An understanding of how maternal posture affected the anti-gravity reflexes may shed some light upon these phenomena.

A mechanism can be defined as "a system of mutually adapted parts working together"[[44], p1728]. Here, semi-reclined BN postures seemed to maximise the 'tummy to mummy' position currently prescribed in the breastfeeding literature [3–9]. The full BN postural range appeared to mandate neonatal ventral positions where the lie, or the direction of the position, varied around the breast like the hands of a clock. However, when mothers fed upright, the baby's position was frequently defined as partial BN with an inflexible transverse lie. Changing to a full BN posture

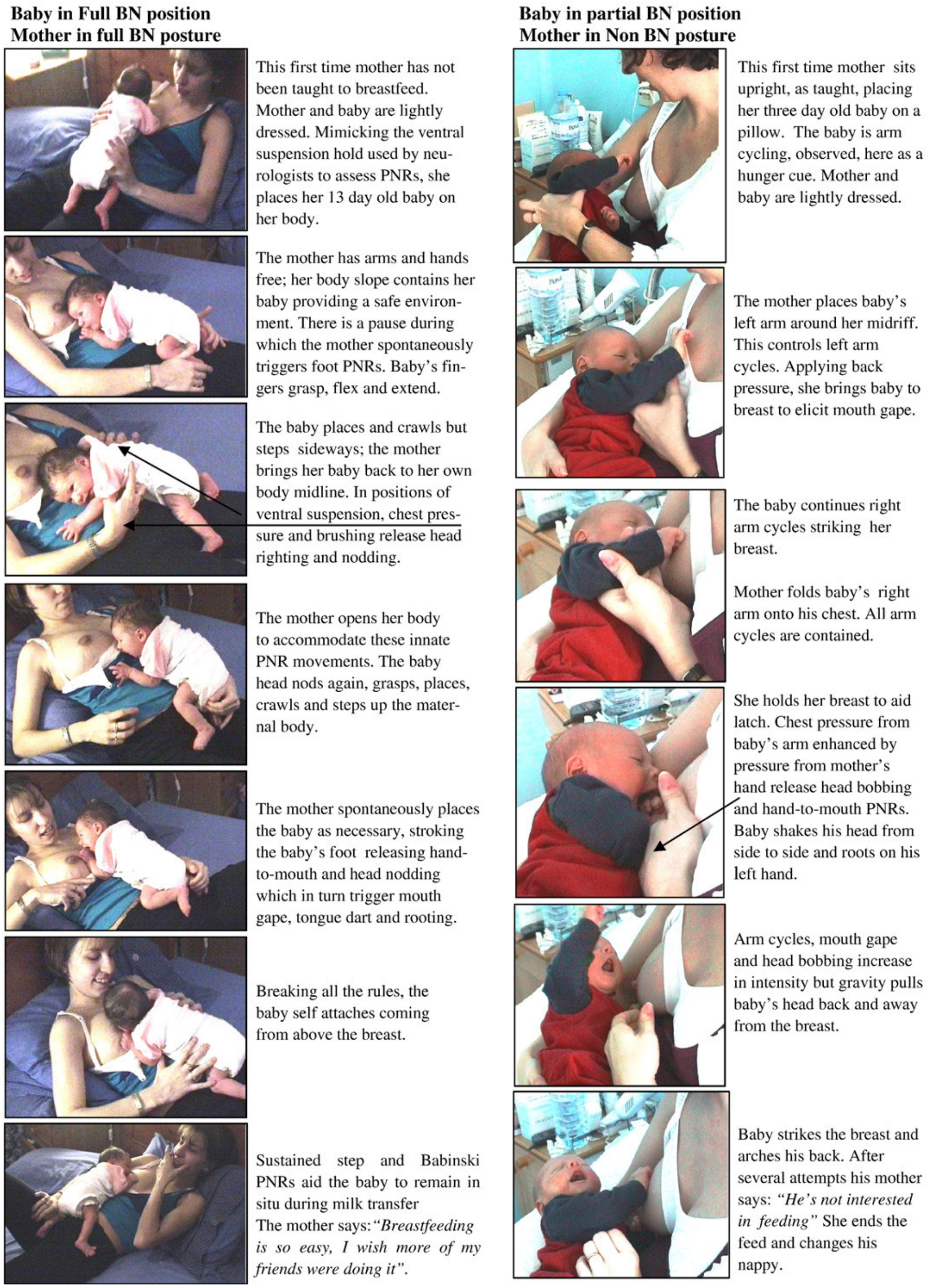

Figure 2 Stimulation or inhibition: the dual feeding role of primitive neonatal reflexes.

