

#### **Centre for Community Child Health**





## Research on brain development: Implications for early childhood services

Professor Frank Oberklaid September 4, 2012









## **Outline of presentation**

- Brain development research the science tells us that the early years are critical in shaping a child's future learning and behaviour
- Life course research what happens in the early years has consequences into school and right through the life course into adult life
- For many children, the developmental trajectory is set well before they start school - data show that many children are already in trouble or vulnerable at school entry
- Implications for individuals and for society
- We need to close the gap between what we know and what we do

#### What the research tells us



- The early years of a child's life are critical in impacting on a range of outcomes through the life course
- The environment experienced by a young child literally sculpts the brain and establishes the trajectory for long term cognitive and social-emotional outcomes
- If we want to improve outcomes in adult life we have to focus on the early years - this has profound implications for public policy
- Investing in early childhood is a sound economic investment ('the best investment society can make')



## Children's development

- Development is the result of complex, ongoing, dynamic transactions between nature and nurture - a dance between biology and experience
- We cannot do much to change biology but we can change the environment in which young children grow and develop
- Optimal development dependent on good environment nutrition, good health, nourishing and stimulating parenting, etc

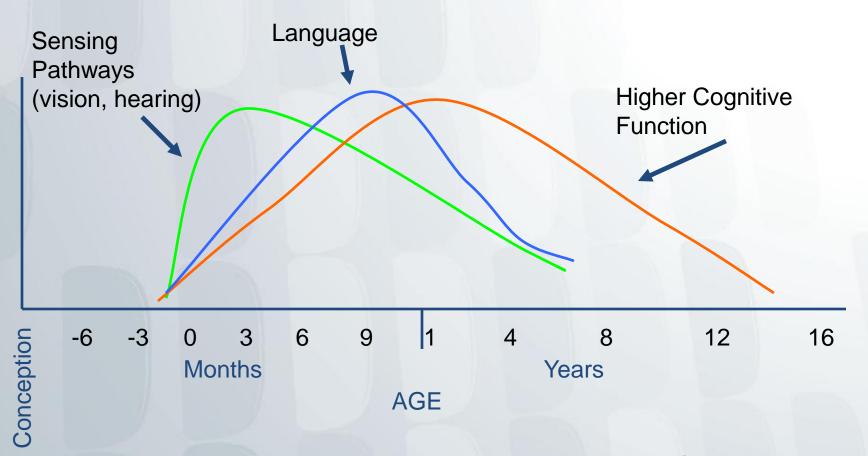
# The neuroscience of brain development



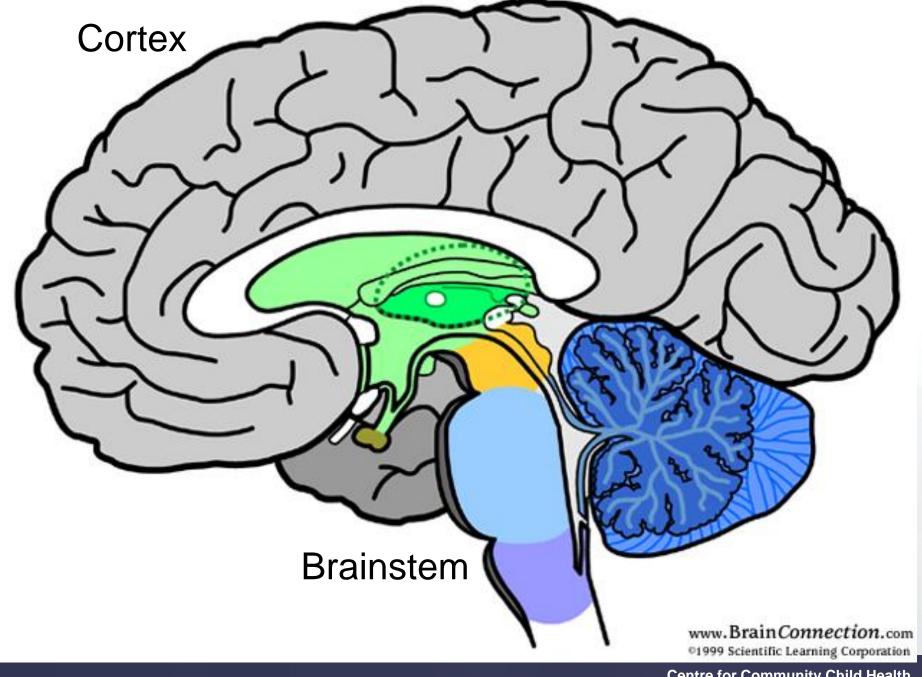
- Brain architecture and skills are built in a hierarchical 'bottom-up' sequence
- Foundations important higher level circuits are built on lower level circuits
- Skills beget skills the development of higher order skills is much more difficult if the lower level circuits are not wired properly
- Plasticity of the brain decreases over time and brain circuits stabilise, so it is much harder to alter later
- It is biologically and economically more efficient to get things right the first time

# Human brain developmentsynapse formation

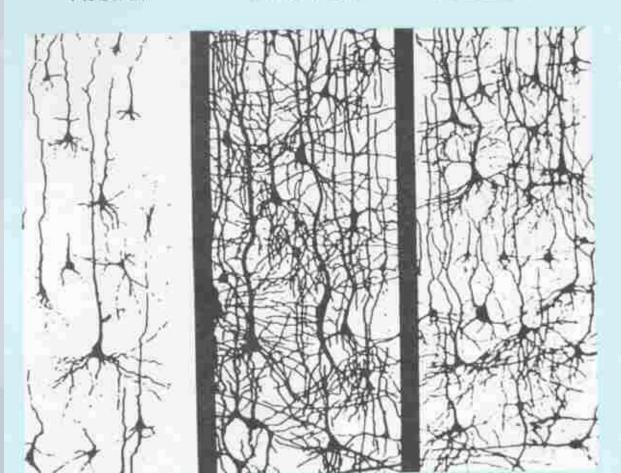




- C. Nelson, 2000



At Birth 6 Years Old 14 Years Old



SYNAPTIC DENSITY: Synapses are created with astonishing speed in the first three years of life. For the rest of the first decade, children's brains have twice as many synapses as adults' brains. Drawings supplied by H.T. Chugani.



## The importance of relationships

- Nurturing and responsive relationships build healthy brain architecture that provides a strong foundation for learning, behaviour and health
- The relationships a young child has with their caregiver(s) literally sculpts the brain and influences the development of neural circuits
- When relationships are dysfunctional, levels of stress hormones increase - this interferes with formation of healthy neural circuits, and disrupts brain architecture

#### **Positive stress**



- Moderate and transient stress responses results in mild increases in stress hormone levels and short lived increases in heart rate
- Precipitants include the challenges of new people and situations, dealing with frustration, adult limit setting, the pain of a fall or injection
- Important part of healthy development as it occurs in the context of stable and supportive relationships





- Stress responses that can disrupt brain architecture, but are buffered by supportive relationships that facilitate adaptive coping
- Precipitants include death or serious illness of a loved one, parent divorce, witnessing a frightening event, major trauma or illness, a natural disaster, homelessness
- Generally time limited, so gives the brain opportunity to recover from potentially damaging effects

#### **Toxic stress**



- Strong and prolonged activation of body's stress response in absence of buffering protection of adult support
- Precipitants include extreme poverty, physical or emotional abuse, chronic neglect, severe maternal depression, substance abuse, family violence
- Disrupts developing brain architecture and leads to lower threshold of activation of stress management systems can lead to life long problems in learning, behaviour, and both physical and mental health





- Problems in childhood
- Beginning of pathways to problems later in life
- Evidence that many problems in adult life –
  including mental health problems have their origins
  in pathways that begin in childhood

