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The effect of developmental activities, embedded into parents activities of daily living, on supine sleeping infant milestone development

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CHAPTER 2 LITERATURE REVIEW

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In this chapter relevant literature is reviewed to provide an overall view of parent-child interactions and the role that stimulation programmes play in that dynamic. The chapter is divided into four sections:

- Mothering and the challenges and successes involved in enfolding a stimulation programme into a normal daily routine.
- The "Back to sleep" campaign and Sudden Infant Death Syndrome (SIDS), its risks and risk reduction.
- A brief discussion on the theoretical background of occupationally-embedded activities and the philosophy of occupational therapists in this regard.
- Programme development and design theory and processes, with a précis of the pedagogy of health education materials.

2.1 The Occupation of Mothering

There is a growing literature base which seeks to examine the role of mothering in human occupational performance.

Maternal work, which is not necessarily restricted to biological mothers, or even to women, is a function and role done by someone who sustains children and aids all aspects of their development.[10, 29]

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Today, most mothering is still done by women[30] and a large portion of household and mothering tasks fall to women, even if they work full time.[29, 31]

Mothering is considered a mainstay of society, and is inherently valued because of the role that mothers are entrusted with - the creation of sanctuaries for their families, care and nurturing of children and as caretakers of a family's time.[10] However, in some instances, mothering also tends to be under-valued in society and not much research in the functioning of mothers is done,[31, 32] because it is 'unpaid' work,[31, 33] which is often not valued,[33] and because of its "commonness",[29] and invisibility.[26, 33] Mothering-work is therefore a paradox as it is both treasured and under-valued, with little research to understand its complexity and eventual effect on society.

Where studies have been completed into the manner in which mothers construct daily routines, the results have important implications for occupational therapists working with mothers.[10]

2.1.1 *The context of time and mothering*

In a qualitative study completed by Francis-Connolly (2000), the researcher found that mothers of young children were "immersed in motherhood" and had enormous demands on their time in an effort to care for their children. Based on interviews with 20 mothers of young children, the author used a modified grounded theory to develop themes. Words used to describe the mothering experience were 'overwhelming', 'intense', 'demanding' and 'unprepared'. The entry into motherhood is recognised as a time of major change in the psychology of a woman in and of itself,[30] without considering the changes to habit use, activity flow and comfort.[7]

A major theme emerging from the discourse is time management and a appreciation of the time it takes to get everything done combined

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with the unrelenting nature of the job. Time can therefore be considered a resource or a limitation.[32]

Due to time constraints, mothers are often obliged to enfold activities (where attention is given to a number of goals in a single activity) in order to achieve many outcomes at the same time. Nurturing and care-taking take place at the same time as teaching, playing and emotional support.[29, 32] The simplicity of playing peek-a-boo while changing a nappy, masks the complexity of what is actually being enfolded into a few minutes. This, writes Francis-Connolly, is mothering.[29]

The coping strategies of mothers were examined in an interview based study of mothers with children with Attention Deficit Hyperactivity Disorder.[32] Mothers coped with time demands by making extensive use of enfolding of activities, but also showed polychronic time use – which introduces the idea of a priority in the focus of tasks. Mothers fit the tasks they need to do around child care.[32] This qualitative study is resonant of other researchers in the field, but lacks generalisation because of the narrow group of participants that were interviewed for data collection.

Conversely, 'unfolding' occurs when one performs one part of an occupation in isolation from a previously established routine of enfolded occupations. Unfolding is therefore more time consuming.[32]

Mothers more readily use enfolding in order to maximise their time, but use unfolding in order to improve the occupational performance of their children when necessary. They also unfold activities in order to play with their children.[34] The findings of this research should inform any potential development programme design. When activities are given that are essentially unfolding in nature, therapists need to find out if these are feasible with regard to the mothers available time resources.[35] Alternatively, given a mother's natural

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proclivity to enfolding, therapists should try to provide programmes that conform to a mother's construction of her routine, and are enfolding in nature.[32]

The factors which influence the construction of daily routines, of mothers with children who had disabilities, were investigated by Hammon Kellergrew (2000) in her qualitative study.[21] Building on previous findings of her research, the author discovered that mothers created 'skill development time' within the ADL of their children, thus allowing crucial practicing time for skill development. They did this if the skill was emergent, if there was future value in developing the skill, and if there was time.[21] This is echoed in other research.[23, 24] Mothers made subtle daily adjustments in the routine to incorporate or exclude such practice time and as a result, children who lacked in a particular skill (for example getting dressed), had less opportunity to practice the skill over time as the mother took over the task.[21]

Eight thought processes were identified by the study conducted by Larson (2000) as being the basis of how mothers constructed their daily routines. They are "planning, organizing, balancing, anticipating, interpreting, forecasting, perspective shifting and meaning making".[34 p 273] Although the tasks of household management may be the same, each mother has to make changes based on their individual families and the child for whom the mothering work is intended.[21, 34] Further to the findings of how mothers create routines, was the emotional theme that highlighted that mothers' own sense of wellbeing was closely related to their success in mothering and in the orchestration of routines that allowed this.[34]

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2.1.2 *Stimulation and play in the mothering time context*

If one dimension in which mothers work is time, another is space. A mother's use of toys and space in the development of an infant's skills was isolated as one component, within a broader study of infant-toddler spatial and temporal development, by Pierce (2000).[26] Interviews and video observations of mother-infant dyads from birth to 18-months of age were coded based on the grounded theory and yielded interesting results regarding mothering skills. The following are of relevance to this study:

The skills of mothers vis a vis which toys to present to their infants were more developmentally appropriate in mothers with other children. This suggests that the art of playing with an infant is learnt. Further, mothers used toys to engage their infants in order to allow them to get on with housework. Mothers consistently positioned their infants and the infant's toys in such a manner as to allow them to complete other work. Positioning devices were used almost universally across all levels of socio-economic strata. As such, mothers tried to reduce the need to be continually available to scaffold play.[26]

Mothers also determined where children may play, and these spaces were most likely to be adjacent to the kitchen as kitchens were where the mother's occupational activities were centred.[26]