appeared to be a catalyst releasing a chain reaction giving direction to how the positional components interrelated and interacted. Full BN postures opened the maternal body instantly eliminating any gap or angle between the mother's body and the baby's chest and often changed the lie from transverse to oblique or longitudinal. These dynamics immediately increased the manoeuvrable space available to the neonate. Gravity seemed to maintain the baby's body in situ and the close body apposition released neonatal locomotion. Regardless of skin-to-skin contact, when a baby lies prone but tilted upward on a gently sloping maternal body, gravitational forces attract the baby's body mass towards the centre of the earth; the slope is not steep enough to inhibit motility. The only anti-gravity movements required are head righting and lifting, both of which are developmentally mature and available to the neonate as PNRs.

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4.5. Reflexes as feeding barriers

When mothers fed upright, spontaneous head lifting, head righting, rooting and head bobbing were observed appearing to be released by back compression together with chest brushing. Instead of aiding latch, these irregular, jerky movements had the opposite effect. Mothers often reacted by tightening their grip. Compelling visual data here suggest that upright postures often hamper latch apparently by gravitational forces resulting from the steep maternal body gradient. The more upright the mother sat, the greater the pull of gravity appeared, dragging the baby outwards away from her body and downwards towards the pillow or her lap, thus reducing feeding efficacy and often creating discouragement or a degree of anxiety in mothers. With increasing stimulation but no sustained latch, these erratic movements intensified, often accompanied by back arching, hand-to-mouth PNRs and arm and leg cycles, perceived as thrashing and flailing or punching and kicking. Upright mothers often said: *My baby prefers sucking on his hand; he fights the breast or does not like breastfeeding*. These negative movements are documented by Gunther [45] as breast fighting, Gohil [[46], p269] as "breast boxing" and by the Baby Friendly Initiative (BFI) [[47], p94] as "apparent but not real breast refusal".

Peiper [20] describes a 'pendular' head bobbing movement in the midline as a vacuum reflex; whereas Andre-Thomas et al., [22] and Prechtl [21] observe 'search automatisms' thought to be part of the 'rooting' complex enabling the abdominal feeding animal, such as the puppy or hamster to locate and latch onto the nipple. Peiper [[20], p412] suggests opposing feeding mechanisms between animal and human: the newborn animal can move head and neck both horizontally or vertically with or without spinal rotation where the "pivot point is fixed on the cervical spine". In contrast, the human neonate, feeding in a dorsal position, "turns his head around the spinal axis;" pendular head movement is restricted by pressure on the baby's back.

This investigation brings to light that the human neonate, like some of his mammalian cousins, also displays this vertical fixed-point head-bob without apparent head rotation. One of the mothers who spontaneously reclined at 25° to initiate feeding noticed these movements, remarking: my baby latches on "by tapping her head just like a woodpecker!" During BN pendular head movements resembled nodding, having finding and latching functions whereas in upright maternal postures, the response was often perceived as head butting. Fig. 2 displays storyboards contrasting these mechanisms. During BN, the cardinal reflexes defined by Andre-Thomas et al. [22] are stimulated simultaneously releasing mouth gape, pendular and rotational rooting or what Blass and Teichner [27] term 'scanning'. In BN postures, there was no need to line up nose to nipple and wait for mouth gape or to assess tongue position as suggested by those teaching 'P&A' skills [3–9,39,40]. Gravity pulled the baby's chin and tongue forward. Together the anti-gravity reflexes often triggered the degree of mouth opening needed to achieve pain-free, neonatal self-attachment even when the baby appeared to be in light sleep.

From a purely mechanistic perspective, these observations suggest that early feeding behaviours are innate, not learned on the part of both mother and baby, thus challenging the skills-teaching approach to initiate breastfeeding. Our findings may help to explain unexpected results [10–14]. Henderson et al. [[10], p241] hypothesizing that skills-teaching increases breastfeeding duration, could not "rule out that the intervention may have contributed to the lower breastfeeding duration and less satisfaction with breastfeeding" found in the 'taught' group. Two explanations come to mind: first, the skills-teaching approach uses fixed positional systems that we have observed to close the maternal body, often releasing PNRs hindering attachment. Second, teaching requires focused attention on the part of the learner, in turn stimulating thinking. Not only can cognition override innate behaviours [48] but neocortical stimulation may inhibit the release of oxytocin [49]. Swedish researchers [50] have shown a strong link between high oxytocin pulsatility on the second postnatal day and increased breastfeeding duration.