## Worrying problems in childhood

- Child abuse and neglect
- School readiness many children vulnerable
- Poor literacy and school achievement
- Mental health problems ADHD, conduct disorders, aggressive and anti-social behaviour
- Obesity

## Adult problems with roots in early childhood



- Mental health problems
- Family violence and anti-social behaviour
- Crime
- Poor literacy
- Chronic unemployment and welfare dependency
- Substance abuse
- Obesity
- Cardiovascular disease
- Diabetes



## The Adverse Childhood Events (ACE) Study



## If ACE score more than 4, then...

•	Smoking:	x 2
•	Alcoholism:	x 7
•	Cancer:	x 2
•	Heart disease:	x 2
•	Ch. lung disease:	x 4
•	Attempted suicide:	x12
•	I/V drug use (men):	x 46

<sup>\*</sup> Compared to ACE score of 0



## **Adversity**

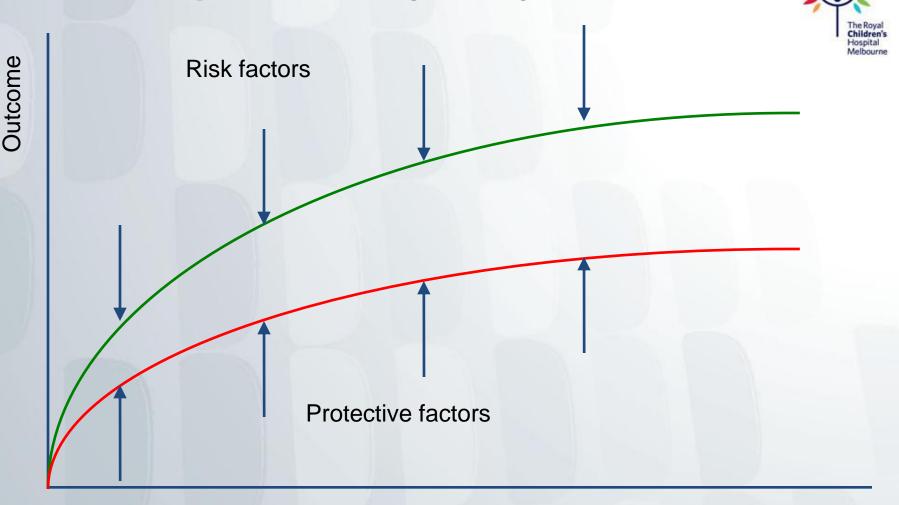
Any adversity that impacts on the parents or caregivers has the potential to have a negative impact on brain development in the young child and therefore act as a risk factor for the health and development of the child





- Leads to changes in DNA (methylation)
- 'Biological embedding of environmental events' (Hertzmann)
- Affects the development of biological systems
  - Immune
  - Cardiovascular
  - Metabolic regulatory
- What appears to be a social situation is likely to be a neurochemical situation - intergenerational nature of disadvantage and social exclusion

#### The developmental trajectory and life courses



Age

## Risk factors in the child's environment



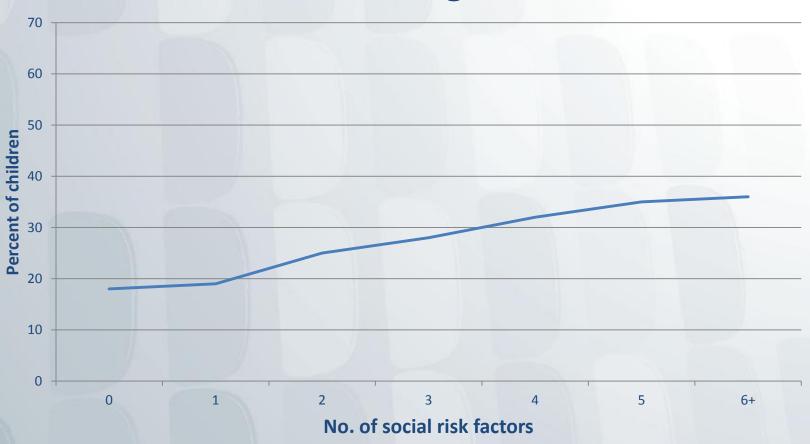
- Parents and family: include low parental education, parental mental illness, social isolation, poverty and its associations - poor housing and poor access to services
- Community: include quality of and access to services, child care and early education, schooling, support for parents, extent and quality of intervention services



- Less than high school education
- Low family income
- Single parent household
- Black/Hispanic
- Uninsured
- Family conflict
- Poor maternal mental health
- Unsafe neighbourhood
  - From Larson K et al. Pediatrics 2008