Pierce (2000) also describes the home as a primary developmental space and highlights the invisible work that mothers do in making use of space, objects and time to support this development. It emphasises how important it is that therapists not de-contextualise intervention, but rather consider the spatial aspects of occupation.[26]

Similarly to the Francis-Connolly study (2000)[29] the extent to which this study can be generalised is limited by the narrow population used

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in the sample selection. This was done in order to create homogeneity in the sample. The sample was spread evenly across socio-economic bands.[26]

2.1.3 *Therapy intervention programmes in the mothering time context*

Mothers also determined what activities to do within home programmes given to them by therapists based on a number of criteria. If mothers felt that intervention programmes robbed their infant of their babyhood, or put them in the constant role of 'therapist', they stopped them.[23] There had to be a sense of enjoyment for the child and mother in order for activities to be included in the daily routine. Most mothers created a mosaic of activities based on what they had learnt about an infant's early needs.[24] In the case of mothers of disabled children, these activities could be casually observed from a therapist, and the mother may not actually consider it to count as a home programme, but the activity would have been successfully assimilated into their routine.[24]

Although many of the studies examined were completed with mothers of disabled children, the conclusions reached can be extended to mothers of very young children, according to a study by Olson and Esdaile (2000).[33] They maintain that there are more similarities than differences between mothers who are at home with young children and those at home with disabled children, in as much as both groups are isolated and under enormous pressure.[33] They concur with the findings of Lawlor and Mattingly (1998) who outline the "Who is the client" dilemma.[36] Both research groups assert that if one focuses on the child as the client, half of the mother-infant dyadic co-occupation is ignored and the occupational needs of the mother will be compromised.[33, 36] As one mother of a child said: "*There is no time in my life that hasn't been spoken for, and for every 15 minute activity that is added, one has to be taken away.*" (p 78)[37]

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> *"Insight into maternal work has implications for occupational therapy intervention. Serious consideration needs to be given to mothers' construction of daily life and the meaning of the mundane but essential routines that create a family's daily life. Dismantling or revising of daily routines for the insertion of intervention requires a deep understanding of family routines and their meaning to family members." (p 251)*[10]

In summary, in all of the studies presented, routine creation is a complex, subtle, often invisible process of accommodation and anticipation, and almost all of these studies indicated that time was a constraint to parents. These manipulations of routine can be considered wholly co-occupational within the dyad, but they constantly take into account the needs of the child over all. By virtue of the pressure of time, where a child is not able to complete a task, the opportunity to practice and master it is quickly lost in the demanding routine that mothers need to create.[21, 26, 29, 34]

2.2 Back to Sleep

2.2.1 *Sudden Infant Death Syndrome*

Sudden Infant Death Syndrome (SIDS) is the most common cause of unexpected, natural death of infants. Infants are most at risk between one and three months, and the risk tapers off toward the end of the first year.[13, 38]

Historically it was believed that SIDS only occurred when infants slept with, and were entrapped under, their mothers. This belief persisted until evidence became available of cultures where co-bedding was common and SIDS was rare.[38] Despite the common term of 'cot

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death' SIDS can occur at any time of the day, but is most likely when infants are sleeping.[38]

Generally, there is a higher risk in infants who are premature. Some of the other risks for SIDS are related to environmental factors: Infants who co-bed with an adult who has had too much to drink, has taken sedatives, or smokes are thought to be at higher risk, as are infants who are placed to sleep on a couch or co-sleep on a couch with another person. Infants exposed pre- or post-natally to cigarette smoke have an increased risk.[38] Patterns of hyperthermia related to raised room temperature, excess bedding and covering the head, resulting in poor mechanisms for heat exchange are also thought to explain SIDS. Deaths are sometimes linked to respiratory illness in the infant's recent past.[4, 9, 13, 38]

In the mid 1980's the first research was published that suggested a link between sleep position and death, a link which has since been confirmed by a plethora of research.[13] In 25% to 60% of SIDS death scenes investigated, the infants were found prone.[12] Researchers and pathologists now delineate between infants who are found face down versus those who are found in a non-face down position.[12] Since the original call in 1992 for the 'Back to sleep campaign', the AAP has extended the risk factors to include side lying too, as there is a risk that infants will roll from side-lying to prone and asphyxiate.[13]

Bed sharing or co-bedding has become a contentious point in the debate and in the west is considered a risk.[38]

Current literature offers the following factors as being potentially protective against SIDS: supine sleeping, breastfeeding, use of a pacifier, omission of soft bedding and pillows, positioning the infant so that their feet are at the base of the cot, sleeping in close proximity to, but not with, parents and monitoring the temperature of the room.[13, 38]

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2.2.2 *The "Back to Sleep" Campaign*

The Back to Sleep (BTS) campaign was launched as a parent education programme following the AAP directive linking prone sleeping position and SIDS.[4] Initially the information given to parents was to make use of the side- or back-lying position. However, when further research linked an increase risk for side-lying infants who rolled over on their own, the policy was changed to advise parents to use the back-lying position exclusively.[9]

Moon, Oden and Grady (2004) found that a 15 minute education session in the small group format was successful in educating parents regarding the risks of sleep positioning for SIDS, even in groups which traditionally had poor compliance with the BTS advice.[39]

Recommendations were extended to hospitals, as nursery staff could influence behaviour by modelling good positioning practices throughout the post-natal stay.[40, 41] Nurses in Neonatal ICU wards were encouraged to do this long before the discharge of premature infants as these infants are at increased risk of SIDS, but are often nursed in prone in order to facilitate breathing.[41]

Since the start of the BTS campaign a significant drop in SIDS rates has been observed.[13, 38,11, 42] Beyond the home environment, the programme has been adopted in day-care centres and crèches. More than 80% of facilities were aware of the BTS campaign, although just under 40% of them were implementing supine sleeping at the time. Fewer were aware of, or using the 'prone playing' corollary in research done by Selleck, Fergus, Berdar, Corriveau, Deltorto and Piazza (2003).[14]

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2.2.3 *Effects of sleep position on motor development in Infants*

