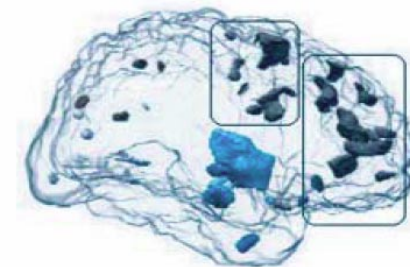
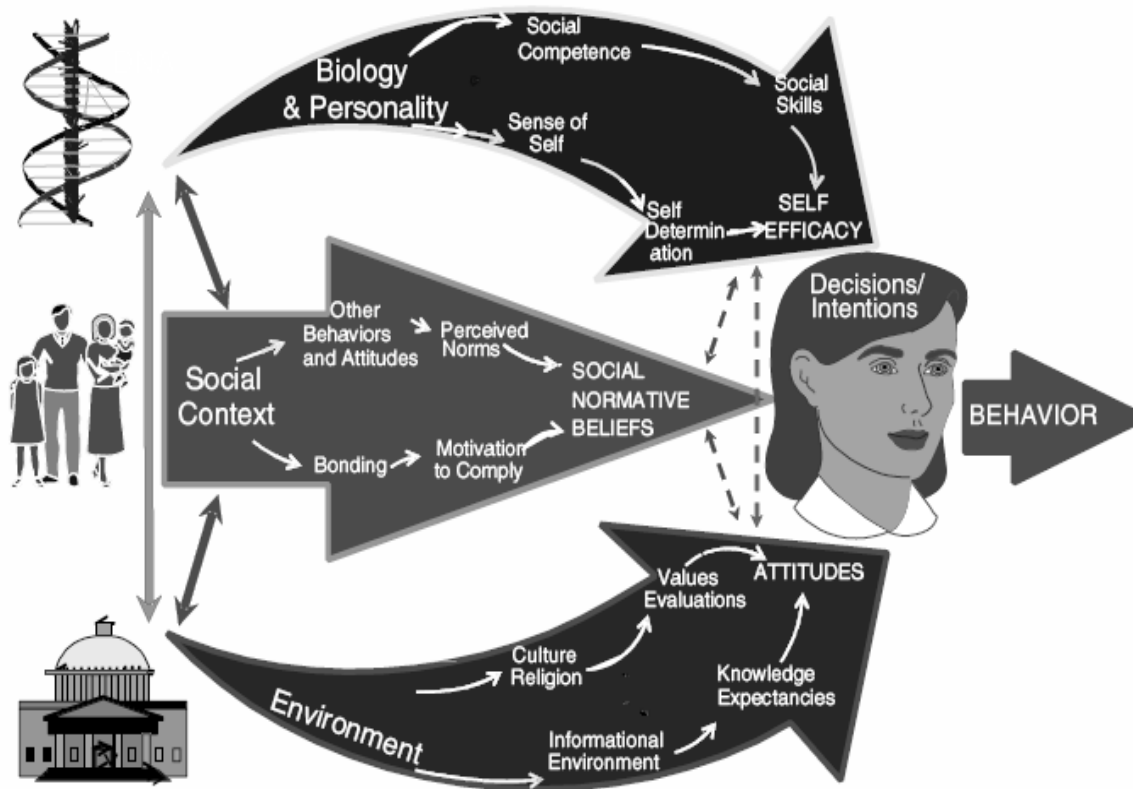