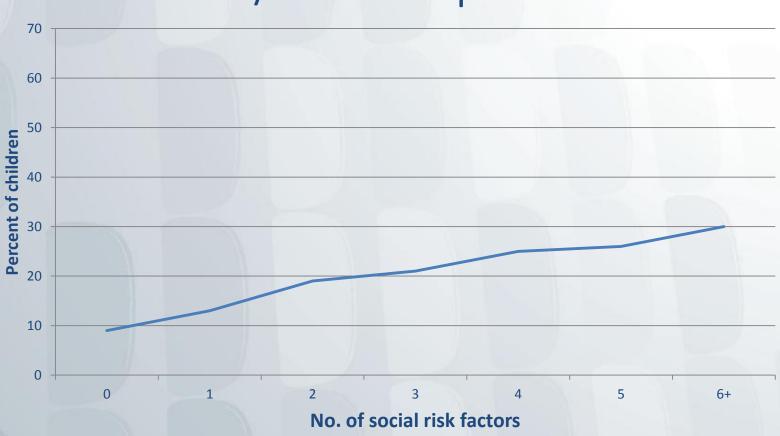


#### Overweight



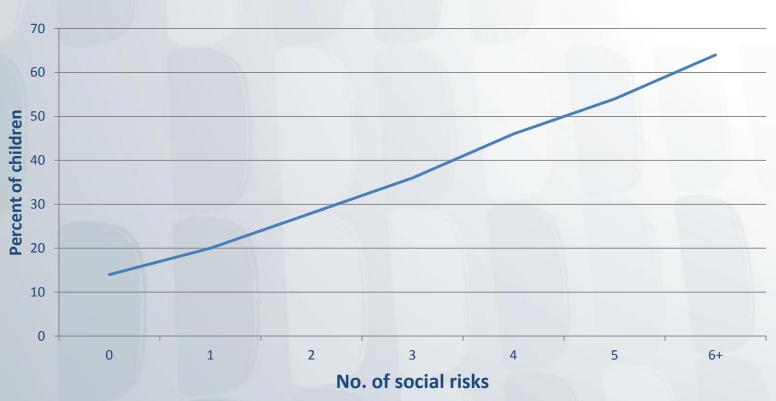


#### Social/emotional problems



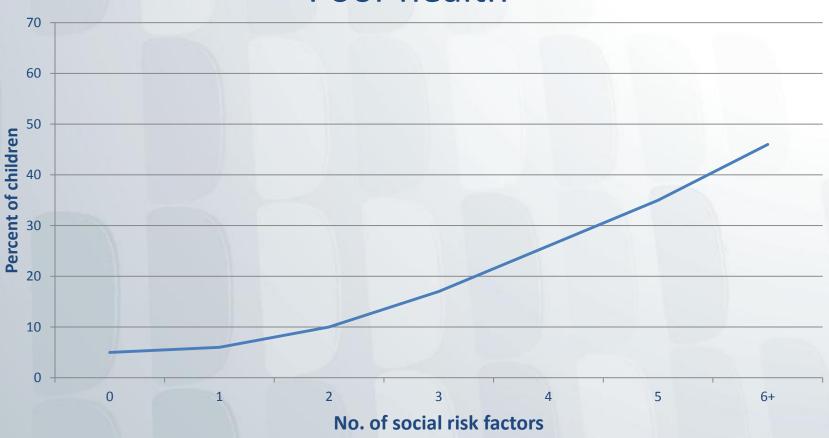


#### Poor teeth



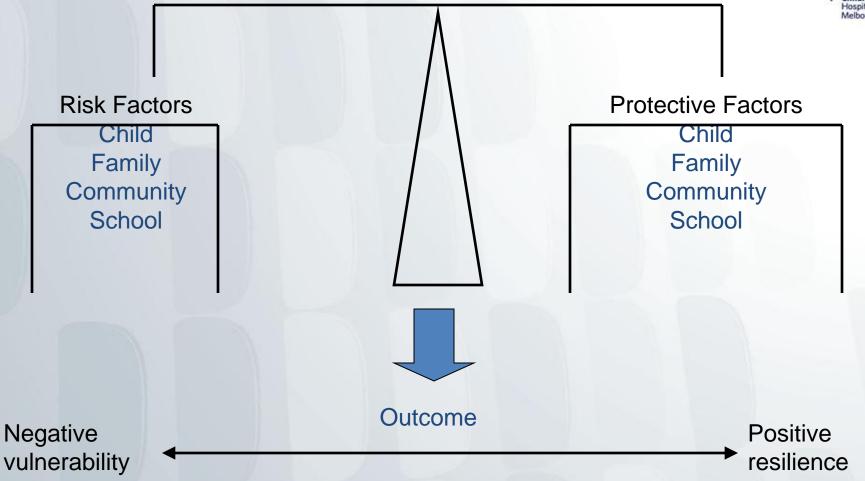


#### Poor health



## Risk and protective factors

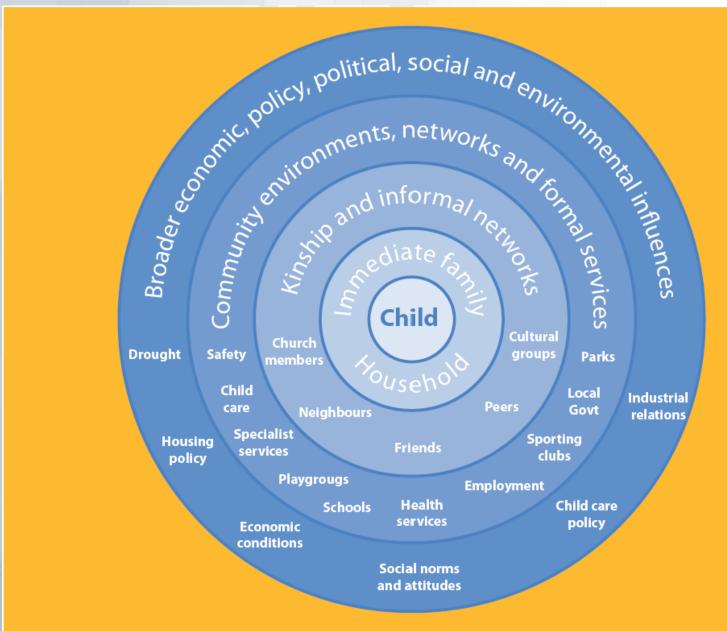




## The ecology of child development

The Royal Children's

Hospital



Reference: Bronfenbrenner (1979).

## The impact of social inequality

- The Royal Children's Hospital Melbourne
- Psychosocial factors impact on health because of association with frequent/recurrent stress
- Major impact in early years affects developing brain and establishment of neural circuits
- Chronic stress affects the body's physiological systems

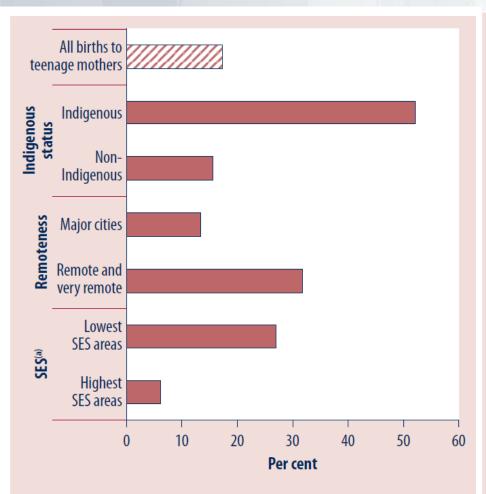
   including the cardiovascular and immune systems increasing vulnerability to wide range of diseases and health conditions
- 'Double jeopardy' have the least access to supports such as consistent health care, quality childcare and preschool, good schools, and family supports



# Health and developmental inequalities

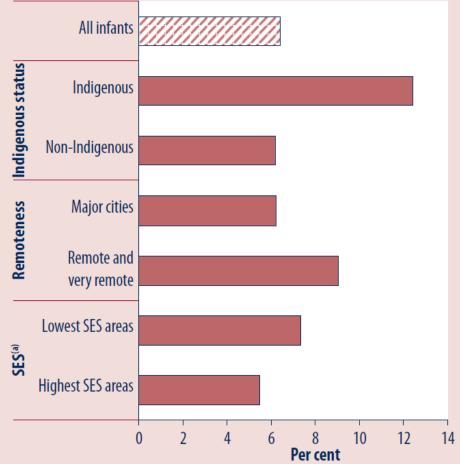


## **Antenatal**



(a) See *Appendix 1 Methods* for explanation of socioeconomic status (SES). *Note:* Remoteness and socioeconomic status based on mother's usual place of residence. *Sources:* Laws & Hilder 2008; AIHW National Perinatal Data Collection, unpublished data.

Figure 19.2: Women who smoked during pregnancy, by population group, 2006



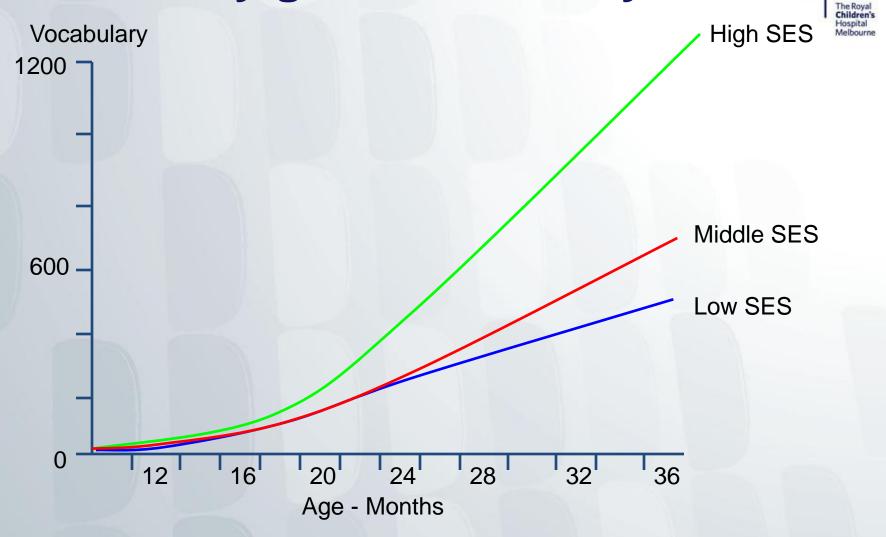
(a) See *Appendix 1 Methods* for explanation of socioeconomic status (SES). *Source:* AIHW National Perinatal Data Collection.

