

What About The Children?

Patrons: Sir Michael Morpurgo, Rebecca Abrams, Sir John Timpson, Dame Sarah Storey



RESEARCH SUMMARY

Childcare outside the family for the under-threes, a summary of two related research papers

Paper 1

Childcare outside the family for the under-threes: cause for concern?

Pereira Gray, D., Dean, D. & Dean, P.M.

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Latest results from the [Office of National Statistics](#) (2019) show there are approximately eight million families with dependent children in the UK, with 6.2 million having either a married or co-habiting, couple as parents. The remainder are lone-parent families. Around 7 in 10 of these couple families had both parents in employment. There was a similar ratio of employment for the lone-parent families. Working mothers help to counter family poverty, and mothers' and child-minders' taxation increase gross domestic product, thus the government childcare subsidy only rewards parents who go back to work, thereby encouraging this, even when the children are in their infancy. But how does this early separation from their mother and father affect the long-term brain development of these babies?

For thousands of years, humans have had to nurture their under-developed babies outside their bodies because, with such a large brain, the baby's head would be too large to pass through the birth canal if delayed until able to survive independently. Plasticity of the brain at birth makes it exceptionally adaptable. The baby will be nurtured because the mother is programmed to bond with her child through the action of the hormone oxytocin, produced during pregnancy and while breast-feeding. Babies tune into their mother through gaze, small gestures and sound. They react differently to their mother's face from others, and a mother can recognise her own baby's cry in a crowd. The more oxytocin the baby's brain releases during bonding behaviour, the more oxytocin receptors will be synthesised in its brain.

Small children seek to stay close to their familiar carer – generally the mother - and become anxious when separated. Attachment theory, based on maternal bonding, means a child acquires emotional security and learns self-regulation through early loving relationships.

When a baby cries or indicates with gestures that something is needed, and a mother responds quickly and appropriately, the young infant acquires this emotional security and thus learns self-regulation. However, if the baby is frequently separated from its mother, and is not reliably comforted while also experiencing emotional neglect, then

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this can, if severe, lead to levels of stress causing a continuously high level of persistent cortisol release and a consequent effect on transcription (“reading”) of some genes. This may in turn cause a reduced number of oxytocin receptors to be formed. These consequences could affect the relationships of that individual throughout their life, reducing their ability to form strong bonds as an adult, or affecting their brain’s regulation of reward and addiction - leading to substance abuse in later life. The term we use for the chemical modification of genes by stress is epigenetic change.

Experiencing stress connects any stimulus in the brain alerting ‘danger’ to the production of cortisol in the adrenal glands near the kidneys. It is an emergency response, and provides the fight or flight response, driving blood into the muscles, reducing digestion and protein synthesis (needed for brain growth) and, as swift action is required, suppressing immune systems. Releasing cortisol is valuable for the body when it is an immediate emergency response. However, if the release continues for hours and days then evidence would indicate that it is harmful.

In the 1980s, it was noticed that externalising aggressive behaviour was more common in children in nurseries, compared with those cared for at home, and especially in children cared for in nurseries for more than 30 hours per week. However, it wasn’t until the 21st century that a simple and non-invasive test for cortisol was available, so that researchers could easily test whether a child was stressed. A tiny swab of saliva from an infant can reveal their cortisol levels. Children brought up in their home environments generally have a declining level of cortisol throughout the day. In contrast, the research indicated that some children in daycare for long hours, had an increasing cortisol level when measured in the afternoon. Although not all children were affected, 63% had a range of effects, and 40% of the children had sufficiently high effects to indicate that they were experiencing harmful stress (Gunnar et al., 2010). These results showed that, on average, children in long hours of daycare had persistent higher levels of cortisol than children at home.

A meta-analysis carried out in 2006 concluded that children in daycare exhibit higher cortisol levels than children cared for at home. Watamura et al., (2010) have linked higher cortisol in saliva in children in daycare to lowered antibody levels and greater illness frequency. Longer term research following these young children into later life, have linked long hours in daycare to increased rates of obesity. Biochemical markers, such as interleukins, have been used in studies to predict chronic physical aggression (CPA) in infant boys which can persist into adult life (Provençal and Binder, 2015). They found different methylation patterns (epigenetic changes) on the genes producing these interleukins, which were correlated with CPA. As the boys with CPA grew older, they developed hyperactivity, impulsive behaviour and were likely to fail at school, and were more likely to have a criminal record in later life.

It is particularly important to note that genes changed through extreme and constant stress can be passed on to future generations. The next step is to investigate the links between the epigenetic changes introduced by persistent &/or severe childhood adversity and changes to health outcomes. There is *not* yet conclusive proof that all children under three, looked after in nurseries for long periods, are *always* harmed, as

the level of proof is mainly associations and not based on randomised controlled trials. Most children are not affected, but it is of concern that as many as 40% may be.

Paper 2.

Science versus society: is childcare for the under threes a taboo subject?