TRIADIC INFLUENCE



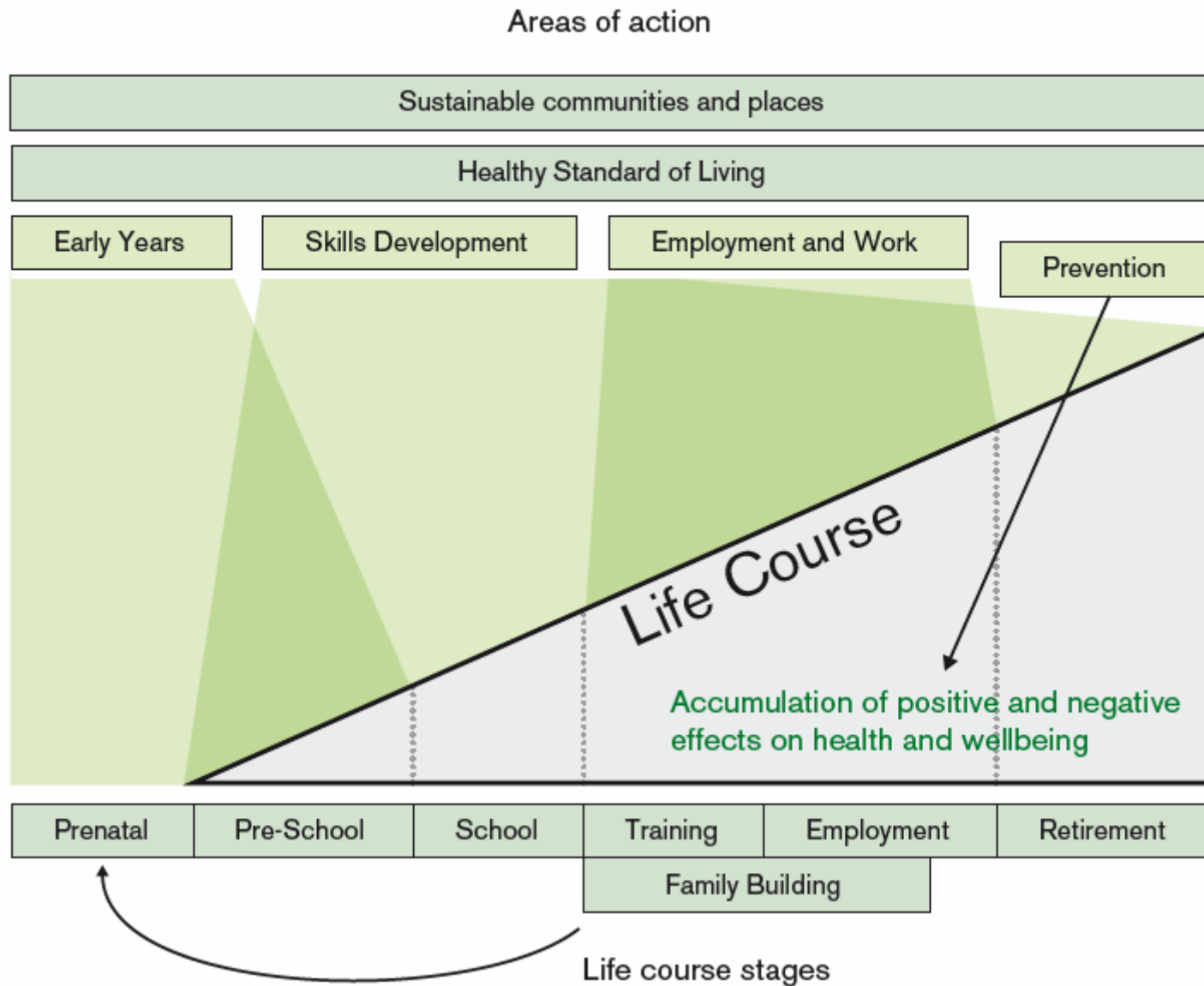
A three dimensional "map" showing portions of gray matter "pruned" from the brain between adolescence and adulthood. The dark portions in the two boxes indicate sections that will be discarded from the frontal lobe. The box on the far right indicates the prefrontal cortex, a subsection of the frontal lobe that controls judgment.
Image adapted from *Nature Neuroscience*.

Use-dependent Brain

FIGURE 4-1 The basics of the theory of triadic influence.
SOURCE: Flay (2005).

Gene → Temperament → Environment → Behaviour →
Neuro-biological changes in brain → Practices