2.2.3.1 The effect of postural control and developmental delay:

Infant milestone achievement is discussed in the literature not so much in terms of dates as 'windows'. Ranges of normal milestone achievement have allowed for the natural variations in development that are seen across the world, and even within single population groups.[43] Variation must be allowed for in order to prevent premature diagnosis of delay. For example, the window for sitting unsupported is wide – anywhere from 3.8 months to 9.4 months. This sample presented a mean of 6.0 months and a standard deviation of 1.1 months or 35 days. The standard deviations reported in this study ranged from 35 days to 57 days.[43]

However, most standardised instruments to assess development place an individual on a continuum that is established by the testing of healthy individuals.[44] Normative standards are set and stratification provides a therapeutic cut off score.[45] These points are based on usual statistical tenets, and as such, one can make use of percentiles to determine when infants are at risk or in a deficit area.[44]

The criteria, used to adjudge whether a child shows developmental delay, vary within the literature and common practice. Within legislation in various states in the USA, a therapeutic cut off of $z \geq -1.5$ SD is affixed, or a child who is delayed by 25% or more in one performance area.[16, 46] Using this criteria, an infant from the WHO study (2006) who is 52 days delayed, or 1.75 months, should be considered for early intervention.

In South Africa, common practice is to use $z \geq -1.0$ standard deviations to inform eligibility for therapeutic services. Because there is no onerous application for funding (as is the case in the USA), any child presenting at a hospital with developmental delay of 1 – 1.5

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months delay would receive therapy. No literature exists around therapeutic cut-off levels in the private sector in South Africa.

Therapists in early intervention are inclined to use narrower allowances for delay than the ranges described in the WHO study (2006)[43]. They carefully observe for functional application and qualitative movement deficits as indicators of possible problems, rather than a simple 'yes' or 'no' around motor milestone acquisition.[47, 48] This allows for early detection of problems, and the earlier therapy is started, in the cases of developmental delay, the better the outcome.[48, 49] Likewise, Jantz et al (1997)[5] noted that a motor assessment that uses a qualitative observation rather than just a milestone achievement scale is more appropriate when assessing the effects of motor delay, as the quality of the movement is evaluated.

Use of these testing cut-offs is based on the assumption that development occurs at a constant rate and delay at any one point will result in delays later on. Bartlett (2000) asserts that this is not the case and her quantitative, longitudinal study of 36 infants from 10-months through to 18-months demonstrated that infants who were delayed at 10-months were not necessarily deemed neurologically behind their peers at 18-months. In the sample at 10-months there was a number of outliers but by 18-months this scatter had pulled toward the mean.[50]

A comparison between the 10- and 15-month assessments indicated a link between locomotion scores at 10 months and the timing of walking, and infants who were delayed at 10-months walked as much as two months later than the non-delayed group. However, the Peabody Developmental Motor Scales -2nd Edition (PDMS-2) scores of both groups were within a normal range at 15 months and only one toddler, delayed at 10-months, continued to be delayed at 18-months

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when tested by a paediatrician. The data therefore does not support the belief that a child who is delayed in infancy will continue to be delayed through toddlerhood.[20]

Bartlett (2000) does caution therapists from having a backlash reaction and missing neurological abnormalities. She concedes that subtle neurological damage can be masked in childhood and only present as clumsiness in pre-school years, and should not miss early identification and intervention.[20, 50] The message for therapists therefore is (in the absence of neurological abnormalities) to undertake serial assessments in order to establish a pattern of delay rather than one picture of functioning at a particular point in development and assuming that that point represents a pattern of delay.[20, 50]

Unfortunately, the study does not elucidate what criteria were used to determine the quality of the developmental skills at the time of the 18-month assessment, beyond describing the assessment as a 'standard paediatric examination'. This information would be useful in the light of studies by Majnemer et al (2006), which suggest that that the quality of movements in delayed infants may remain affected, even if a milestone has been acquired.[16]

The concern, when discussing delay within postural development, is that postural control is the central basis off which all motor actions take place. The stability of the musculature of the trunk determines to a large extent the ability of the individual to carry out age appropriate motor activities.[20, 47, 51, 52] Postural control is a dual function of the sensory and motor domains of the central nervous system. It is dependent on feedback from the vestibular, proprioceptive, visual and tactile systems, allowing a sense of the body in space and eliciting an adaptive motor response.[51, 53] Changes within the postural control system occurs across the lifespan, but are most easily observed in infancy as a progression of motor milestones.[53] Development of postural control has further links to

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reaching skills, fine motor development, adaptive balance control and anticipatory postural preparation in a feed-forward mechanism of motor planning. Postural control may play a more important role than co-ordination as a predictor of sport participation in young children.[54] And problems in physical engagement in play are linked to social and educational sequalae which have a trickle-down effect on other areas of development.[54, 55] Preventing developmental delay caused by positioning choices is easier than remediation of the problem at later stages of development, or of long term consequences.[56]

Simpson, Colpe & Greenspan (2003) determined that the longer a child is delayed, the more encompassing the deficit becomes. In their study, young children (4 – 15 months) exhibited particular, functional delays, but the older toddlers (16 – 59 months) were more likely to present with a generalised delay.[48]

In order to test a hypothetical model of the interactions of early motor milestone acquisition and motor skill mastery in childhood, Viholainen et al (2006)[51] conducted a longitudinal study with 130 children from birth to 3.5 years as part of a larger study on dyslexia risk factors. Their data analysis of Movement-ABC scores obtained at three and a half years against developmental milestones logged in the first year of life resulted in the finding that early hand control in infants has a poor correlation for gross motor skills, but that early body control has a high correlation for manipulation skills. Hence, if an infant develops hand function skills earlier than body control skills, their gross motor skills are negatively affected. They speculated that this may be attributed to focus of attention; infants who are proficient at object manipulation may not need to move as much in their environment and so lose out on the practice time needed to challenge their postural control muscles.[51]

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Their research also underscored the role of early intervention, confirming that early motor proficiency provides a good indicator for later motor skill. Therefore, early intervention for motor difficulties observed in infancy could improve later motor skill acquisition. The mediator between development in infancy and skill in childhood appears to be postural control. The Viholainen et al (2006) study therefore confirms the body of knowledge that asserts that postural control is the basis of motor development.[51]

