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Towards a New Theory of Play with Particular Reference to Preterm Babies

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Abstract: In this paper, we discuss theories of infant play and perception and put forward our new theory of play which states that instead of play being linear with progression from "lower" to "higher" play types (Tamis-LeMonda and Bornstein 1996), play may be more profitably conceived of as having 2 separate trajectories. One trajectory is the much investigated trajectory of sensori-motor operations to concrete operations to symbolic play (the linear-linguistic type of play); the second is for the trajectory of perception-emotion-spatial play (creative-artistic type of play). We suggest that before play in its details can be profitably examined, there has to be a methodology for investigating play in the newborn. Most studies look at play (and perception) starting when the baby is about 6 months of age. Does the newborn, and in particular the newborn preterm, show motor behaviours which indicate he or she may be capable of play? To enable the preliminary investigation of play in the neonate, we put forward the methodology described here. It is essentially a technique of detailed description of behaviour favoured first by ethologists studying animal behaviour in the wild. We describe a preliminary ethogram of preterm neonatal motor behaviour. The motor patterns of medically high-risk ventilated preterm neonates in spontaneous activity periods lasting for three minutes are analysed. This ethogram could be used to investigate the behavioural effects of intervention therapies on preterm neonates, e.g. TAC-TIC therapy, presence of toys in the incubator.

Resumo: *Uma Nova Teoria de Brincar para o Bebê Pretermo.* Neste artigo, discutimos teorias da percepção e do brincar e propomos uma nova teoria que situa o brincar como sendo constituido de duas trajetórias separadas, em vez de ser uma progressão linear partindo de categoria "baixa" para uma mais "alta" como tem sido proposto por Tamis-LeMonda e Bornstein (1996). Uma trajetória tem sido bastante estudada, isto é – das operações sensório-motores para as operações concretas e o brincar simbólico (o estilo ou tipo de brincar linguístico-linear); a segunda trajetória aqui proposta, é a da percepção-

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emoção-espaço de brincar (estilo criador-artístico de brincar). Nós sugerimos que antes de estudarmos o brincar com detalhe, uma nova metodologia para sua investigação com relação ao recém-nascido precisa de ser desenvolvida. A maioria dos estudos examinam o brincar (e percepção) quando o bebê está com mais ou menos 6 meses. Será que o recém-nascido e, particularmente o recém-nascido pretermo exibem comportamentos motores que revelam sua competência para brincar? Propomos neste artigo, uma metodologia que nos habilitará a investigar, preliminarmente, o brincar no recém-nascido. A técnica usada é essencialmente a descrição detalhada de comportamentos preferida pelos etologistas estudando o comportamento animal na selva. Nós descrevemos aqui um etograma preliminar do comportamento motor do neonato pretermo. São analisados aqui, três minutos dos padrões motores de neonatos pretermo de alto risco recebendo terapia de oxigênio, artificialmente, durante atividades espontâneas. Este etograma poderia ser usado para investigar os efeitos de intervenções no neonato pretermo no seu comportamento, como por exemplo, a terapia TAC-TIC, e a presença de brinquedos na incubadora.

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Introduction

Play with Objects

Following Piaget (1962), Tamis-LeMonda and Bornstein (1996) point to the "naturalistic" developmental progression in children's play behaviour with objects during the first two years of life. They suggest that three stages in the development of play have been distinguished:

1. First 9 months: play is predominantly characterised by exploration in the form of sensorimotor manipulation and the extraction of information about objects and their perceivable qualities. Infants mouth, look at and touch toys.
2. Towards the end of the first year, non-symbolic play emerges, in which children act on objects in concrete ways in order to extract information about the unique functions of objects which permits combinations of functions to be performed, e.g., the nesting of dolls.
3. In the second year, children's play with objects takes on a non-literal and generative quality and they begin to play pretend scenarios. Pretence schemes tend to be applied to the self before they are applied to others (e.g. pretending to feed from a cup before giving the cup to a doll to drink from); substitution object play appears – a stick could "stand for" a telephone; (presumably, a drawing could substitute for a phone in a still later stage); with the incorporation of expressions of affect being the latest development (e.g. making the doll "cry").