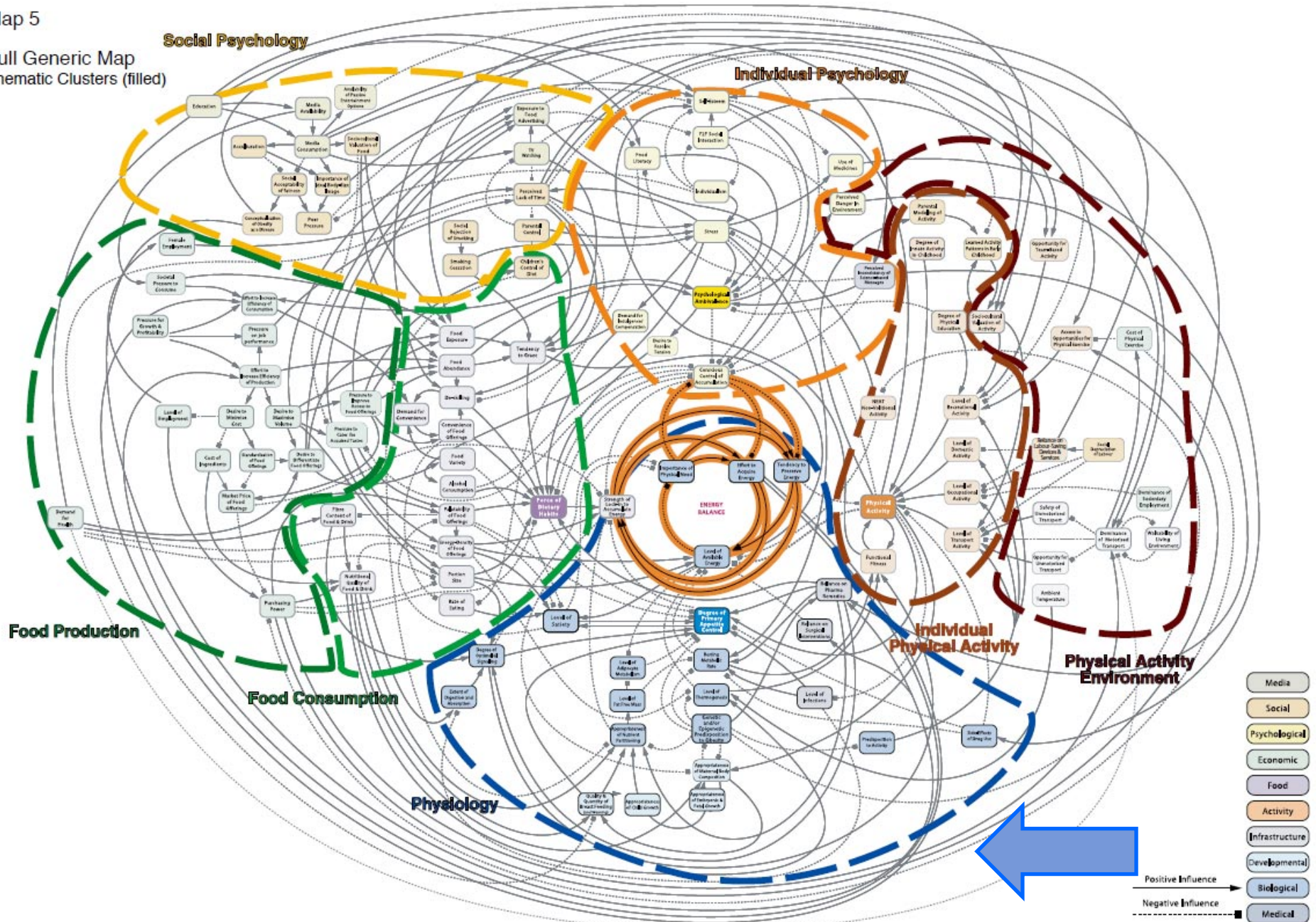
Figure 5 Action across the life course



OBESITY

Map 5

Full Generic Map
Thematic Clusters (filled)