There are other consequences to atypical development apart from just motor delays.[56] Shortening of the rhomboids, with external rotation of the shoulders and adducted scapulae, resulting from excessive supine positioning on a flat surface, can cause delayed self soothing, because of an inability to bring the hands to the mouth. This can have attachment and parenting side effects.[56] When an infant is consistently placed in supine they will begin to turn their heads consistently to one side, which results in precocious handedness, usually toward the right, and this can result in an inappropriate diagnosis of hemiplegia.[56]

Another debate which has been raised since the discovery of motor delays related to supine sleeping, has been the potential value of re-evaluating the norms provided for this current generation of children.[5] The debate to push developmental norms out a few months are rejected by Hunter and Malloy (2002), who call for medical practitioners to teach parents effective techniques to facilitate prone positioning, rather than loosing valuable exploration time for infants, the long term effects of which are not currently known.[56]

2.2.3.2 Discussion: The effect of supine sleeping on developmental motor milestones

Positioning an infant has a number of effects on the skeletal, muscular and behavioural systems. Applying sound positioning principles can be one of the simplest interventions to correcting

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developmental problems, but a lack of attention or underestimating the effect of positioning that is unvaried, can have a detrimental effect on the infant.[57] Skeletal examples include positional plagiocephaly (flattening of the skull on the back or sides depending on consistent placement). Muscular examples include torticollis (shortening of the sternocleidomastoid muscle on one side with elongation on the other). Muscle shortening can occur rapidly if there isn't a variation in position and can interfere with behavioural organisation such as the ability to bring the hands to the midline.[57] The sequalae of these behavioural delays are fussiness, or the delay in learning to self calm.[56]

One example of a position overuse having an effect on development is the current examination of the effect of supine sleeping on motor development.[57] The effects are not merely linear, but have ripple effects in many subsystems of development.[58] It is believed that babies who sleep in prone would spend time just after waking up lifting their heads, pushing on their arms and generally practicing the movements afforded by the prone position, for as long as it took for them to get an adult's attention. This practice time was sufficient to make up for any positioning choices that mothers made after lifting them out of their beds. It is this prone time that appears to be in deficit for infants who sleep in supine.[56]

Early discussions on the effect of supine sleeping were presented by Mildred, Beard, Dallwitz and Unwin (1995)[19], who concluded that parents avoided the prone position for play following the BTS campaign. Thereafter, Jantz, Blosser and Fruechting (1997) observed delays, within a single private practice setting, in 4-month old infants who slept in supine. They concluded that sleep position should be taken into account when infant were assessed for motor delay and that parents' fears should be allayed by explaining that this could have an effect.[5] Dewey, Fleming, Golding and the ALSPAC Study

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Team concluded that any delay noted at 6-months was transient.[59] One of the earliest attempts to quantify sleep position and the position used when awake was conducted by Davis, Moon, Sachs and Ottolini (1998).[20] A convenience sample of 400 healthy, full term infants were followed from birth to 18 months. Analysis of the log books, which parents completed, revealed that prone sleepers spent significantly more time in the prone position when awake than supine sleepers. The authors concluded that prone sleepers achieved their milestones earlier than supine sleepers. Supine sleepers were significantly slower to roll prone to supine, sit supported by one arm, creep, crawl and pull to stand. Although all infants walked within normal ranges, Davis et al (1998) concluded that this was not a necessarily an adequate indicator, since the infants who were delayed were typically delayed in areas that required upper body strength.[20]

A study which sought to investigate the effect of all wakeful positions on motor control touched on the effect of prone wake time. Bridgewater and Sullivan (1999)[60] made use of parent logs over three days before enrolled infants were assessed by blinded assessors. They concluded that infants with more active play time – in which they were handled in a playful manner through a variety of positions – benefitted developmentally. Playful bath time was also positively associated with head righting. Static positions were poorer positions in which to enhance maturation, with prone being better than supine or side-lying. The researchers concluded that the positions that involved close contact with caregivers, and great variation in position, such as bathing and playful handling resulted in the most mature responses within the postural adjustments of infants.[60] The study was conducted with a small sample, and was considered a pilot study by the authors. A larger sample size would be required before generalisation could be made.

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In contrast to the finding of Bridgewater and Sullivan (1999), Salls, Silverman and Gatty (2002)[18] found no differences in 4- and 6-month-old-infants when using the Denver II Gross Motor Sector, regardless of positioning. However, there was a change in the progression of development, as supine sleeping infants rolled from supine to prone first. They noted that infants who spent 15 minutes or more in prone while awake were statistically similar to the normative data. This timing is based on parental estimates of the time their infants spent in prone.[18]

The first discussion around inappropriate therapeutic referrals for developmental delay was raised by Majnemer and Barr (2005).[15] Testing a control group of prone sleepers against a group of like-aged supine sleepers, the researchers found that, at six months, 58% of supine sleepers obtained a score one standard deviation lower than normal range for the Gross Motor Quotient (GMQ) of the PDMS-2. Increased supported sitting was negatively associated with GMQ scores and associated with raised Fine Motor Quotient (FMQ) scores. These findings are consistent with other research.[51] In the 6 month old group, the GMQ and FMQ means were almost 1 SD below the mean of a normative sample, and 22% fell below the therapeutic cut off of <78 for GMQ. This would warrant therapeutic intervention. When compared with the prone sleepers, there was a statistically significant difference in the prone raw score, supine raw score, total raw score and percentiles on the Alberta Infant Motor Scales (AIMS), and in the GMQ for the PDMS-2. With regard to long term delays, more infants were below the therapeutic cut off at 15- months in the supine sleepers than the prone sleepers.[15, 16] This research design by Majnemer and Barr (2005) also showed that parental recall of the amount of time an infant is in prone during the day is less than it really is when a Baby's Day Diary© is used.[16]