Pereira Gray D., Dean D., Dineen M. & Dean P.

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Twitter # brain changes, children in Day-care, cortisol levels, DNA methylation, ELS (early life stress), epigenetics.

The authors of the above scientific paper are introducing a subject which is probably taboo amongst our modern generation. This is about whether the custom in recent decades for the under-threes to be placed in group day-care with non-family carers, often for many hours a week is, in some cases, changing the way genes in infant brains are being expressed, leading to changes in their behaviour. Changing patterns of care for babies and young children is one of the biggest social revolutions in history, resulting from the positive social movement in western society to afford opportunities for women across all aspects of modern life.

Through much of history, small children were reared within close family settings or wider kinship groups, but most often by mothers. This is still the normal way of raising children for many UK families, and globally within most cultures.

During the last trimester of pregnancy and the first 3 years after birth, the synaptic pathways between neurones in the infant brain are gradually forming, at different rates in different areas of the brain. This is the time when mother-child bonding is so important for crucial synaptic connections to be made. This is why brain building is harmed when small children suffer adversity. *When*, and *how* adversity happens can be critical. For example, at all stages of early infancy, there are detectable adverse effects **for some** children if separated from their mothers for too long, too frequently.

Early life stresses (ELS) or adverse childhood experiences (ACEs) are severe stresses, including abuse, death of a parent or emotional or physical neglect. Their relation to children's behaviour has been described, for example, in the WATCH? summaries of research papers of [Chen Yucai and Taille](#) (2016), [Caspi et al](#) (2016) and [Hambrick et al](#) (2019) which are listed on the What About The Children? website.

The authors Pereira Gray *et al.* conducted an in-depth review of available research to find out whether daycare is an early childhood stress, and whether the increased cortisol registered by young infants in daycare is likely to cause changes in the brain. They looked at papers which studied chemical changes of controlling elements of genes (which are called promoters) or of the DNA of the genes themselves, which feature significantly in determining behaviour in the child. They were looking for evidence of long-lasting effects on behaviour and alterations in the genes of succeeding generations. They identified around 1,000 research reports in different sciences spread over 30 years, which showed that very young children separated

from their mothers, particularly for lengthy periods, were more at risk of a variety of adverse effects.

During pregnancy, cortisol is released from the mother when she is under stress. This increases methylation, which is a chemical modification (or epigenetic change) of a variety of genes. Research showed that chemical modification of the promoter region was more frequent than modification of the structural part of the gene

Oxytocin is also released during pregnancy, to prime the mother for bonding, but the amount of oxytocin released will be reduced if the gene is methylated because of stress. The timing and amount of oxytocin released is controlled by the promoter region (the on-switch) of the gene. Chemical modification (or methylation) of many places on the DNA in the promoter region reduces the rate of synthesis of the hormone.

Topfer *et al* (2019) have studied the DNA methylation pattern of the mother's oxytocin gene. They discovered that the methylation of this gene is constantly changing in the mother during pregnancy. The level of methylation during pregnancy can predict how intrusive a mother's behaviour to her infant will be.

When a mother interferes with the behaviour of her infant, by over-controlling what they do, or neglecting the child's wishes to do something, when the child's gaze indicates what its personal interest is, this is called 'intrusive behaviour'. This intrusive activity by the mother interferes with the normal development of the child's autonomy. In the brain, the oxytocin molecules are detected by oxytocin receptor proteins. The genes making these proteins are called oxytocin receptor genes. Their promoters are also found to be methylated and there is a wide variation in the pattern of methylation between mothers and infants of different ages. Krol *et al.* (2019) showed a correlation between the level of methylation of this gene in the mother and with the corresponding gene in infants at 5 months and 18 months old.

They measured the amount of mother-child engagement through play and this predicted the level of methylation of this gene at 5 months (the more engagement, the fewer methylation sites). At 18 months, the level of methylation of this gene correlated with traits of fearfulness, sadness, shyness, frustration and soothability (the fewer the methylation sites, the lower the scores). Although there was correlation, they were not yet able to show definitively the cause for poorer outcomes in the infant's temperament and the negative effects in their later life.

How can we interpret this in the light of the children who are now being raised in long hours of group daycare, where their carers may need to be somewhat inflexible in relation to an individual child's needs to fit in with nursery routines and protocols? Are the children being affected by a level of intrusive behaviour by their carers in the long hours of nursery, when they are asked to conform with the group needs? It will depend on how many children are in their care, the time they can spend with them, their training and their experience with babies, infants and young children.

There is also evidence for correlation of methylation of oxytocin receptor genes with increased callous social and emotional behaviour in youths and also with the rigid thinking of young people with anorexia nervosa and other problems.

The biggest implication for society is that persistently over-stressed children could pass on their epigenetically altered genes to future generations. It seems that we need to realise that there is a conflict between what science now tells us and the childcare customs of modern society.

Dr Elizabeth Bland