Figure 21.3: Low birthweight infants, by population group of mother, 2006

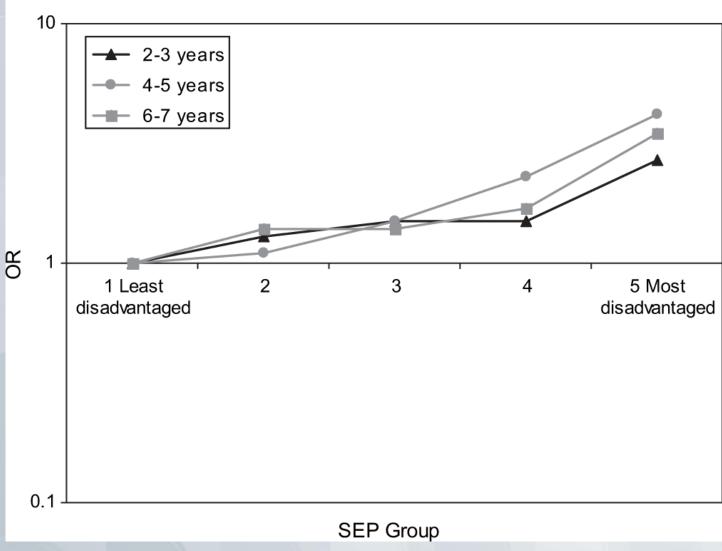


## **Preschool**

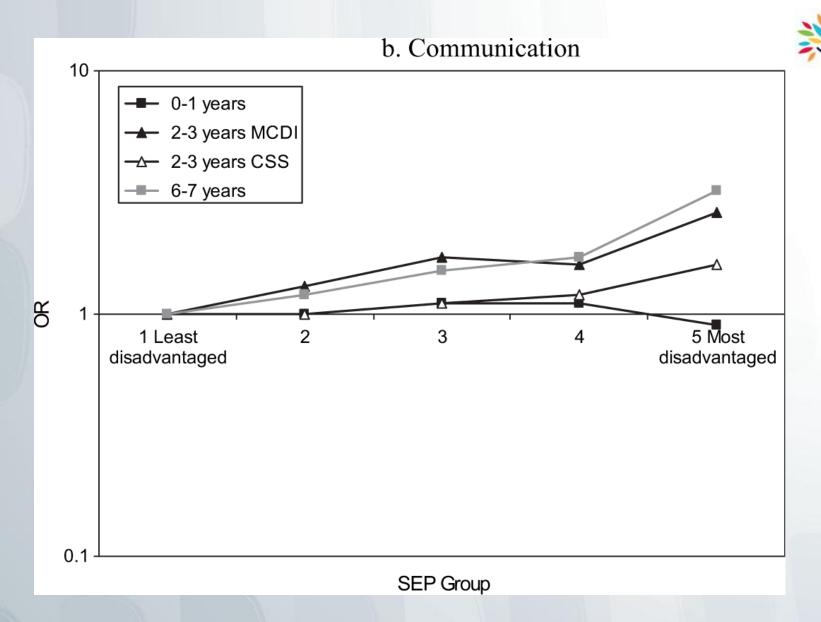
## Vocabulary growth - first 3 years



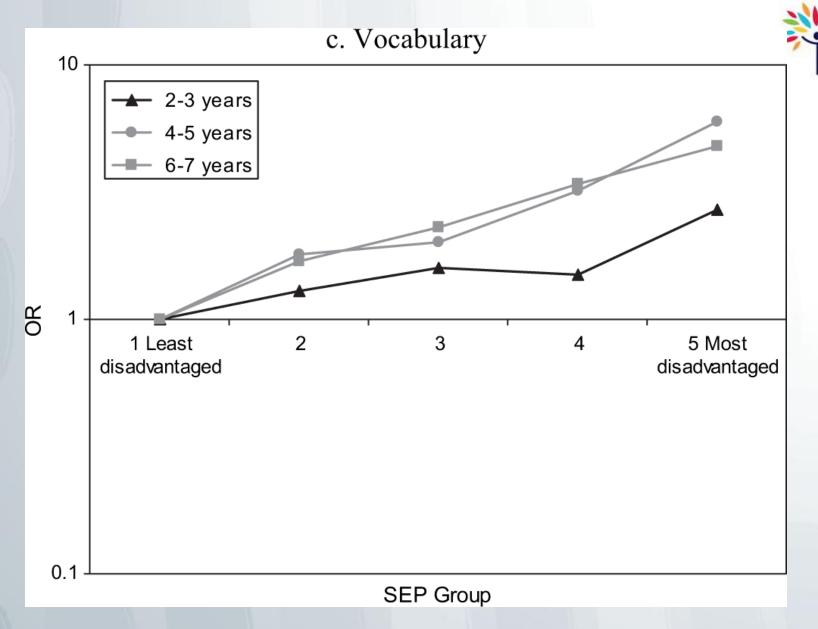
#### a. Socio-emotional difficulties



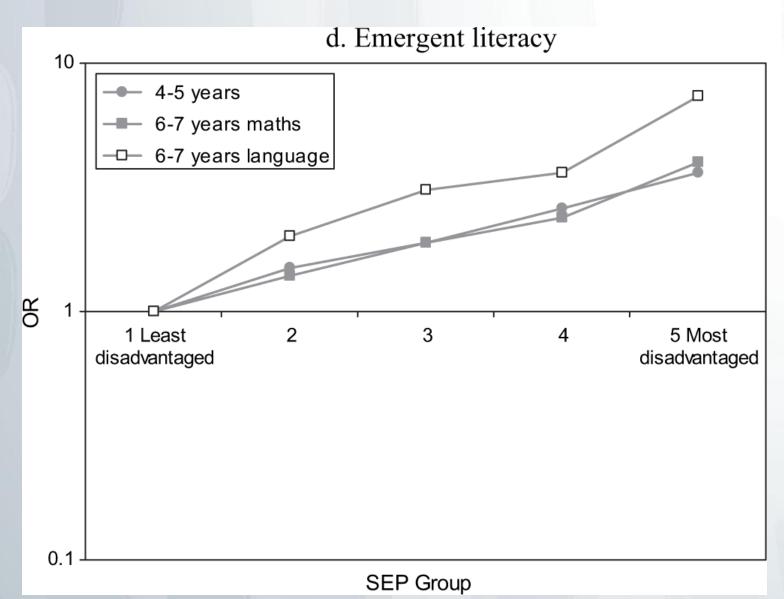
OR by socioeconomic position quintile for socio-emotional difficulties



OR by socioeconomic position quintile for socio-emotional difficulties



OR by socioeconomic position quintile for socio-emotional difficulties
Nicholson JM, Lucas N, Berthelsen D, et al. *J Epidemiol Community Health (2010)*, doc 10.1136/jech.2009.103291