Tamis-LeMonda and Bornstein (1996) differentiate nonsymbolic play and symbolic play, calling the former "Lower" play and the latter "Higher" play forms. However, the reverse may be the case. It is questionable to call forms of play "higher" or "lower" in the first instance, and additionally, it could be argued that it is a predominant cognitive / linguistic bias that mistakenly claims that symbolic representational play (play relying heavily on language and enculturalisation), should be seen as the desired endpoint, or highest play type. Perhaps sensori-perceptual-emotional play should be given more emphasis in theoretical

treatments. The latter play type could even be claimed as the highest endpoint of development, not symbolic play, as previously argued by academics. This is hinted at in the literature, for example, Tamis-LeMonda and Bornstein (1996, p. 42) point out "Finally, emotive play, in which internalised concepts of affect or feeling are expressed (e.g., making a doll cry) emerges, but usually after other forms and combinations of symbolic play have been mastered."

We suggest here that emotive play in one of its aspects (namely a strategy for information-processing) is linked to the development of perception and leads to the development of the creative-artistic mental "style" or approach to problem-solving and information gathering. We claim that this kind of play does not follow on from symbolic play at all, but rather is of a different quality with its own developmental trajectory. The fact that it appears in time after symbolic play has occurred masks the fact that this type of play relies on perception rather than linguistic story concepts and is of a different mental process altogether. Masking of one aspect of development by another system is not a new concept (Turkewitz and Devenney 1993; Gottlieb 1993). See Fig. 1.

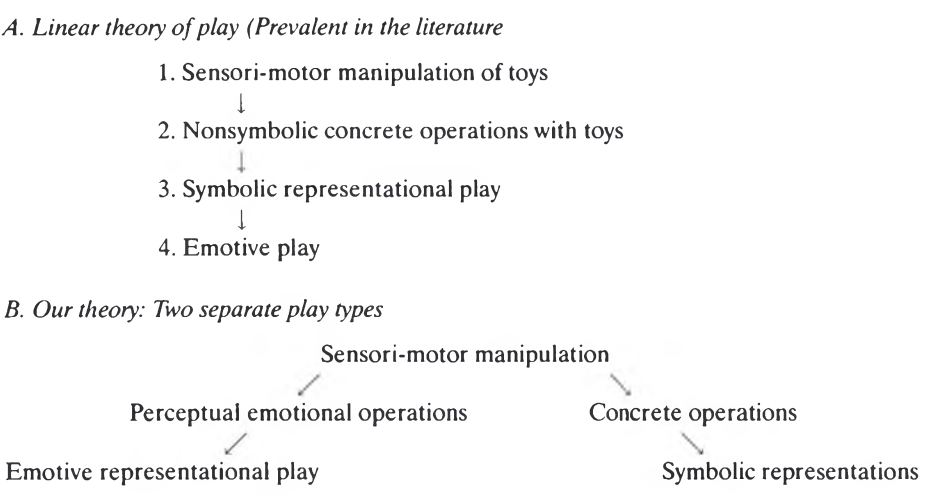

Fig. 1. The development of play

In Fig. 1, the current prevalent view of the development of play is shown in (A). This is represented by a linear trajectory which describes the onset and occurrence of play types, but just as words in a sentence are linear yet the transformational grammar generating their occurrences may be quite different, so we argue that development of play relies on at least two different mechanisms. These are depicted in part B of Fig. 1. In part B, we have suggested that underlying the superficial linear development of play are two quite different play types which rely on two different information processing styles: firstly, the perceptual-emotional-spatial style of mental processing and secondly, the linear-linguistic style of cognitive processing. The separation of these two styles is not new in the adult literature on cognition but it seems to be new in its application to neonate/ infant play.

We suggest that a close examination of the details of play, from day one of life, using an ethological approach, will lead to a teasing out and understanding of these two strands in the development of play.

Play in the Neonate

Adamson-Macedo (1998) has suggested the phrase "preterm neonatal psychology" to refer to the need for a psychology of early behaviour (the first 28 days of life being the neonatal period). At present, there are a few detailed studies of the behaviour of preterm neonates (see Prechtl 1990; Macedo 1981, 1984; Adamson-Macedo 1985; Als 1986; Adamson-Macedo et al. 1994; Hayes 1996). Most behavioural studies begin around 3 months of age (Bigsby 1996; Rose et al. 1978), although Gibson and Walker (1984) looked at the behaviour of 1-month-old full-term infants.