OBESITY

Map 27

Weighted
Causal Linkages

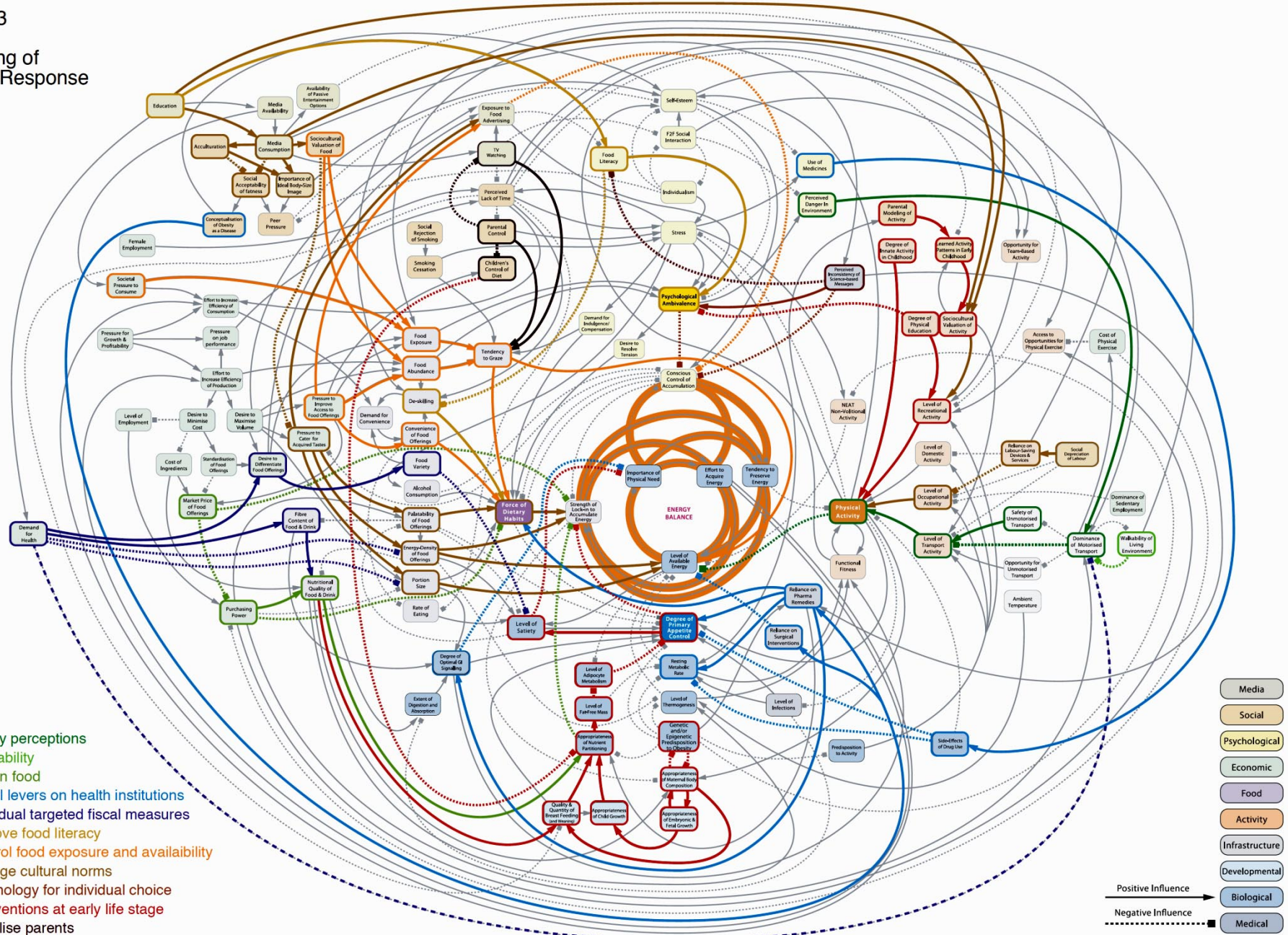
Strength of the Impact

- Very High (4.5-5.0)
- High (4.0-4.4)
- Medium (3.5-3.9)
- Limited (3.0-3.4)
- Low to None (0-2.9)
- (grey = no information)



Map 33

Mapping of Policy Response Ideas



Appendix 2. Excess Health Risks Associated with Not Breastfeeding

Outcome	Excess Risk* (%) (95% CI [†])	Comparison Groups
<i>Among full-term infants</i>		
Acute ear infections (otitis media) ²	100 (56, 233)	EFF [‡] vs. EBF [§] for 3 or 6 mos
Eczema (atopic dermatitis) ¹¹	47 (14, 92)	EBF <3 mos vs. EBF ≥3 mos
Diarrhea and vomiting (gastrointestinal infection) ³	178 (144, 213)	Never BF [¶] vs. ever BF
Hospitalization for lower respiratory tract diseases in the first year ⁴	257 (85, 614)	Never BF vs. EBF ≥4 mos
Asthma, with family history ²	67 (22, 133)	BF <3 mos vs. ≥3 mos
Asthma, no family history ²	35 (9, 67)	BF <3 mos vs. ≥3 mos
Childhood obesity ⁷	32 (16, 49)	Never BF vs. ever BF