Our findings suggest that, the principle component of BN, a range of semi-reclined maternal postures, releases those PNRs pivotal to the establishment of breastfeeding. However, these descriptive results are preliminary and speculative; experimental work is needed to compare the promotion of Biological Nurturing upon breastfeeding duration with the widespread skills-teaching approach.

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References

[1] Bolling K, Grant C, Hamlyn B, Thornton K. Infant feeding survey 2005 2007, The Information Centre, London.

[2] Renfrew M, Dyson L, Wallace L, D'Souza L, McCormick F, Spiby H. The effectiveness of public health interventions to promote the duration of breastfeeding systematic review. National Institute for Health and Clinical Excellence Mid City Place 71 High Holborn London,UK WC1V 6NA; 2005.

[3] Woolridge MW. The 'anatomy' of infant sucking. Midwifery 1986;2:164–71.

[4] Renfrew M, Woolridge MW, McGill HR. Enabling breastfeeding. London,UK: TSO; 2000.

[5] Royal College of Midwives. Successful breastfeeding. 3rd Edition. London: Churchill Livingstone; 2002.

[6] Ingram J, Johnson D, Greenwood R. Breastfeeding in Bristol: teaching good positioning and support from fathers and families. Midwifery 2002;18(2):87–101.

[7] Inch S, Law S, Wallace L. Hands off! the breastfeeding best start project (1). The Practising Midwife 2003;6(10):17–9.

[8] Renfrew M, Fisher C, Arms S. Bestfeeding: getting breastfeeding right for you. 3rd Edition. Berkeley, Calif: Celestial Arts; 2004.

[9] Demott K, Bick D, Norman R, et al. Clinical guidelines and evidence review for post natal care: routine post natal care of