OR by socioeconomic position quintile for socio-emotional difficulties



### **School entry**

### **Australian Early Development Index (AEDI)**

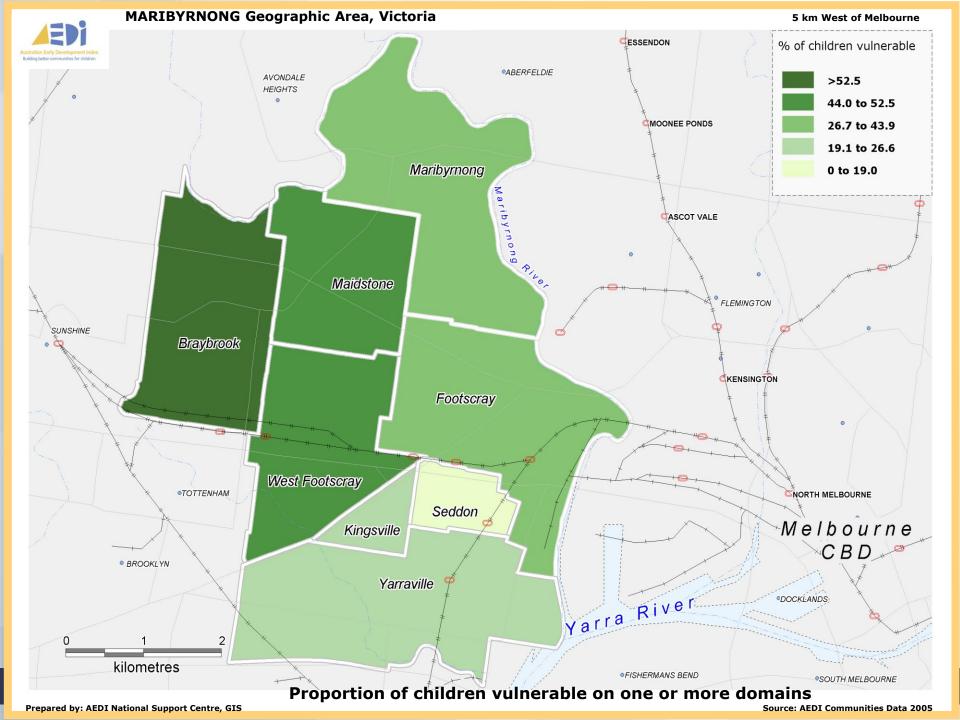


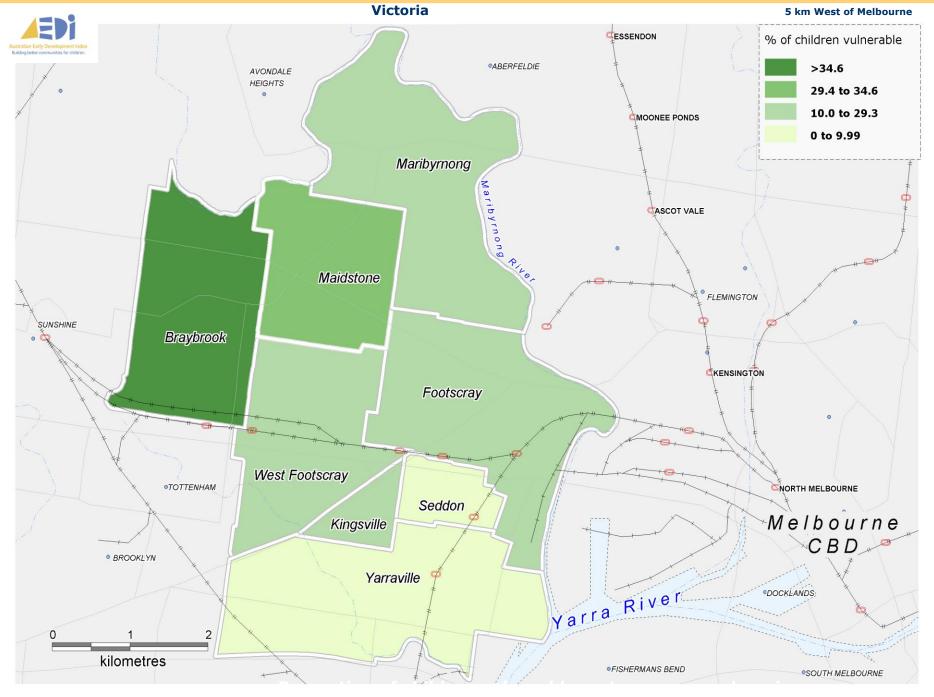
- A population based measure which provides information about children's health and wellbeing
- 100+ questions covering 5 development domains considered important for success at school
- Teachers complete the AEDI online for each child in their first year of full-time schooling
- Results are provided at the postcode, suburb or school level and not interpreted for individual analysis

#### Five AEDI 'subscales'



- The AEDI measures a child's development in 5 areas:
  - physical health and well-being
  - social competence
  - emotional maturity
  - language and cognitive development
  - communication skills and general knowledge







#### **AEDI National Rollout 2009**

•	Number	of	communities	660
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Number of schools 7,423

% of schools completed 95.6%

Number of teachers 15,528

Number of students 261,203

% of students completed 97.9%

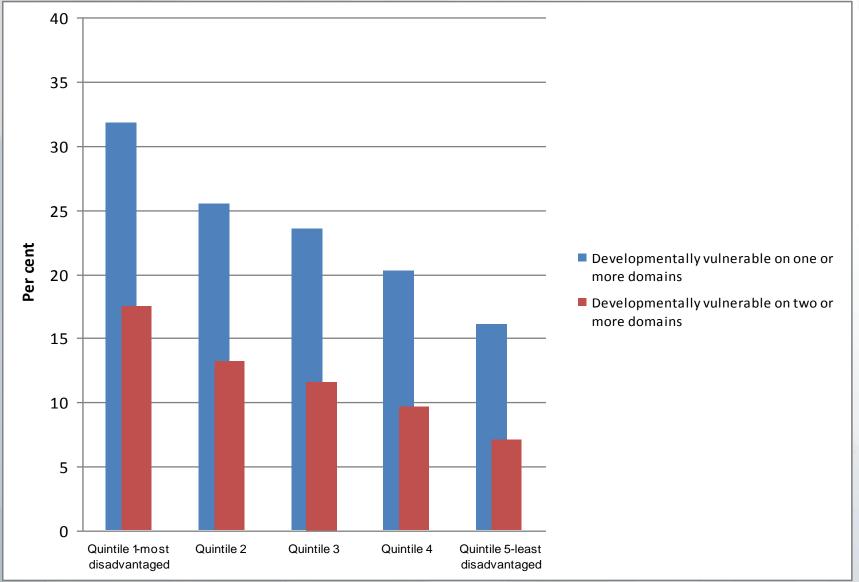
**Key Findings** 

Percentage of children developmentally vulnerable (DV)

	DV ≥ 1 domains (%)	DV ≥ 2 domains (%)
Australia	23.3	11.7
New South Wales	21.2	10.2
Victoria	20.1	9.9
Queensland	29.2	15.6
Western Australia	24.3	12.0
South Australia	22.5	11.4
Tasmania	21.7	10.8
Northern Territory	36.3	22.1
Australian Capital Territory	21.9	10.8