Type 2 diabetes mellitus ⁶	64 (18, 127)	Never BF vs. ever BF
Acute lymphocytic leukemia ²	23 (10, 41)	Never BF vs. >6 mos
Acute myelogenous leukemia ⁵	18 (2, 37)	Never BF vs. >6 mos
Sudden infant death syndrome ²	56 (23, 96)	Never BF vs. ever BF
<i>Among preterm infants</i>		
Necrotizing enterocolitis ²	138 (22, 2400)	Never BF vs. ever BF
<i>Among mothers</i>		
Breast cancer ⁸	4 (3, 6)	Never BF vs. ever BF (per year of breastfeeding)
Ovarian cancer ²	27 (10, 47)	Never BF vs. ever BF

* The excess risk is approximated by using the odds ratios reported in the referenced studies.

[†] CI = confidence interval.

[‡] EFF = exclusive formula feeding.

[§] EBF = exclusive breastfeeding.

[¶] BF = breastfeeding.



Early Nutrition Programming

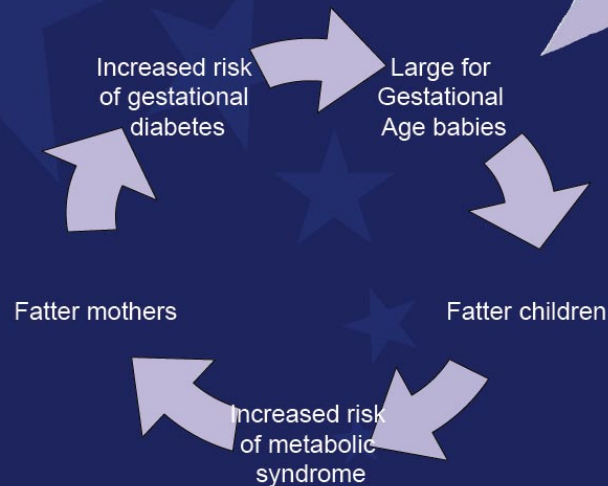


Early nutrition programming is the physiological "setting" by an early stimulus or insult at a critical period, with long-term consequences for function