Perhaps there are few studies of play in detail at this age because firstly, investigators did not separate out the two different strands of play, and secondly, assumed that the symbolic representational play type is the goal of play development which comes in with the development of language, thus justifying, somewhat, a rushing over of the sensori-perceptual-emotional period in play development. Possibly, there are also logistical problems with studying the neonate; many mothers would not desire a study of their new born infant, preferring to bond with him or her in the peace of the home environment. The necessary occurrence of hospitalisation on medical grounds, e.g. for the baby born premature, and the desire of the parents to find out that the baby is behaviourally normal, can lead to the occurrence of a population of neonates for non-intrusive studies of play behaviour, and we will report on a preliminary observation of a small sample of preterm neonates here.

Just what kinds of play might we expect the newborn to be engaged in? The first play of the human neonate involves sensori-motor manipulation. What might this involve in the "mind" of the neonate? (Adamson-Macedo 1998). As a preliminary suggestion, we propose that sensori-motor play involves the creative and flexible manipulation of information in the mind. Thus we could picture the neonate mind as containing a loose assemblage of touch-texture information, to take one sensory example. Play for the neonate may then involve not only touching substances in the environment, an action we may observe, but play may also consist of flexibly creating and recreating touch-texture memories in the mind. In the latter case, the baby may look as if he/she is just lying in the cot doing "nothing".

Mental manipulatory play is, at present, not directly observable, however, if such "mental" play does occur, it may be detectable in future studies using multimodal imaging techniques, e.g., some combination of NMR (nuclear magnetic resonance); MEG (magneto-encephalography); or other physiological recording methods for detecting brain activity profiles in neonates.

"Creativity Theory of Play"
Play's Importance in the Organisation of Behaviour

Here, we put forward our working theory of play and its place in the development of behaviour. We have termed it a "creativity" theory of play as it emphasises flex-

ibility in behaviour. It has been developed partly from hypotheses already present in the literature (see for example, Bruner 1972; Sutton-Smith 1967; Mussen 1983) and partly from the observation of non-human primate play behaviour.

In our theory, play is regarded as a programme director and co-ordinator of mental behaviour, a central administrator which allows the free-flow of information amongst behavioural patterns and states such as aggression, exploration, locomotion, sex, maternal behaviour and so on, in human and animal species. Its function is primarily to allow for flexibility, and hence creativity, for as long as possible in development before the separate behaviour patterns become rigidly organised into respective emotional categories, i.e., become self-contained and self-directed as fixed responses to stimuli, by the erection of barriers which come into place to allow the individual to function in the "mundane" world. See Fig. 2.