# Results: Socio-economic status

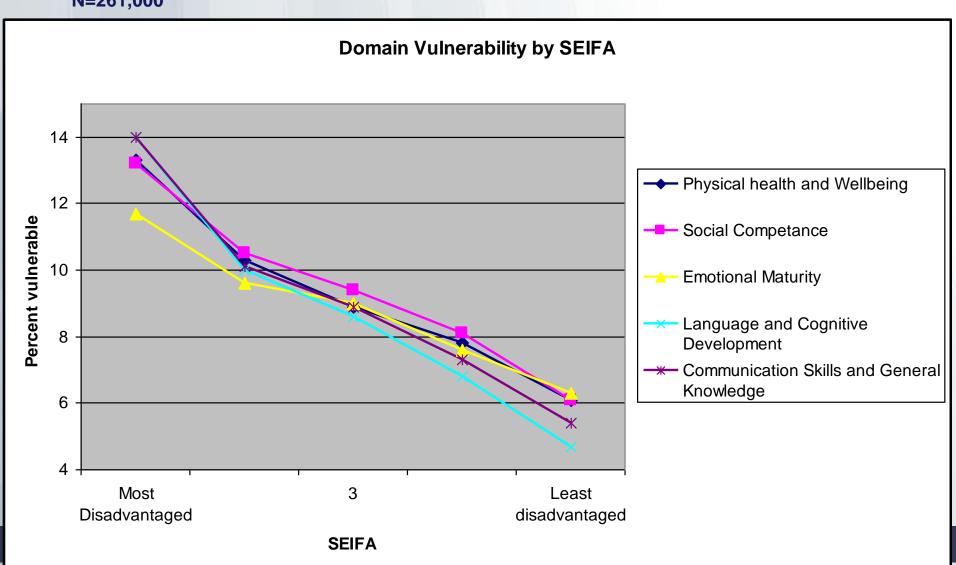




# **AEDI Domain comparison – vulnerability by SEIFA**

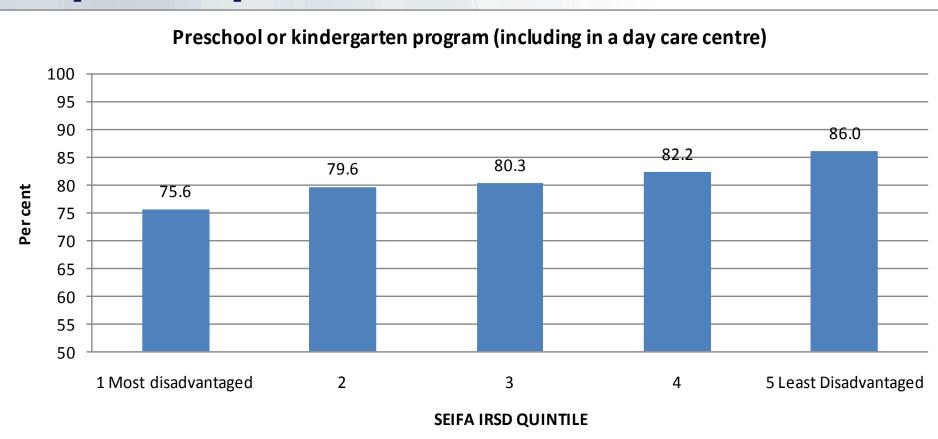


N=261,000



# Disadvantage and preschool participation

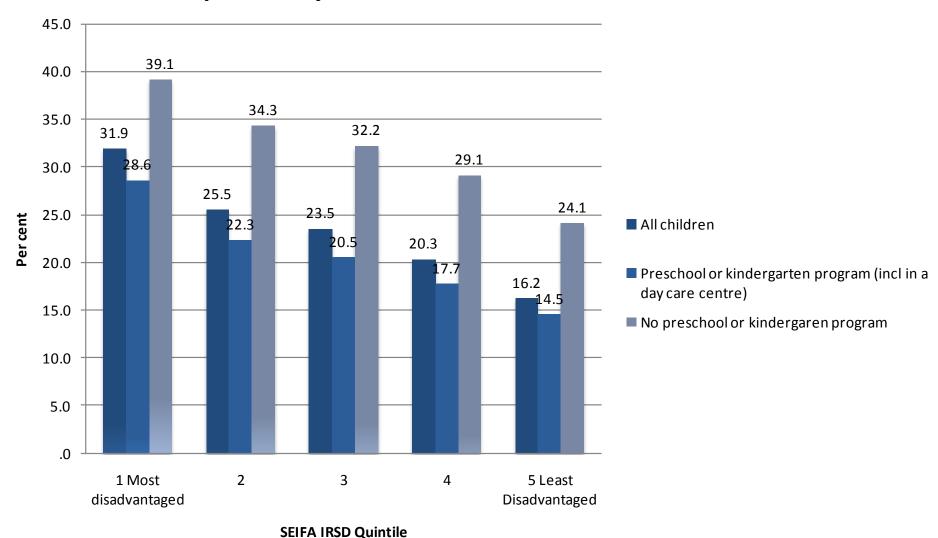




## AEDI results and preschool participation



#### Developmentally vulnerable on one or more AEDI domain





# The importance of skills in the modern economy

'A large body of research...shows that skill begets skill; that learning begets learning. The earlier the seed is planted and watered, the faster and larger it grows. Environments that do not stimulate the young and fail to cultivate both cognitive and non-cognitive skills place children at an early disadvantage'.

(James Heckman, 2006)





'Once a child falls behind, he or she is likely to remain behind. .... Impoverished early environments are powerful predictors of adult failure on a number of social and economic dimensions.'

(James Heckman, 2006)

### Ability gaps open early in life



'Ability gaps between advantaged and other children open up early before schooling begins. Conventional school based policies start too late to completely remedy early deficits, although they can do some good. Children who start ahead keep accelerating past their peers, widening the gap... Early advantages accumulate, so do early disadvantages... The best way to improve the schools is to improve the early environments of the children sent to them.'

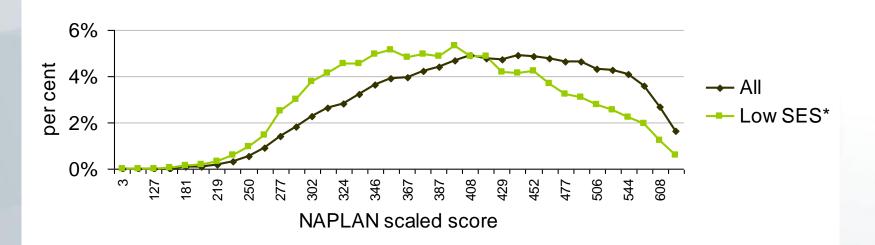
(Heckman J. & Masterov DV, 2005)



### **NAPLAN**

# A comparison of NAPLAN scores for low SES and all students





<sup>\* &</sup>quot;low SES" defined as occupation of parent is ... machine operator, hospitality staff, assistant, labourer or related worker, or not in paid work in last 12 months

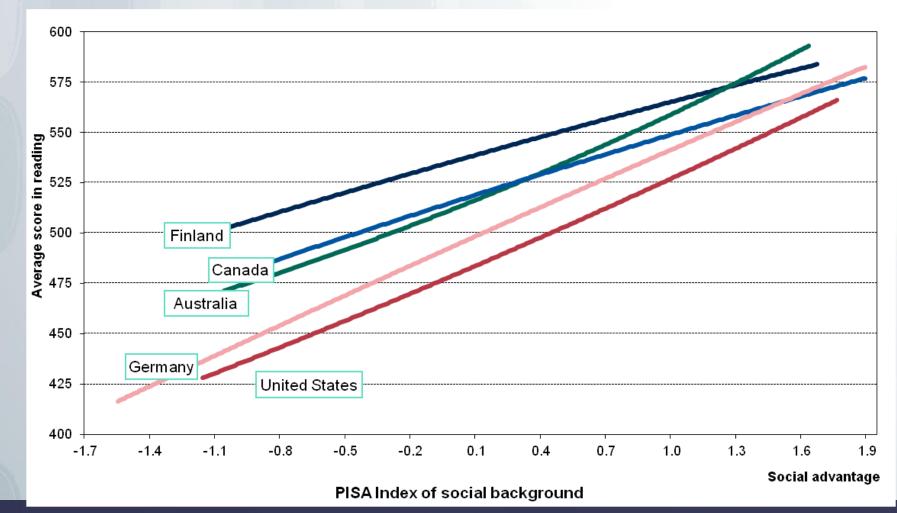
2009 year 3 NAPLAN Victoria



### **School trajectories**

## Relationship between social background and achievement in PISA 2003 reading







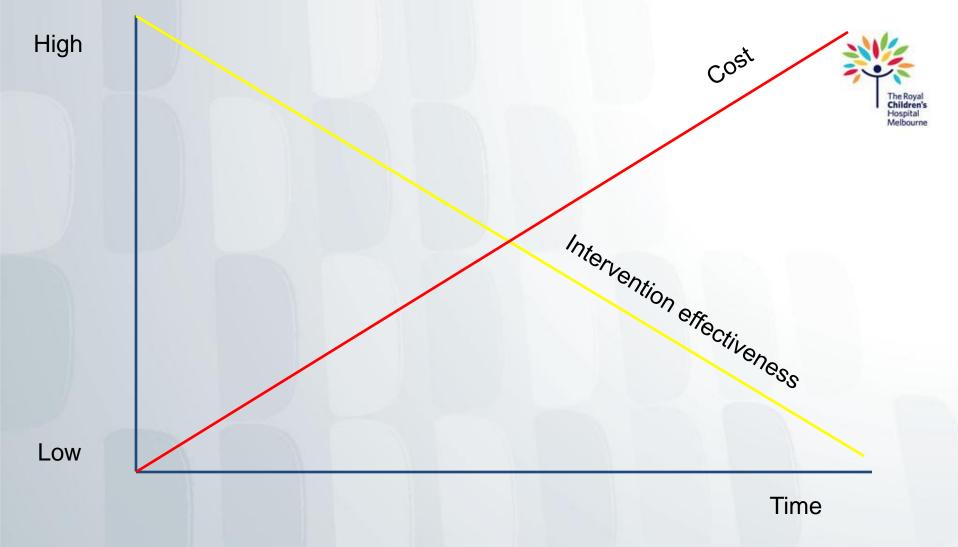
#### So what are the answers?