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The role of supine positioning in psychomotor skill development was investigated by Vaivre-Douret, Dos Santos, Charlemain and Cabrol (2005)[61] They found that infants who lie in supine acquire psychomotor skills later than those who lie in prone and that the postural habit that is formed at birth tends to lead the organisation of motor patterns from birth to four months. This research was based on parent recall for detailed infant milestones. More recent research suggests that by 12 months, parents are not able to recall early milestones with accuracy.[62] Vaivre-Douret et al (2005) concede that many milestones for supine sleepers remained blank on answer sheets, but also argue that it is possible that parent did not recall these transitions because they weren't expressed. They found that deviations from normal developmental patterns were more likely to be observed from the supine sleepers. Supine sleepers were also more likely to skip dynamic/transitory skills such as crawling and were more passive about being moved or seated in a chair. The authors noted that there was the potential for implications for later development in terms of the quality of movement, and that there may be consequences of a psycho-affective and attention span that warrant longitudinal study of infants into their pre-school years.[61]

The negative relationship between supine sleep and motor development has also been confirmed among premature infants. Premature infants were always considered at risk for developmental delay because of their perceived or actual fragility, inherent physiological hypotonia and potential for neurological problems.[27, 56] Ratliff-Schaub et al (2001) confirmed that there is a link between supine sleep and motor delay in premature infants and this has been confirmed by more recent research.[63-65]

A similar study, conducted within a South African sample, demonstrated that supine sleeping infants were delayed according to developmental guidelines set forth by Bly.[66] Infants who spent less

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than 30 minutes in prone a day and slept in supine, were significantly different to infants who slept in prone. This study also made use of parent recall for estimating the time spent in prone, and made use of a non standardised assessment, but the findings are consistent with the international literature that is available.[66]

In summary, the research conducted to date has highlighted that infants who sleep in supine are more likely to play in supine and to actively resist being positioned in prone. As a result they are not afforded opportunities to practice the movements this position encourages and are inclined to be delayed when assessed on norms that were created at a time when most infants were placed in prone to sleep.[67] However, these infants do catch up with their prone counterparts and all infants achieved their walking milestone within normally accepted timeframes.[67]

Little research has been conducted into the quality of movements that are achieved in the attainment of these milestones, however, and the potential long term effects on childhood activity levels, visual perception, motor proficiency and psychomotor skills should be examined.[16, 56, 58, 61, 67]

2.2.4 *Prone playing in supine sleeping infants*

The importance of using a prone position during play has been examined to reduce the cases of developmental occipital plagiocephally and torticollis, as well as motor delay. [9]

It has been found that infants tolerate prone positioning if it is introduced at birth.[56] By three months, the preferred sleep position is more or less fixed, and observations of infant-directed positioning show that infants prefer to play in the position in which they sleep.[61, 65] Therefore, since the BTS campaign should start from birth, infants

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will quickly become averse to playing in prone, if it is not started early.[8, 18, 20, 56]

Bly (2000) indicates that the importance of the prone position is related to strengthening the extensors of the neck and back and the musculature of the shoulders, as well as being important for the development of rolling, creeping and crawling, unsupported sitting and pull to stand.[68] Tolerance of the prone position may be important in the development of bilateral integration because of the important role of rolling in development. Dissociation patterns are learnt through rolling. A paucity of prone positioning in awake time negatively affects developmental milestone achievement.[18]

However, parents and child care institutions alike place infants in prone to play for less time than is recommended and in some instances never put their infants down in prone.[5, 14, 16, 19, 69] There are many reasons for this. Fear may be a powerful motivator for parents not to use this position in play, as an over-extension of the warnings that they are given for sleep positioning.[8, 19] Prone is, however, a normal position in which to place an infant and they are at no increased risk of SIDS when supervised in this position.[9]

The problem of a lack of prone time is exacerbated in crèches, because research shows that infants there are more likely to be placed in a seating device, or to be held, than placed on the floor in any position.[70] Infants who sleep in supine and go to crèche are therefore the least likely to have prone playing time.

Less information is known about the effects of other infant devices such as car seats and baby chairs. Since they encourage the flexion position and bring the shoulders forward, they don't allow for the strengthening of the extensors, which is essential for developing the stability required for such weight-bearing positions as pushing up for reaching, crawling, pull to stand and standing.[47, 67] Bartlett and

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Kneale Fanning (2003) found negative relationships with prolonged carrying or swing use and motor development.[65]

There is also a wide range of teaching regarding the amount of tummy time needed, and when to implement it during the day. Parents are seldom given any advice on how to help a baby who is resisting tummy time to become accustomed to that position.[8] In an information article provided to nurses, the importance of teaching parents to place their babies to sleep in supine was emphasised. The authors highlighted the important role that prone positioning plays in the prevention of plagiocephaly and motor milestone delay. However, the article did not provide any guidelines to nurses, regarding the amount of prone time necessary to compensate for supine sleeping. Rather, recommendations were that the baby be positioned in prone for short periods of time, two to three times a day. It was also recommended that prone play be started immediately post-nataly.[40]

In a quasi-experimental study, designed to determine whether brochure or video education campaigns were effective in teaching parents about the importance of tummy time, Jennings, Sarbaugh and Payne (2005) found that parents who received the brochure at 4-weeks, were already finding their infants resistant to being in prone. It was recommended that mothers receive the information as close to the time of the birth as possible.[8]

The effect of the brochure campaign is adjudged, by the authors, to have been successful, as there was an increase between phase I and II of the study in the number of mothers who incorporated tummy time into their daily routine, although the link between the brochure and the observed change in behaviour could only be inferred. The written document was considered to be a good means of conveying

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information regarding prone positioning, including time frames and ideas for when and how to implement the programme.[8]

The result from the longitudinal component of this research contrasts other research in that it indicated that there was a significant difference between infants who were 'routinely' placed in prone more than once a day compared to those classified as 'not routinely' placed in prone by their parents. This difference was seen on the gross motor scores when the infants were re-tested at 18-months of age. Since parent recall was required in order to group the infants, it is not clear how accurate these groupings were, or whether the terms 'seldom', 'frequently', or 'routinely' were a sensitive enough delineator of prone 'dosage' in order to truly determine an effect on gross motor milestone acquisition.[8]

Prone positioning is not only based on parental knowledge and parenting trends.[28] It is also based on infant ability[21, 65] and preferences.[20] Following the early 'set point' of positions[61] which are comfortable and which allow for mastery of the environment, infants make choices as to where they want to be and vociferously make their preferences known.[20] Across a range of studies, mothers frequently reported that their infants didn't like lying on their stomachs.[8, 20, 61]

The efficacy of prone awake time and the exploration of the results of supine sleeping have received equal study by researchers, and are often reported in the same articles as a continuum of ideas. Various studies have examined the effect of 'no prone' vs. differing lengths of time in prone.[17] Infants, who spent awake time in prone, scored higher on the AIMS than their 'no prone' counterparts and these scores were statistically significant in all the subtests, except sitting and standing, in a study by Monson, Deitz and Kartin (2003).[17] This research design did not define time periods in prone, and the 'no

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prone' group was defined as infants who were in prone "zero to once a day". As a result, it is conceivable that an infant who is in prone two or three times a day, but for only a minute at a time, could be compared with an infant who is placed in prone once a day, but for 20 minutes.[17] This makes generalisation of the findings difficult.