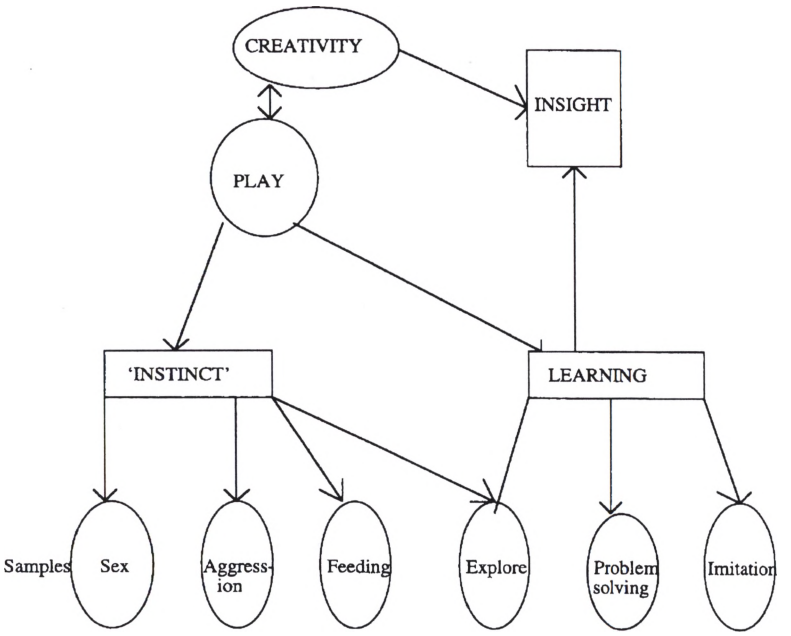

Fig. 2. The place of play in the organisation of behaviour

In this diagram, creativity is the general description of the class of behaviour of interest. Play is seen as the tool, or handmaid, of this class. It is the behavioural state that permits flexible organisation of the units of behaviour that can be classed variously as sexual behaviour (e.g., mounting in the play of monkeys), aggression (e.g. lunging), feeding (e.g. eating or giving food to another), exploring (e.g. visual scrutiny, tactile gathering of information about an object) and problem solving, etc.

The entrance into the special play state is signalled, in the stream of ongoing behaviour, by specific play communication gestures, which in effect say "this is now play"; i.e., the behaviour pattern may look similar to aggression or parental care taking, but it is in fact play. These play signals include, the open mouth play face; various play initiation signals, like hit with the hand and run off, etc.

The play state permits behavioural units to be "borrowed" from anywhere in the behavioural repertoire which is why you can see grabbing followed by kissing followed by running away and so forth in species like macaques (Walker, personal observations 1976). This means these various behavioural units can be associated in novel, higher-order, patterns, permitting adaptive response to novel situations, before settling into fixed patterns.

For example, in Japanese macaques, it is the infant who first adopts a novel behaviour pattern (exploration and play with wrapped sweets in order to find out how to unwrap and find the toffee to eat) and passes it on throughout the monkey troop. In human adults, many tribal people participate in rituals to break down cognitive barriers erected for secular, or profane, living in order to enhance creative response [i.e., obtain blessings from the "gods" (see Walker 1997, unpublished M.Phil. Thesis)]. Loose connections permit novel combinations and permutations ... the raw stuff of evolution and creativity in artistic expression. Creativity directs play; whilst play, for the time that it occurs, directs the "lower order" behaviours (for this theory) such as aggression, sex and so forth.

The Play State may be signalled not only by special Meta-communication expressions and postures but also by a characteristic brain chemical profile. Thus the literature on play in humans refers to the association of play behaviour and an emotional factor of joy, or at least, pleasurable feelings, often signalled by laughing and smiling and so forth. In animals, the play face and relaxed muscle tone generally accompany the Play State. We might expect to find that neonates engaged in mental play have a different brain chemical profile from those that are engaged in fussing behaviour or relaxation without play, or attention to the environment without play.

The flexible/creativity function for play is applicable to both the perceptual-emotional and the linguistic-symbolic types of play. Given our current emphasis on the emotional-perceptual dimension, we have chosen to investigate the relationships amongst the following variables:

1. Perception: amodal invariance detection in neonates;
2. Emotion: non-verbal expressive communication gestures in new-borns and infants.
3. Visualisation strategy-use: examination of the drawings of children for creative solutions.

This is a novel route through the play-perception-cognitive strategy field.

Previous Theories of Play in Humans

From 1930 until the mid 1960's, psychoanalytic theory (Freud 1961) was the dominant theory of human play in infancy and childhood. Most research focused on play as therapy and its role in emotional development. This was usually in the direction of helping mal-adjusted children solve emotional-social problems (see Axline 1964, for example).

Emotional development in these cases is not the same as the emotional-perceptual-creativity axis of behaviour we have proposed above. The psychoanalytic approach focuses on enabling normative emotional system development, we are interested in the use of affect as a component of the visual/spatial information

processing cognitive ability in humans that leads to a creative approach in mental style.

As the cognitive approaches of Piaget (1952, 1962) and Vygotsky (1976) came into prominence in the late 1960s, attention shifted from the role of play in emotional development to its role in cognitive development. Play has been linked in this approach with IQ score, conservation ability, problem-solving skills and creativity.

Lieberman (1977) found that kindergarten children, rated high in playfulness scored higher on tests of divergent thinking than others. Dansky and Silverman (1975) found that there is a causal link between play and creativity. Children allowed to play with objects were later able to find more creative, non-standard uses for them.