- · 'Different, rather than more.'
- Need major shift in public policy, focusing not just on treatment but also on prevention and early intervention (fence on top of cliff rather than more ambulances at the bottom)
- There is evidence from successful demonstration programs that early intervention works - ie the research tells us how to build the fences

### Making a difference



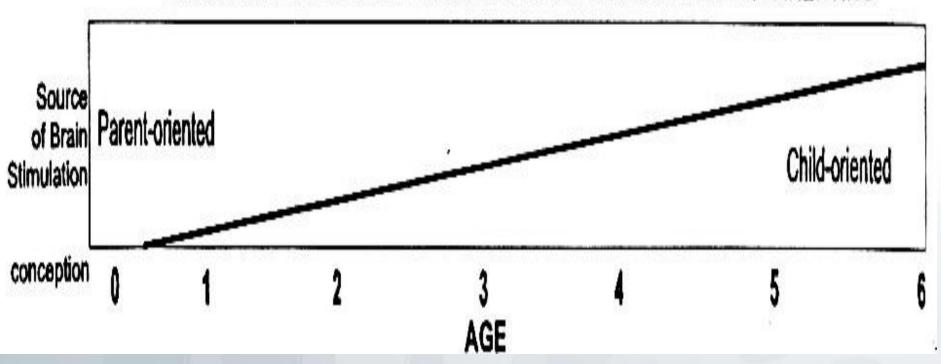
- Address risk factors and emerging difficulties before they become entrenched problems
- Goal is to diminish or remove risk factors and strengthen protective factors, so improving chances of good outcome
- The earlier the better more leverage in younger years



Intervention effects and costs of social-emotional mental health problems over time (Bricker)



#### FIGURE 6.1 FRAMEWORK FOR EARLY CHILD DEVELOPMENT & PARENTING

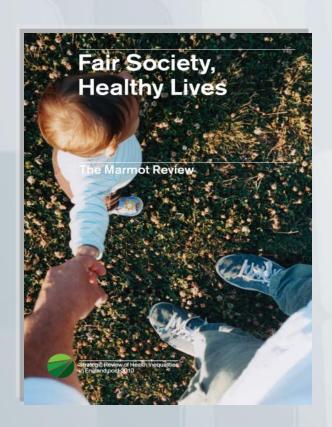




'Complex social issues cannot be dealt with merely by interventions with children or by strengthening families or by building community capacity. Policy needs an integrated focus on all 3 elements: children, families and communities.'

- A. Hayes, M Gray, AIFS, 2008





Focusing solely on the most disadvantaged will not reduce health inequalities sufficiently. To reduce the steepness of the social gradient in health, actions must be universal, but with a scale and intensity that is proportionate to the level of disadvantage. We call this proportionate universalism.



Effort is devoted to identifying and managing the high risk group



risk amongst the entire population

# Implications of the science of early childhood



- Education
- Parents and families
- Communities and the built environment
- Child care
- Child protection system
- Services
- Business
- Media
- An expanded view of building infrastructure

# Can schools remedy early disadvantage?



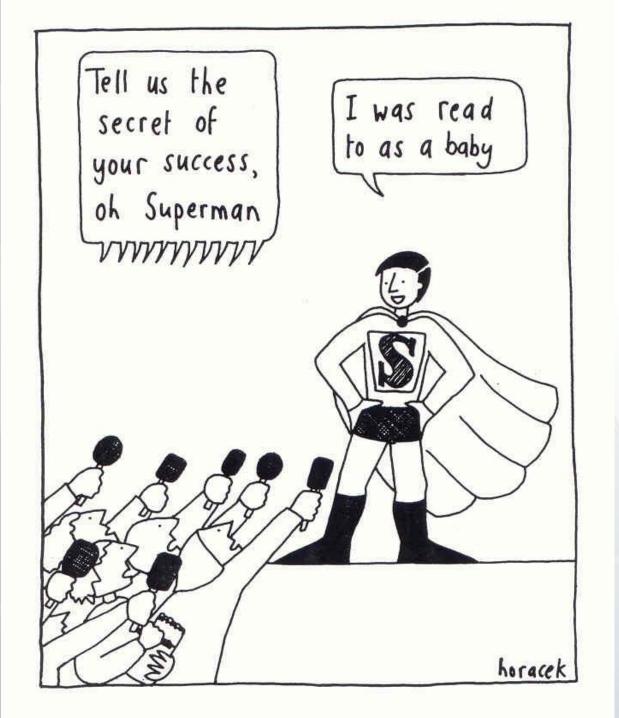
'Research suggests (Coleman 1996) that schools and school quality contribute little to the emergence of test score gaps among children - families, not schools, are the major sources of inequality in student performance. By the second grade, gaps in test scores across socioeconomic groups are stable by age, suggesting that later schooling has little effect in reducing or widening the gap that appears before students enter school'.

(James Heckman, 2006)

#### Impact of poor literacy



- Poor school performance, low self esteem and reduced adult life chances
- Generally lower employment and social outcomes
- Higher rates of welfare dependence, high risk behaviours and teenage parenting
- Poor health literacy and increased risk of poor health outcomes





### Barriers to learning - 3 groups



- No barriers to learning will do well regardless
- Severe barriers generally have access to special services which begin prior to formal schooling
- Subtle to moderate barriers to learning and school success - may elude early detection, and intervention often delayed until problems entrenched and difficult to treat

### What are the barriers to learning? Biological and/or environmental



- Chronic medical conditions
- Developmental weaknesses language, memory, visual-motor integration, etc
- Attentional and behavioural problems and
- Poor environmental circumstances in the early years

#### **Parents and families**



- Information about child's health, development and behaviour - what to expect and what to do -'responsive' parenting
- Support parents as individuals
  - Address personal issues relationships, financial stresses, ill-health, housing, depression
  - Family friendly workplaces leave provisions
  - Security of employment

# Communities and the built environment



- Community can be effective buffer against stress
- Create child friendly communities
  - Access to services eg children's centres
  - Child oriented workplaces, organisations, community settings - child care, schools, libraries, parks, transport, pubs, pools, shopping facilities...
- Social connectedness
- Schools matter

#### **Child care**



- Early learning environment not child minding
- Universal access to everyone, especially disadvantaged - cost and availability should not be a barrier
- Quality vital staff ratios, physical amenities, and especially expertise of caregivers
- Need radical rethink of training, pay and conditions, and career structure of child care workers



## Rethinking child care

Refocus child care based on three sets of relationships

- With children training and quality of services
- With parents health promotion and early detection of problems
- With community child care as platform

# Refocusing child care - relationships with children



- Brain development research
- Relationships with caregivers program brain development
- Experiences in early years influence developmental trajectory and life course
- Expertise of providers and quality of child care services is critical





- Modelling for parents
- Credible advice and guidance on child development, behaviour and health
- Early detection of problems and risk factors
- Early referral to community agencies and professionals

# Refocusing child care – relationships with community

- Reconceptualise child care as an early learning environment and platform
- Establish links with other providers and service systems - MCH (community) nurses; GPs; preschools
- Develop links with community agencies and resources - libraries; service organisations