As a continuation of their examination of supine sleepers, Majnemer and Barr (2005 and 2006) found that awake prone positioning was still the most significant factor impacting on early motor development of supine sleeping infants.[15, 16]

A longitudinal study, conducted in order to determine the influence that duration and preference for prone positioning had on a cohort of infants at 4-, 6-, 12- and 24-months-of-age, showed that infants who spent more time in prone had earlier milestone achievement in incremental levels through the four groups.[62] Assessors were cognisant of the family preference for positioning of the infant when conducting assessments at 6- and 24-months. Few infants, in the three to four month window, spent more than 60 minutes in prone during the day and these were grouped into a larger group who spent ≥40 minutes in prone. Most infants in this window were either held or placed on their backs. In the 6 month window infants were more polarised, allowing only two groupings – prone and non-prone. The group that preferred prone wakeful positions represented only 16% of the sample. Data analysis of infants, who had experience in prone, showed that they rolled, crept and crawled (prone specific milestones) earlier than infants who had no experience in prone.[62] A threshold of 20 minutes a day in prone, elicited significant results. Delays found in the non-prone group in early infancy were transient. A cautionary note was interjected by the authors, as this transience may have been reflective of the nature of testing at two years – tests for gross motor competence tend to evaluate movements in sitting and standing and few tests look at antigravity control.[62]

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Most of the studies conducted into the effects of supine sleeping and the efficacy of prone awake time made use of parent recall of the amount of time the infant spent in prone during the day.[5, 18, 62, 66, 71] This has been shown to be an inaccurate measure of evaluating said time.[16] Some studies made use of parent recall for milestone achievement,[20] without comment on the quality of movement, which may prove to be where residual difficulty persists.[16, 71] Few studies made use of a blinded assessor to evaluate infants' development.[16, 60, 71]

Despite these weaknesses in research methodology[67] used across the studies, the findings presented have been consistent. Generally it is held that infants who spend wakeful time in prone benefit developmentally.[5, 8, 17, 18, 20, 59, 71] Infants who did not, were found to be delayed at 4- and 6-months.[18, 20, 59] Those studies with a longitudinal component, found that the delays were transient and by 15- and 18-months, no delay was observable.[16, 18, 59, 62] However, long term research, continuing to preschool, is needed to determine whether there is an effect on motor activity levels, concentration and motor planning later.[16, 18, 27, 61] Assessments also need to determine whether there is a qualitative variation in the manner in which milestones are achieved, rather than a simple yes/no adjudement.[16, 18] Research in this area whose methodologies are rigorous, have been conducted with small sample sizes and therefore lack the ability to be generalised.[67]

2.3 Occupationally embedded exercise

The concept of occupationally-embedded exercise is currently gaining popularity as various theory bases confirm the basic tenet of occupational therapy,[2] which is that change and recovery occur through participation in the everyday activities which make up life.[53, 72] Practice outside of normal life can be meaningless to a client.[73]

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Many survivors of trauma and illness actually figure out how to recover, by themselves, once they are released from rehabilitation facilities and have to live in the context of real life again.[73] This knitting together of occupational science and therapy has the following factual basis:

The advantage of embedded exercise over rote exercise has been shown to be that the development of skill occurs naturally in the pursuit of a goal. Occupationally-embedded activities are part of the narrative, the story-telling daily life, and are put in because they enhance the story.[73] They are part of a plan of recovery or prevention and the client therefore is motivated to persevere.[74] In order for the control to be in the hands of the client, they need to know what they are doing and why and how that activity will add meaning to their life. Rote exercise does not do this unless the client is motivated by exercise for its own sake.[2] Further, activities themselves guide and shape movements around tools and objects, thereby producing a skill and eliciting exercise. As a result, it does not result in the training of a single movement, but rather co-ordinates the transitions between multiple movements and postures within the environment. The multi-dimensional nature of the activity may provide other non-motor benefits – sensory pleasure, cognitive feedback and social interaction – which act as motivators throughout the task and in the case of developmental goals, provide multi-layered developmental opportunities. These are motivating in themselves and therefore become internal or intrinsic and do not depend on an external force coaxing for a 'little bit longer, a few more steps". It is possible that one will tolerate the discomfort of a movement or exercise for longer and perform it more smoothly if distracted by the activity in which the exercise is embedded, whereas rote exercise, not being intrinsically motivating, may be stopped when discomfort is perceived.[2]

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In a meta-analytic review of occupationally-embedded activities, Lin, Wu, Tickle-Degnen and Coster (1997) concluded that motor performance is indeed improved when participating in naturalistic occupations. Objectives or tools within occupations should shape and direct movement towards a goal that the subject finds motivating. This in itself possibly results in a smoother, more controlled movement as the conscious focus is on the goal and not on the movement.[3] The key feature of occupationally-embedded activities is that the meaningfulness of the task is maintained and therefore motivation is maintained.[3] There is also more carry-over of skills than is observed in decontextualised exercise.[75]

The term 'activity focused interventions' is used by Valvano and Rapport, in the same manner that Nelson makes use of the term 'occupationally-embedded activity'. They essentially apply the benefits of occupationally-embedded activity to the daily routines of infants. Although the infants in their study have neurological conditions, the application of occupationally-embedded activities will affect the parenting skills of their mothers, and these can be generalised to mothers of small children. The activity focused intervention programme is designed using principles from motor learning theory and motor development theory, and is based on activities within the family daily routine. Important components are repetition and problems solving so that the skills are generalised across many actions. For this reason, the programme isn't prescriptive because the newness of each day and different contexts is a tool in itself.[72]