Such findings give weight to the argument connecting play and creative information processing style. However, none of the studies have examined the development of play behaviour, from day one of life, recording details of actions over time, and in relation to perceptual ability, and subsequent effects, if any, on the perceptual-emotional (visual) style in cognitive behaviour.

Our criticisms of prior studies are twofold:

1) Theoretical: there is a need to separate out "types" of play; specifically, the visual style (perceptual-emotional-representational) from the linguistic style (symbolic-representational);
2) Methodological; there is a need to look at details of actual behaviour and not just higher-order constructs like "engagement" behaviour (Bigsby 1996)

Given the proposed link between play, creativity and perception, it is necessary to briefly review theories of perceptual development in infancy.

Psychological Theories Concerning the Nature of Sensori-Perceptual Development in Humans

Basically, there are two different schools of thought regarding how perception, and in particular the ability to make cross-modal comparisons, develops in human infants. In one camp, are theorists who favour an *Integration hypothesis* and their major proposals are:

1. The senses are independent (uncoordinated) at birth
2. Intersensory perception emerges gradually as the result of experience
3. Cross-modal perception is impossible during early infancy; particularly the period referred to as the neonatal period (first 28 days of life).

The major proponent of this school of thought is Piaget (1952; Piaget and Inhelder 1969). Piaget suggests that actions such as *touching a toy* gradually become co-ordinated with actions such as *looking at the toy* or *hearing the toy* (Bahrick and Pickens 1994).

The second major school of thought favours the *Differentiation hypothesis* and their fundamental tenets are the following:

1. The senses are unified early in infancy

2. Development is a matter of differentiation of increasingly finer aspects of perception
3. Intersensory perception is possible from day one of life.

Within this second school of thought, there are two divergent branches: the invariant detection hypothesis (favoured mainly by Gibson 1966, 1969) and the intensity hypothesis (favoured by Turkewitz, Lewkowicz and Gardner 1983). One major difference between these two sub branches of the differentiation school is that whilst both agree that neonates and older infants have the capacity to perceive amodal invariance's, they disagree as to how the infants do so. Turkewitz, Lewkowicz and Gardner (1983), for example, proposes that when infants match stimulus properties across sensory modalities they do so by focusing on quantitative properties only, and then mainly on intensity of stimulation; they do not perceive qualitative parameters like texture or shape until 4 or 6 months of age.

Figure 3 outlines the relationship of play to sensory-perceptual development. This diagram suggests that play in the lynch-pin which enables flexible combination of sensori abilities in the various dimensions such as touch, hearing and seeing, which allows cross-modal matching to take place. The ultimate creative peak may be the ability to perceive sensory synesthesia, useful for making artefacts.

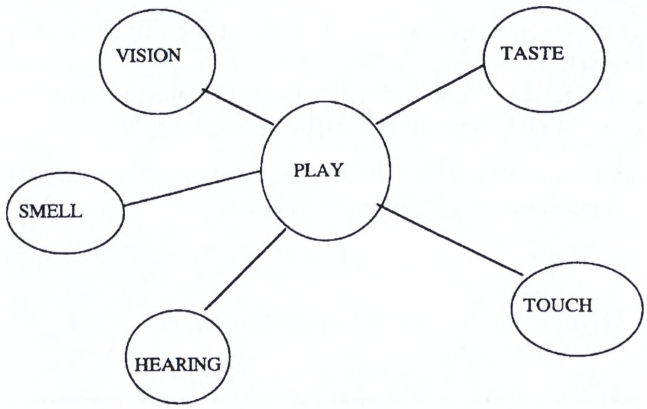

Fig. 3. Play permits sensory integration

In this paper we report an initial ethogram for the motor behaviour of the baby born prematurely (26–36 weeks gestational age). In a separate paper, we have reviewed some of the literature on the sensori-perceptual abilities of neonates (Walker et al., in prep.). In future work, we hope to continue with an examination of the development of play and later drawing ability of infants initially born prematurely, and at high medical risk.