## **Child protection system**



- Highest risk segment of early childhood and parent population
- Services should reflect needs of children rather than families (or the legal system)
- Virtually all families need ongoing, intensive (early) intervention
- Virtually all children need referral to early intervention and early education services
- Need strong links between welfare system and early intervention system

### Infrastructure of existing services



- Child care
- Family day care
- GPs
- MCH nurses
- Preschool
- School
- Specialist services
- Parenting programs

- Neighbourhood houses
- Family support
- Telephone counselling
- Family violence
- Problem gambling
- Child protection
- Adoption/foster care
- Mental health services

**Fragmentation of services** 

Child health information

Family support

Childcare



School

Parenting programs

**Preschool** 

Early intervention programs

Pediatrician

Disability services

Child protection agency

Kindergarten

Children's library services

Linking services Child health Childcare Family support information Child protection agency School Early intervention programs **Parenting** Kindergarten programs Pediatrician **Preschool** Children's library Disability services

Integrating services Child health Childcare Family support information Child protection School agency Early lidtervention Peramy Hub **Parenting** Kindergarten programs Pediatrician Preschool Children's library Disability services

#### Media

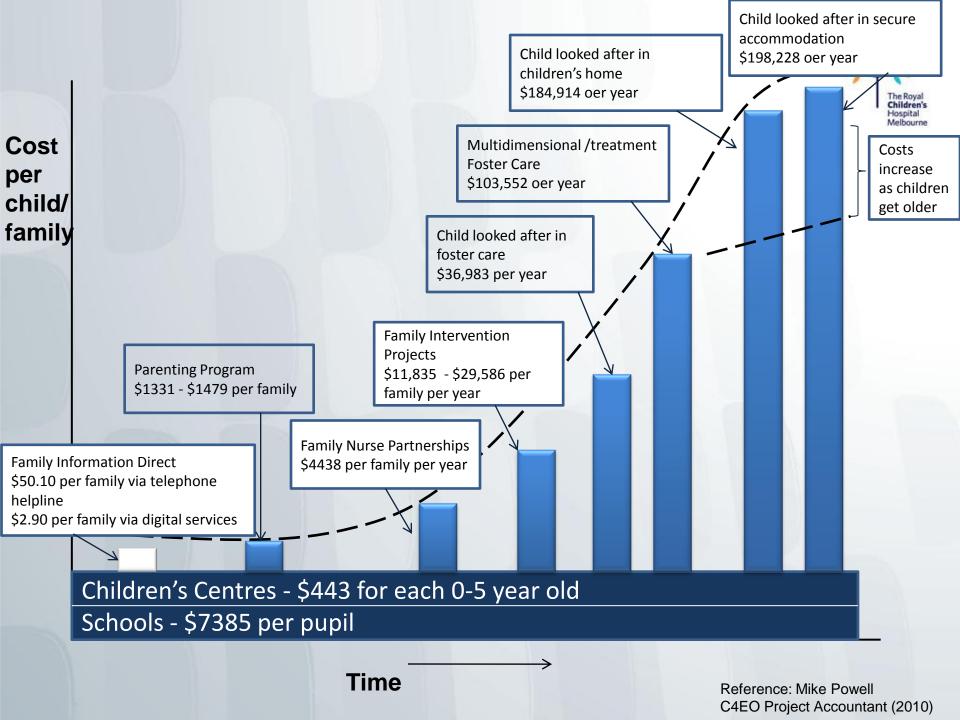


- Important role to play
- Need a more sophisticated approach to major issues such as child care, education, addressing social gradient, tackling disadvantage
- Early childhood issues beginning to move from women's pages and parenting magazines to financial pages
- Need media to help with translation and dissemination of the research about the importance of the early years

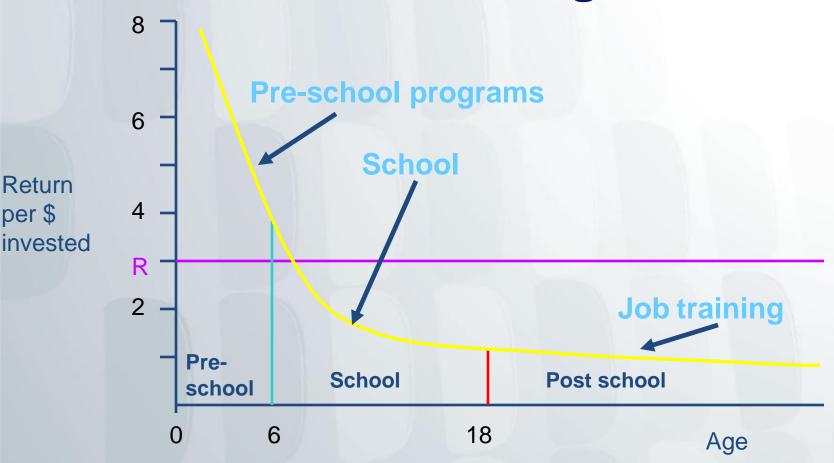
#### **Business**



- Will understand the importance of early childhood concerned less with the cost of programs and services but rather the return on investment
- Business sector has two parallel sets of interests
  - Macro level (broad economic): skilled and educated workforce, social capital, international competitiveness, preservation of democratic institutions and fair society
  - Micro level (workplace): attraction and retention of skilled staff, productivity, work life balance



# Rates of return to human development investment across all ages



Pedro Carneiro, James Heckman, Human Capital Policy, 2003

# **Building infrastructure - human** capital



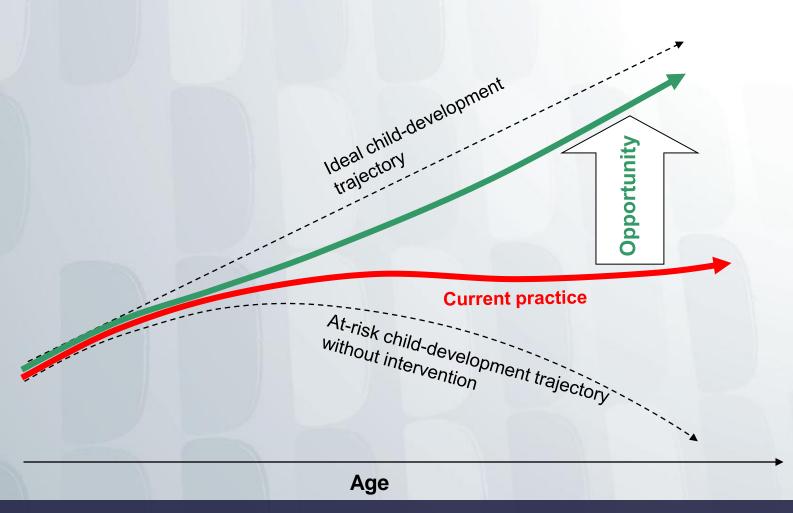
'The implications of this rapidly evolving science for human capital formation are striking. The workplace of the 21st century will favor individuals with intellectual flexibility, strong problem solving skills, emotional resilience, and the capacity to work well with others in a continuously changing and highly competitive economic environment. In this context, the personal and societal burdens of diminished capacity will be formidable, and the need to maximize human potential will be greater than ever before.'

- Knudsen El, Heckman JJ, Cameron JL, Shonkoff JP (2006)

Proceedings of National Academy of Sciences

### Developmental health - Aims





### Sustainable solutions (Dr. Julius



Richmond)

- 1. Knowledge base
- 2. Political will
- 3. Social strategy

#### Conclusion



- Promoting the healthy development of children is both an ethical imperative and a critical economic and social investment
- Our agenda for the 21st century has to be the application of science to policy and practice - to close the gap between what we know and what we do



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  - www.rch.org/ccch