One way in which a disruption of a role, such as the shift to motherhood, creates stress is that it results in increased energy expenditure being necessary in order to try to consciously plan, that which was previously smooth or unconsciously executed.[7] By embedding one activity into another, which was previously known,

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energy expenditure can be reduced. This allows the mother to recreate a flow of activities which is once again, seamless and comfortable.[7]

2.4 Programme Development

In the development of an intervention programme, background study into the basic biological processes is necessary.[76] An understanding of the underlying framework and principles is important. This groundwork is informed by what is already known about a particular biological process, occupational pattern, or deficit and is directed by the notion held by the investigator as to what the problem/solution may be. A theory as to the intervention is created, and measures are identified or created to determine change of the dependent variable.[77] Thereafter a process of testing and refining should be entered into before one can legitimately say that a programme has been developed.

The use of randomised controlled trials, rather than case studies or anecdotal evidence, does not have a strong historical standing in occupational therapy. This is a process that is necessary, in the context of evidence based medicine if occupational therapy interventions are to be considered credible and adoptable. Fortunately, this historical gap is changing.

2.4.1 *Principles for designing family centred programmes*

This programme was designed based on the principles of family-centred care.

The concept of 'Family centred care' has really grown out of the Early Interventionist Model of providing therapy services for disabled infants and children.[49, 78, 79] Even when the programme is preventative in nature, and no pathology is observed, we have moved

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away from the mindset that the delayed or 'at risk' child is the client in totality.[79, 80] A key concept that resonates with this study is that the child's care is actually a part of the parent's ADL. Therefore the programme – if it is not to place additional stress to a parent's schedule – should be within the tasks with which the parent is routinely engaged. Advice to parents, should therefore be non-didactic, and should encourage parents to observe their child and intervene, rather than depending on a child care professional to intervene. This strengthens the parent-child relationship and often results in more sustained, generalised improvements for both parties.[79] A non-didactic approach teaches a mother principles of intervention and how to adjudge for herself whether they are working.[25] The locus of control is left with the mother, as the expert on her child,[81-83] throughout the process, and her own expertise with her baby is emphasised and facilitated. In this way the mother, not the therapist, is the mechanism of change.[83] The therapist is a collaborator and a large part of the success between parent and therapist is the relationship that is built on the flow of information.[25, 78, 81, 83]

In order for a programme to be embraced by a mother or family, the family needs to have identified it as being a necessary change and the process of implementing it needs to have functional importance and also needs to be easily enfolded into family life, as has been discussed in the literature review of 'mothering'.

The intervention programme also needs to allow for skill practicing through repetition in order to become habitual and automatic.[35] Another principle in the programme design, drawn from the family-centred model of intervention, was that the focus should be on changing the environment to best enable the child to develop, rather than focusing on the child's movement and stopping any so-called abnormal patterns. In this case, it may refer to the early

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development of hand skills. Rather than stop the infant from focusing on objects in their hands, environmental changes can be used to rather encourage the exploration of space and movement and allow the infant chance to spontaneously discover a different path.[72]

The family-centred therapy model also informs the evaluation of the programme. In acknowledging that parenting is a deeply personal experience, and a parent's own resources are brought to bear on the work of parenting, therapists acknowledge that not all parents are going to respond in the same manner to an intervention programme and therefore, non-implementation can't be judgmentally considered in the light of 'compliance'.[82] The language of 'non-compliance' holds no place in the family-centred model. There is an unspoken cultural expectation for people to comply with programmes that reduce their health risks. However, the aim of a prevention programme is not to medicalise life, but to focus on living and wellness, which occupational therapy seeks to do.[84] Parenting should not be given over to the control of experts who tell mothers what is good and what is not.[85] Hanna and Roger (2002) hold that the success of a programme should be evaluated by asking questions about parent stress, and ease of implementation, rather than by measuring developmental improvement.[82] In this study, the *effect* of the programme was in question, but to answer questions about the *success* of the programme, focus groups with mothers would have needed to be run.

2.4.2 *Theory base of the IPCP design*

The programme design process was initiated with a background study of motor development and an investigation into the mechanisms of change underpinning the observable process of maturation. Detailed descriptions of infant maturation are to be found in abundance. Insight was gained from a number of sources,[47, 58, 68, 80, 86-94] each of

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which contributed to a further understanding of what was considered 'optimal' for this age span.

Initial studies by theorists such as Gesell (1940)[95 cited 58] and McGraw (1943)[86] attribute development to factors such as muscle strengthening and cortical maturation. The observable succession of development occurs when a 'better' method of achieving a goal is uncovered, with an underlying assumption that this progression toward the 'optimal mature state' was somehow hard-wired into the individual. This allowed for predictability, despite variation and differences in culture and individuals. The notion was that there were some significant phases in the development of specific motor functions that act as the 'key' in unlocking the means to move.[86] These were qualitatively observed, and acted as the precursors to a motor milestone. They develop simultaneously, but unlock movements in sequence. For example, McGraw (1943) hypothesises that 'rolling' is in evidence from birth. Initial movements are not systematic or functional, but changes in muscle tension in relation to reflex activity and the effect of gravity can result in an infant appearing to roll. Turning of the head or shoulders to see or to reach, but no functional rolling (phase A) is seen as a progression toward (phase B) arching the head and back into extension and pushing the pelvis over the underneath leg, followed in a log by the shoulders, to effect a roll. This manoeuvre is not terribly effective because the infant can just as easily tip back to the starting position, so as muscle strength and further motor control is gained (encompassing phase C), the infant rolls with deliberation (phase D). McGraw saw a significant amount of overlap in these phases, such that parts of phase A and C can be seen together, and at about 300 days of age, phase B is waning and phase D is waxing.[86]

This construct by McGraw is held across many developmental theories such as cognition and perception. Theorists attribute development to