Why premature babies? The literature reports they may have deficits in the areas we are interested in, namely:

1. Affect-regulation problems (Adamson and Bakeman 1985);
2. Difficulty in joint toy play with mothers (Landry 1986; Garner and Landry 1994)
3. Poorer performance on tests of cognitive ability (Rose 1981; Friedman et al. 1981; Adamson-Macedo et al. 1993)

4. Sensori-perceptual difficulties, e.g. poorer at cross-modal transfer tasks (Rose et al. 1978)

In addition, the parents of preterms behave as if their new-born is capable of play, or at least, they wish him/her to be capable of play, for then they could be regarded as "normal" and there would be the possibility of "normal" responses to them, which, for the parent, includes, play with toys.

Therefore, it would be advantageous to discover what the preterm is capable of in play. Difficulties in play may then be investigated to see whether they occur as a condition of prematurity, or as a condition of not having appropriate stimulation (e.g., inadequate toys), or even a consequence of interference from overstimulation of inappropriate kinds.

Methods

This study involved the analysis of videotape data from a TAC-TIC therapy study (Hayes 1996) conducted at various hospitals in England (including Royal Newcross Hospital, Wolverhampton; Royal Gloucester Hospital; Royal Shrewsbury Hospital, Royal Worsdley Hospital.). Approval was obtained for this study from the ethics committees before undertaking research. Informed consent from parent(s) was also obtained for their neonate(s) participation in the study.

The aim was to describe an ethogram, or behaviour catalogue, of minute motor actions, described accurately in the manner of animal behaviour studies, particularly ethological field studies of wild animals. The method had been pioneered for older children in the work of McGrew (1972). It has the advantage of providing detailed descriptive records of natural behaviour and it may be used without sophisticated equipment. Thus whilst it can be used in video recording with computer programs, like the Observer (Noldus, Netherlands), it may also be used for recording behaviour as it occurs with the relatively unsophisticated tools of pencil and paper. The observer and recorder of the behaviour must, however, take time to train in the rapid and reliable use of the method. The advantage of using video and the observer computer program is that records can be examined for reliability and repeatedly examined for new insights.

Participants

The sample consisted of 6 neonates born prematurely. The gestational age ranged from 26 to 29 weeks. Sex of neonates in the group = 3 males and 3 females. At birth, the weight of neonates ranged from 0.91 gms to 1.19 gms. Gestational age and birthweight were missing for one male neonate. All of the neonates were medically of high-risk and all on ventilator-assisted breathing apparatus in the incubator environment.

Criteria for inclusion consisted of first six neonates on video where all four limbs of the neonate were in full view. A total of 18 minutes of observational data (1 three minute session per baby) were analysed for this reported study; a total of 45 minutes of observational data for the 6 babies was collected (3 consecutive three minute sessions per baby) but only the first 3 minute period of spontaneous behaviour is reported here. This enables the basic behaviour ethogram to be con-

structed prior to any intervention therapies. The effect of TAC-TIC therapy on motor behaviour will be presented in a future paper.

Procedure

Infants were filmed in a period of spontaneous behaviour for three minutes in their normal incubator environment, prior to a first three-minute session of TAC-TIC therapy (Adamson-Macedo at al. 1994; Hayes 1996). Only the spontaneous behaviour condition is reported here. This gives a baseline indication of the behaviour of neonate alone in his/her regular incubator environment. No toys were present; all of the 6 infants were on ventilators, and had either a sheepskin rug or crocheted blanket for contact comfort (Scott and Richards 1978).

One observer was involved in viewing the behaviour of the neonates and in developing the behaviour coding system reported here. This observer was "blind" to the history of the participants viewed and had not searched the literature previously to construct the ethogram, but was experienced in constructing ethograms for nonhuman primate motor behaviour (Walker-Leonard 1979, 1980).

The guiding factor for this research was the development of toys for preterm neonates and older neonates; thus the focus was on motor behaviour. What movements do preterms perform spontaneously which may be engaged for play with toys specially designed for their needs? This had the effect of focusing attention on small details of possible hands, arms and legs. Because of this interest, behaviour items that occurred infrequently were not excluded. Prior studies (e.g., Bigsby et al. 1996), focusing on motor behaviour of preterms at 3 month corrected gestational age, have recorded behaviour units (such as finger-fold; point index; thumb suck) and then collapsed units into higher-order constructs, such as engagement (leg kick; arm wave; brow raise); midline component (hand to mouth, thumb sucking) and disengagement (brow lowered).