Lucas, 1991

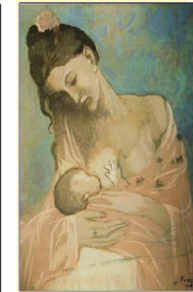
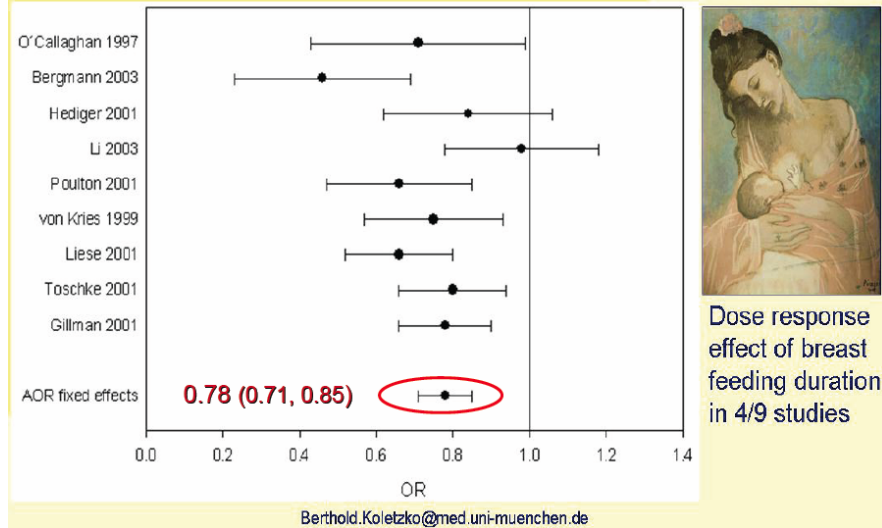


The Intergenerational Cycle of Obesity



Breast feeding protects against later obesity (Meta-analysis of 9 studies)

Arenz, Rückerl, Koletzko, von Kries. *Int J Obesity* 2004



Dose response effect of breast feeding duration in 4/9 studies

Faster growth in infancy adversely programmes the metabolic syndrome (Singhal and Lucas, 2004)

- higher blood pressure at 6-8 years (Singhal, 2007)
- higher LDL/HDL ratio in adolescents (Singhal, et al, 2004)
- greater insulin resistance and endothelial dysfunction in adolescents (Singhal et al, 2003)
- greater obesity later in life (Monteiro and Victora, 2005; Baird et al, 2005; Ong and Loos, 2006)

The Surgeon General's Call to Action to Support Breastfeeding

2011

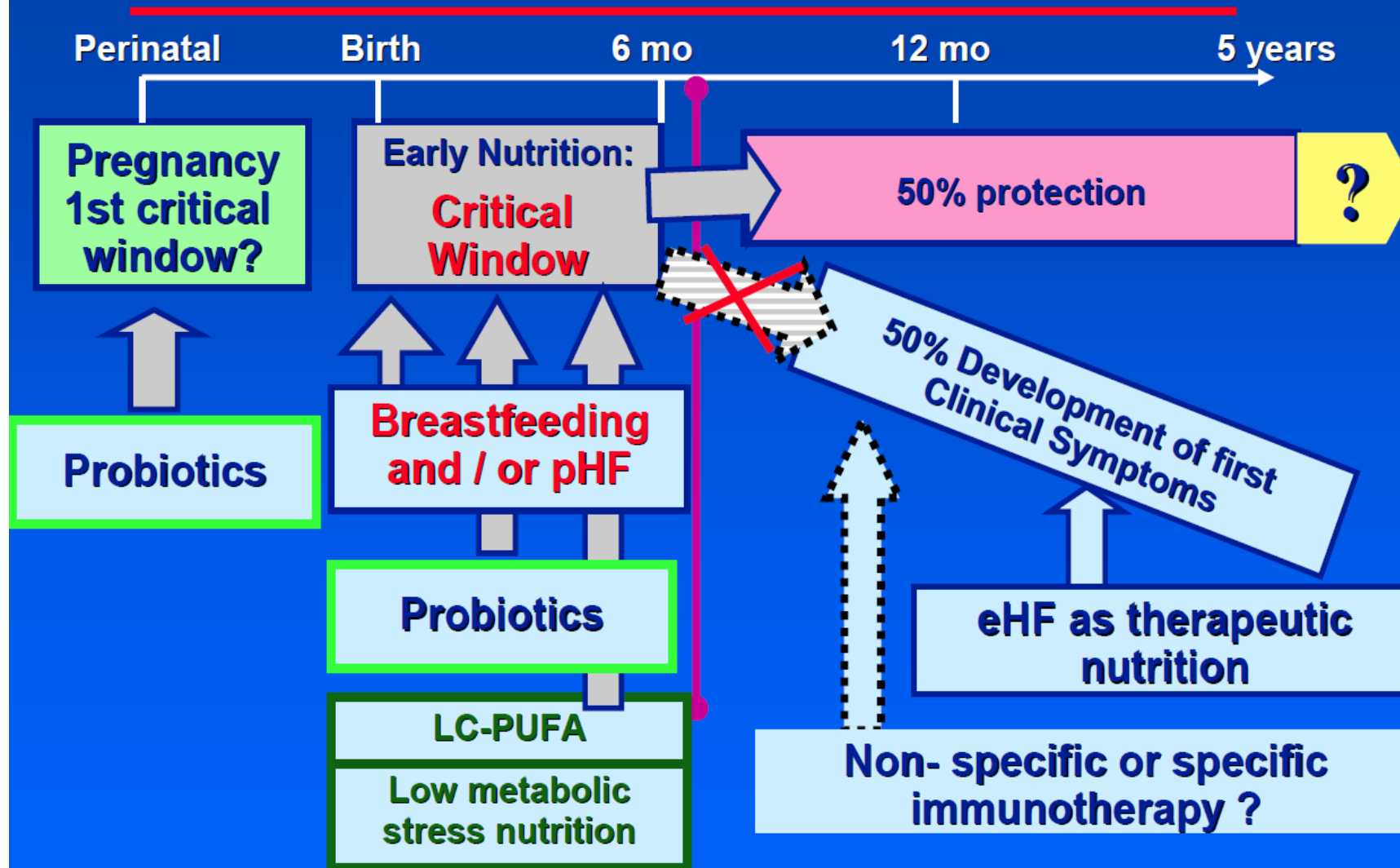
Longitudinal data on:

1. Feeding practices
2. Growth pattern
3. Long term outcomes

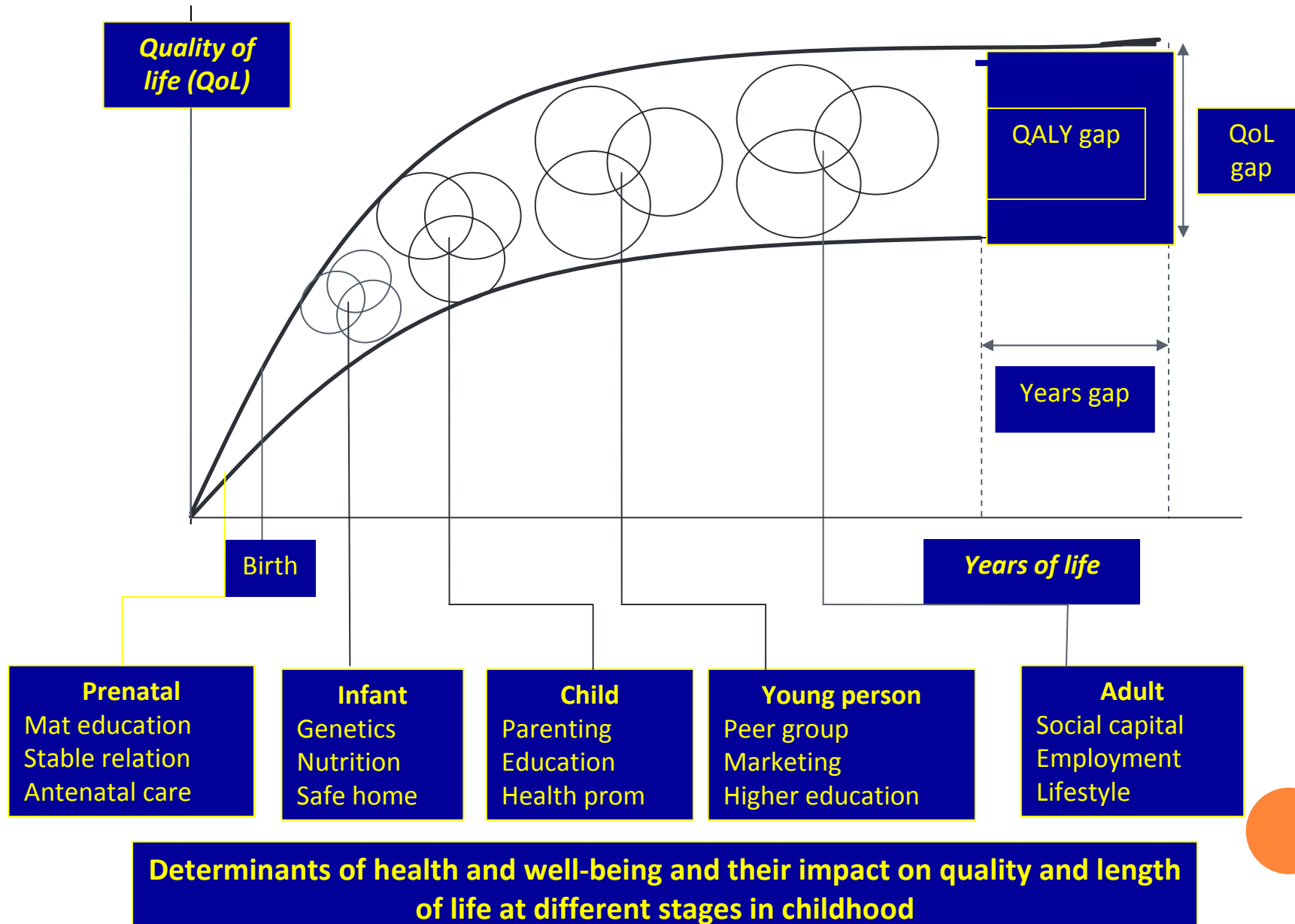


Allergy

Synergetic effects of early strategies for balancing the immune responses towards oral tolerance



Life course epidemiology



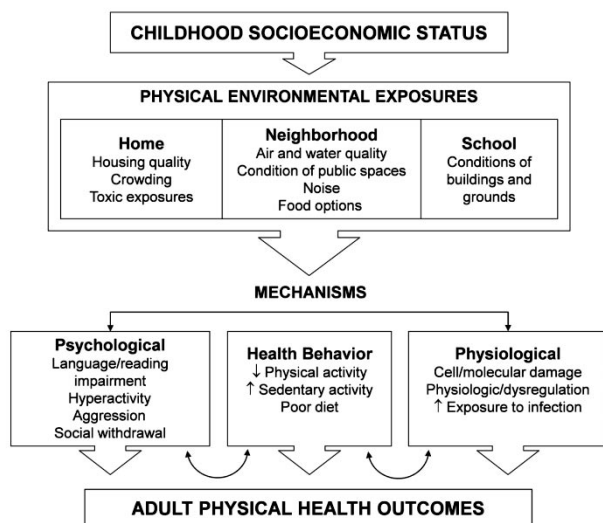


Figure 1. Examples of pathways that may link physical exposures associated with childhood and adolescent SES to adult health.

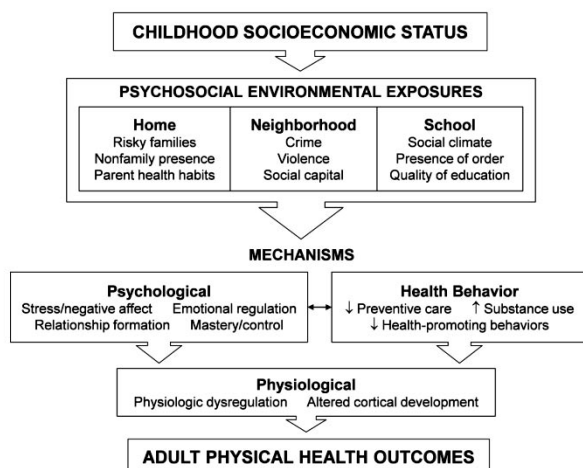


Figure 2. Examples of pathways that may link psychosocial exposures associated with childhood and adolescent SES to adult health.