recently delivered women and their babies. London: National Collaborating Centre For Primary Care And Royal College Of General Practitioners; 2006.
[10] Henderson A, Stamp G, Pincombe J. Postpartum positioning and attachment education for increasing breastfeeding: a randomized trial. Birth 2001;28(4):236–42.
[11] Labarere J, Bellin V, Fourny M, Gagnaire JC, Francois P, Pons JC. Assessment of a structured in-hospital educational intervention addressing breastfeeding: a prospective randomized open trial. Br J Obstet Gynecol 2003;110:847–52.
[12] Forster D, McLachlan H, Lumley J, Beanland C, Waldenstrom U, Amir L. Two mid-pregnancy interventions to increase the initiation and duration of breastfeeding: a randomized controlled trial. Birth 2004;31(3):176–82.
[13] De Oliveira LD, Giugliani ERJ, et al. Effect of intervention to improve breastfeeding technique on the frequency of exclusive breastfeeding and lactation-related problems. J Hum Lact 2006;22(3):315–21.
[14] Wallace LM, Dunn OM, Alder EM, Inch S, Hills RK, Law SM. A randomized-controlled trial in England of a postnatal midwifery intervention on breastfeeding duration. Midwifery 2006;22(3):262–73.
[15] Widstrom AM, Ransjo-Arvidson AB, Matthiesen AS, Winberg J, Uvnas-Moberg K. Gastric suction in healthy newborn infants. Acta Paediat Scand 1987;76:566–72.
[16] Righard L, Alade MO. Effects of delivery room routines on success of first feed. Lancet 1990;336:1105–7.
[17] Colson S. Biological suckling facilitates exclusive breastfeeding from birth a pilot study of twelve vulnerable infants. 2000; London, UK: London South Bank University MSc Dissertation.
[18] Colson S, DeRooy L, Hawdon J. Biological nurturing increases duration of breastfeeding for a vulnerable cohort. MIDIRS Midwifery Digest 2003;13(1):92–7.
[19] Touwen BCL. Primitive reflexes—conceptual or semantic problem? In: Prechtl FR, editor. Continuity of neural functions from prenatal to postnatal life. Clinics in dev med Spastics Internat Medical Publications. London: MacKeith Press; 1984. p. 115–25.
[20] Peiper A. Cerebral Function in Infancy and Childhood 1963; (3rd Edition, tr Nagler, B., Nagler, H.) New York, NY: Consultants Bureau.
[21] Prechtl H. The neurological examination of the full term new born infant. Clinics in Developmental Medicine, Spastic International Medical Publications, 2nd Edition, vol. 63. London, UK: William Heinemann Books Ltd; 1977.
[22] André-Thomas Chesni Y, Saint-Anne Dargassies S. The neurological examination of the infant. London, UK: The Medical Advisory Committee of the National Spastic Society; 1960.
[23] Amiel-Tison C, Grenier A. La Surveillance Neurologique au cours de la Première Année de la Vie. Paris, France: Masson; 1984.
[24] Brazelton TB, Nugent JK. Neonatal behavioral assessment scale. 3rd Edition. London, UK: MacKeith Press; 1995.
[25] Dubowitz L, Dubowitz V, Mercuri E. The neurological assessment of the preterm and the full term newborn infant clinics in developmental medicine no. 79. Spastics International Medical Publications. Philadelphia, PA: JB Lippincott; 1999.
[26] Weber F, Woolridge MW, Baum JD. An ultrasonographic analysis of sucking and swallowing in newborn infants. Dev Med Child Nuerol 1986;28:19–24.
[27] Bu'Lock F, Woolridge MW, Baum JD. Development of co-ordination of sucking, swallowing and breathing: ultrasound study of term and preterm infants. Dev Med Child Neurol 1990;32:669–78.
[28] Blass EM, Teicher MH. Suckling. Science 1980;210(3):15–22.
[29] Als H, Lawhon G, Duffy F, McAnulty G, Gibes-Grossman R, Blickman JG. Individualized developmental care for the very low-birth-weight preterm infants. JAMA 1994;272:853–8.
[30] Als H. Manual for the naturalistic observation of newborn behavior. Newborn Individualized Developmental Care and Assessment Program (NIDCAP). Boston: The Children's Hospital; 1995.
[31] Nyqvist KH, Sjoden P, Ewald U. The development of pre-term infants breastfeeding behaviour. Early Hum Dev 1999;55:247–64.
[32] Preyer W. The mind of a child. In: Brown NW, editor. Part I: the senses and the will. New York, NY,USA: Appleton; 1893. Trans.
[33] Darwin C. Biographical sketch of a small child. 1872 cited in Peiper A, (tr Nagler, B., and Nagler, H.) Cerebral Function in Infancy and Childhood. New York: Consultants Bureau; 1963:417.
[34] Tashakkori A, Teddlie C. Mixed methodology combining qualitative and quantitative approaches. Thousand Oaks, CA, USA: Sage Publications; 1998.
[35] Creswell JW. Research design qualitative, quantitative, and mixed methods approaches. 2nd Edition. Thousand Oaks, CA, USA: Sage Publications; 2003.
[36] Labbok M, Krasovec K. Towards consistency in breastfeeding definitions. Studies in Family Planning 1990;21:226–30.
[37] Henderson C, MacDonald S. Mayes' midwifery. 13th Edition. London, UK: Balliere Tindall; 2004.
[38] Wolff PH. Observations on newborn infants. Psychosomatic Medicine 1959;21:110–8.
[39] International Lactation Consultant Association. Evidence-based guidelines for breastfeeding management during the first fourteen days. Washington DC,USA: US Maternal-Child Health Bureau; 1999.
[40] Walker M, editor. International Lactation Consultant's Association: core curriculum for lactation consultant practice. Sudbury, MA,USA: Jones and Bartlett Publishers; 2002.
[41] Nugent JK, Lester BM, Brazelton TB, editors. The cultural context of infancy. Biology, Culture and Infant Development-Norwood, NJ, USA: Ablex; 1989.
[42] Rosenthal R, Rosnow RL. Essentials of behavioural research: methods and data analysis. 2nd Edition. Boston, MA,USA: McGraw-Hill; 1991.
[43] Matthiesen AS, Ransjo-Arvidson AB, Nissen E, Uvnas-Moberg K. Postpartum maternal oxytocin release by newborns: effects of infant hand massage and sucking. Birth 2001;28(1):13–9.
[44] Brown L. The new shorter Oxford dictionary. 5th Edition. Oxford, UK: Oxford University Press; 1993.
[45] Gunther M. Instinct and the nursing couple. Lancet 1955;265 (6864):575–8.
[46] Gohil JR. Boxing neonate on an engorged breast, a new behavior identified. J Hum Lact 2006;23(3):268–9.
[47] World Health Organization. Breast-feeding management: a modular course. London,UK: WHO/UNICEF; 1997.
[48] Carlson NR. Physiology of behaviour. 5th Edition. Boston: Allyn and Bacon; 1994.
[49] Odent M. The scientification of love. London UK: Free Association Books; 1999.
[50] Nissen E, Uvnas-Moberg K, Svensson K, Stock S, Widstrom AM, Winberg J. Different patterns of oxytocin, prolactin but not cortisol release during breastfeeding in women delivered by caesarean section or by the vaginal route. Early Hum Dev 1996;45:103–18.

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