In this study, the catalogue of preterm neonate behavioural capacities was constructed by the following method:

1. Observation of neonate behaviour on videotape;
2. Coding of behaviours with two digit alphanumerical label that could be used either as a hand-written symbol notation system to record frequency and sequence of behaviours or could be coded in a computer programme.

In this preliminary report, we use hand-written recording of neonate behaviour in real time.

Results

Behaviour Catalogue for Recording Movements of Neonatal Preterm

Table 1 gives description and definitions of observed and recorded hand behaviours; other recorded behaviours included arm and leg movements, and whole body patterns.

Frequencies of Motor Behaviour

The numbers observed were too small for statistical analysis.

Table 1. Hand Movements of Preterms in Incubators (N = 6)

Number	Code	Brief description	Additional info
1.	PT	As if pointing with index	Looks as if pointing: index finger flexed, thumb and other fingers curled into palm
2.	PG	Precision grip	Index and thumb brought together in precision grip (precise pincer action); not necessarily around an object
3.	TT	Touch object front tips	Front tips of fingers contact object; usually seems as if neonate is feeling and gathering information about the object
4.	TB	Touch object back	Back tips of fingers contact an object (feeling it)
5.	TS	Touch self	Contact of own body with fingers; and looks as if registering information. Not accidental contact. Can be back or front of fingers
6.	GP	Grasp object thin	Thin object therefore precision grasp
7.	GB	Grasp object thick	Thick object therefore bulky grasp; fingers more open than thin grasp above
8.	SO	Stroke object	Slides fingers down an object as if registering information
9.	SS	Stroke self	As above but object is own body
10.	FF	Flat palm flexed	Flat palm with fingers outstretched and flexed
11.	FR	Flat palm relaxed	Flat palm with fingers outstretched and relaxed
12.	C1	Finger curls 1	Flat palm with one finger curled into palm
13.	C2	Finger curls 2	Two fingers curled into palm
14.	C3	Finger curls 3	Three fingers curled into palm
15.	O1	Open and close fingers	Fingers simultaneously stretch open and relax into palm
16.	O2	Open fingers like a flower	Fingers open like a flower; one finger at a time till open palm is achieved
17.	O3	Fingers open to right angle	Fingers open simultaneously but only to a position at right angles to palm
18.	W1	Wrist swivel lateral	Swivel hand on axis from side to side
19.	W2	Wrist swivel longitudinal	Wave hand up and down
20.	NN	Novel behaviour	Behaviour not in list
21.	RS	Resting position	Resting position for this baby
22.	C4	Four fingers curled	All four fingers curled into palm

For the purposes of toy design, the important thing is not necessarily frequency of behaviour but whether it occurs, i.e., is it in the neonate's repertoire so that it can be used in interactive play with objects. Numbers recorded in brackets refer to behaviours code number and not to frequency of behaviour.

Hand Movements

The behaviours flat palm relaxed (code number 11) and flat palm flexed (10) were the most frequent in occurrence. There are behaviours of low frequency but

which occur in half or more of the neonates observed, e.g. flat palm behaviours (10; 11) and curl all four fingers into the palm (22), and open fingers to a right angle position (17) were the most frequent. Behaviours that did not occur include stroke object (8) and stroke self- (9), and also wave hand (19). No novel hand movement's (20) were recorded in this sample.

Arm Movements

The behaviours shown most frequently are jerking (code number 8), rest (19), hand down to thigh (5). Those of low frequency, but shown by half or more of the sample include hand to thigh (5), arm to head (6), jerking (8), resting (19) and small movements (23). Behaviours not shown in this sample include; swings arm onto and off chest from lateral position (1); arms cross together (12); arms open out from crossed position (13); flail (16) and novel behaviours (18).

Leg Movements

The highest frequency classes were rest (18); knees move apart (15); knees together (16); one leg up and down (3); knees move up/down (5); slide leg up (12). Classes shown by half or more neonates are knees move up/down (5), slide leg up (12); and rest (18). Behaviours not shown in this sample include slide leg in (7); toes flutter (8); foot rocks (9), and novel behaviour (17).