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factors such as muscle strengthening, neural development and myelinantion. Motor development is considered to be sequential, progressing in a cephalocaudal direction, from proximal stability to distal control. Postural control is seen as a precursor to movement and is the balance between mobility and stability.[53] This provides the platform upon which more organised or skilled movement occurs.[80, 96] All of these theoretical constructs assume that the end-point is innate, with the components present at birth, but 'waiting in the wings'. This has provided a robust nature vs. nurture debate. [53, 58]

However, biology is not supportive of this reductionistic thesis.[58] What is known about neural cell proliferation, migration and myelination insists to a certain extent, that the foetus is indeed a *tabula rasa* – a blank slate – and a certain amount of self organisation is required for behaviours to become established.[58, 97]

A more recent construct is the dynamic systems theory. This theory base states that it takes more than just muscle strength or neuronal maturation to produce motor advancement.[58, 81] The theory is that multiple systems, both intrinsic and extrinsic to the infant, interact *in the context of a task* to produce behaviour.[80, 81, 98]

This alternate view, Thelen and Smith argue, provides a more multifaceted concept of development.[58] When viewed from a distance, the development of normal individuals has the appearance of a neat, linear conformation to an unseen code of rules, inevitably sequenced and predictable. When zooming in on the details though, the start and end become inextricably linked with multiple systems, biological properties and the context in which the individual is learning. Opportunities used and opportunities missed create messy cycles of function, achievement and exploration. From a starting point at birth, each system develops on a trajectory that is strangely dichotomous and concurrent, independent and interdependent,

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dynamic and yet seeking stability. In the end, the set of 'rules' created must be malleable and sensitive to change in order to allow adaptability and context driven variation. The result is a web, rather than a process, of development[58] where the law of unintended consequences can be observed, as a small change in one subsystem can have an unexpected effect on another system, showing itself to be a heretofore unknown factor.[81]

As such, some factors can become rate limiting,[58, 81, 91] as Thelen and Smith (1996) have demonstrated in a study of infant kicking and stepping behaviours. They concluded that the loss of stepping at around 7 months in infancy is related to the ratio of fat to muscle in the infant, and not, as previously thought, to a phasic thesis[86] related to neural development and the extinguishing of behaviours. Thelen and Smith (1996) critique McGraw's work as being a panoramic sweep of progression, yet flawed in that the only explanation for progression along the patterns was 'cortical maturation'. Further, what began as a *description* was equated at the time as a *process,* a maturation driven phenomenon that resulted in species specific outcomes. In their summary of developmental theorists, Slater and Lewis (2002) concur, pointing out that numerous other factors need to be taken into account.[91]

Within the dynamic systems theory of development explanation a principle of stability and instability is noted, with neuroplasticity and exploration working together to create transition phases between stable motor patterns and emergent patterns, and in these windows an opportunity exists to intervene in the pattern of development.[81] Because movement is initiated for a reason, interventions will be most successfully inserted at such a time and in such a manner that assists the child who is trying to attempt a new task.[72] This is a basic tenet upon which occupational therapy stands.

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Using the dynamic systems approach to motor intervention resonates with occupational therapy because of the emphasis on normal activity within the context of life, where motor advancement is unsurprisingly best learnt in daily routine.[2]

Any programmes in this area therefore, are most successfully adapted when drawing from dynamic systems theory[58] and motor learning theory[53] and what is known of the sweep of development,[47, 91] with motor practice structured within activities in such a manner that repetition and problem solving provide an easily generalised skill.[72] For this reason, a programme cannot be prescriptive or rote, because of the variation in daily living[2, 7] A key factor to this is self-movement – passive movement does not have the same training effect.[72] In the case of young infants, little purposeful movement is seen and movements against gravity are the main area of mastery that is expected in this age group.[80]

2.4.3 *Health education materials*

A core philosophy of occupational therapy lies in education of clients in such a manner as to empower them to make good choices.[74] But there is a sentiment that the process of finding the best manner to teach a client a programme, is best left to experts in pedagogy. Therefore, simple rules and insights into the best teaching method for the programme were sought for the fulfilment of this design.

The basic principles that are encouraged in the literature on health education materials, are that the information brochure must be credible, useful and adoptable. Written text needs to be evaluated for readability, which is "the ease with which material can be read"[99] and if possible a readability score calculated for the content, for example the Flesch-Kincaid Formula.[100] Documents produced on a computer, can calculate their own readability score.[101] Readability scores are based on the number of words per sentence and the

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average number of syllables per word. Results are expressed as grade or age based reading levels, depending on the test.[100]

Most therapists used written information to supplement verbal teaching and provide the written information in order to help their clients to remember what had been said.[102] Parents prefer a combination of approaches to convey information – written information, verbal explanations and demonstrations of the motor pattern required.[23, 103]

Literature in this area recommends that words be typed in font size 12 or larger and that a limited number of fonts be employed. Text should be graded at a Grade 9 (USA) reading level (i.e. the wording would be readable by a child who has had 9 years of education and is 14 years old),[104] although other sources recommend that it be lower - at a Grade 5 or 6 level.[99] It is important to reduce sentence length and to limit technical or anatomical terms, in order to improve the readability of the document.[104] The use of illustrations significantly improves the comprehension of a piece. Stick or line drawings are considered difficult to interpret. With appropriate illustrations, 'poor readers' have a better comprehension of a more difficult written piece than they would have experienced without them.[105] These illustrations need to be next to the text they elucidate. Text should be presented in the present tense and in a manner that encourages positive decision making.[104] Of further importance is the emotional tone of the presentation. Information that evokes a positive emotional response is more likely to be accepted and remembered.[106] A language tone that is coercive does not empower a reader to make informed decisions to their benefit, nor does it imbue a sense of the reader being in control.[85] Of particular importance in conveying information to a parent, such that the family centred approach will be maintained, is conveying the message that the parent is in charge of the process, and that the information and techniques are really just

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tools which the mother uses to achieve her goals and she herself is the mechanism of change.[83]

2.4.4 *Conclusion*

The IPCP was therefore designed based on a wide range of subjects, including the normative data of what can be expected from an infant within these months, and combining these with the principles of family centred programme development. The medium of disseminating this information to parents was through written brochures, and the guidelines for forming this health material informed the process of designing and wording all information. In the end these three components could be drawn together to create the educational programme.

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