Whole Body Movements

The highest frequency classes were rest (17), arm and corresponding leg move up (7); legs out and in; arms up and down (1); and knees up; one arm down (11). Those behaviours shown by half or more babies are legs out and in; arms up and down (1); arm and corresponding leg move up (7); knees up; one arm down (11) and rest (17). Those behaviours not exhibited in this sample include open mouth cry, arms up and down (2); arms raised; legs bicycle (3); arm and corresponding leg down (13); arms above head; knees closed (14) and novel behaviour (16).

Individual Behaviour Profiles

Each individual baby had a characteristic profile of behaving. For example, baby 1 could be described as highly motoric with respect to hand movements, which include flat palm, pointing, swivelling wrist and most of the finger curl behaviours; whereas baby 5 showed very little in the way of hand movements. Baby 2 showed the most leg movement; followed closely by baby 1 (the most motoric neonate in the sample). However, the patterns each exhibited were different. Thus baby 1 showed a high frequency of pushing legs down from body and pulling them up again; she also showed toe bending; whereas baby 2 showed mainly knees moving together and apart and knees moving up and down.

Complex Sequences of Motor Behaviour

Table 2 shows sequences of behaviour. This was scored on the following criteria: 3 different behaviours performed in flowing order and producing a recognised

Table 2. Complex sequences (Three different behaviours performed in flowing order to produce a recognised pattern)

1.	DU	One arm moves down; legs move up; opposite arm lifts to head which inclines to meet hand
2.	LH	One arm lifted; head rolls away; opposite leg lifts
3.	KD	One arm moves down; legs close at knees; opposite leg moves up and knees part; other arm lifts up and then down
4.	RL	Rock on hips; move one arm down; legs straightened down but apart
5.	CK	Knee swings open; arm swing down; one hand contacts knee; opposite hand covers first; then moves up
6.	SF	Knee moves up; one arm swings across chest; opposite hand moves up and down feeling material; other arm moves to contact this hand
7.	MS	One arm lifted; opposite leg lifted; other leg lifted; opposite arm swings down then up; feet move up and down; the legs straightened down
8.	KB	Kick both legs; one hand open and close fingers whilst moving hand up and down; opposite hand moving down and up (is this just a whole body pattern?)
9.	SA	Shoulders hump; one leg lifted and replaced; opposite arm and replaced
10.	NN	Novel sequence
11.	RS	Rest
12.	NS	Not sequence

sequence with a beginning and end (which was usually rest). These sequences occurred very infrequently in a 3-minute observation period with a small sample of 6 babies. They are included as descriptive of sequences that were observed at least once for one baby in sessions observed. They are useful pointers to the possibility of the higher order organisation of behaviour in the preterm neonate, which may be a function of integration, either at the subcortical or cortical level.

Discussion

Since each baby has a characteristic behaviour profile, this could be used in determining which type of toy might best fit his/her needs. Thus baby 16 which preferred to use his/her legs could be given a foot toy to encourage an already active behaviour, if this was the aim of therapy; by contrast, baby 10 could be given a hand toy to encourage it to perform hand movements. The detailed description of motor patterns allows this close fit of therapy tool or toy to behaviour need.

The outlined behaviour ethogram can now be used in studies where neonates are given special toys, e.g., to test cross-modal abilities. The behaviour units would useful as the dependent variable. Does the neonate show more finger curls when contacting textured toys compared to non-textured toys etc.?

The ethogram method could be profitably extended, adding categories, for use at different ages, so that direct comparisons of behaviours in different situations may be made.

It would be useful to correlate motor behaviour, especially those behaviours useful for engaging in play with objects, with brain neurotransmitter chemical profiles in future studies. Do infants playing with toys show a different profiles, measured by multi-modal imaging techniques, compared to infants who are sleeping, fussing etc.? Do different sensori toys result in different brain states?

Conclusion

The ethogram method of detailed description of motor behaviour should prove useful in future studies of the effects of various therapies for babies born premature.

The variety of behaviour recorded indicates the real possibility of new-born preterms being capable of play with objects, but the design of such objects requires careful consideration (see Walker et al. 1999, unpublished paper).

The occurrence of complex sequences of behaviour in the neonatal repertoire show the possibility that preterms have for combining and recombining motor patterns in a flexible manner corresponding to a creativity theory of play. We intend to elaborate this theory in a future paper.

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