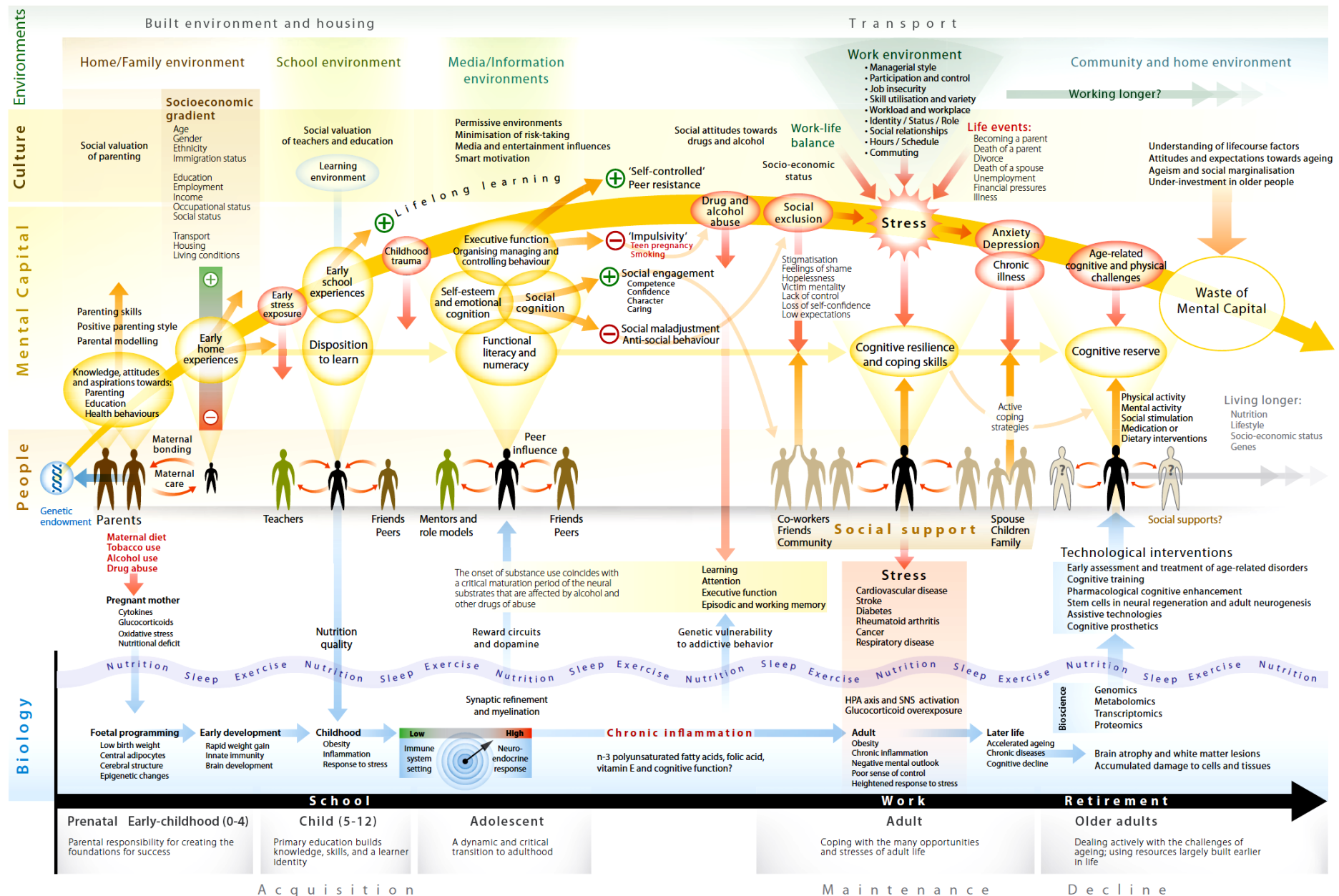
TABLE 1. Risk factors for poor development^{77,86}

Risk	Prevalence	Effects on children	Strength of Evidence
Stunting ^a	25–30%	6–13 DQ points, (0.4–0.8 SD), social and emotional effects	Strong
Iodine deficiency	35%	9–13 IQ points (1 SD)	Strong
Iron deficiency anemia	20–30%	1.73 IQ/10 g/L Hb; Some supplementation trials show benefits to motor, social-emotional, and cognitive development of 0.3–0.4 SD	Strong
Lack of child stimulation and learning opportunities	60–90% of parents do not stimulate	Provision of stimulation/ learning opportunities has benefits of 0.5–1.0 SD in IQ	Strong
Maternal depression	17%, rates may be higher	0.5 to 1.0 SD in cognitive development scores	Correlations clear; need for treatment approaches
Exposure to violence and conflict	Major armed conflict in 27–38% countries from 1990–2003, affects 20 million children	Behavior problems, PTSD	Urgent need for research particularly on interventions
Intrauterine growth retardation	11%	0.25 to 0.5 SD compared to non-LBW	Associated with developmental deficits to age 3 yr; need for longitudinal studies
Malaria	40% of population in 90 countries—300–600 million children	Significant cognitive impairments associated with severe or cerebral malaria or number of episodes of malaria	Negative associations clear; needs further study
Lead levels	40%	2–5 IQ points	Correlational studies in developed and developing countries
Lack of breastfeeding	40–50%	Small effects on cognition (2–5 IQ pts), may affect bonding	Consistent but small-to-moderate effects; hard to design good studies
Parental loss	Over 43 million orphans in Sub-Saharan Africa, 16% below age 6 (7 million) in 2003	Descriptive studies show higher rates of mortality, some behavior problems, sense of vulnerability, depression, improves over time	Need for interventions and intervention research
Lack of maternal responsiveness	Unknown	Associated with less secure attachment, lower cognitive ability and more behavior problems	Need for more intervention studies
Zinc deficiency	33%	Cognitive development and activity	Mixed results
Intestinal helminths	33%	Cognitive development	Inconsistent results
HIV Infection	2%	Can be severe; developmental delays, language delays	Evidence for risk is strong
Diarrhea	Common	Some associations with cognitive development found	Suggestive; needs further study
Arsenic	High in areas such as Bangladesh	Lowered IQ	Correlational data; only investigated in older children
Manganese, pesticides	Depends on area	Lowered IQ	Some data but need for more

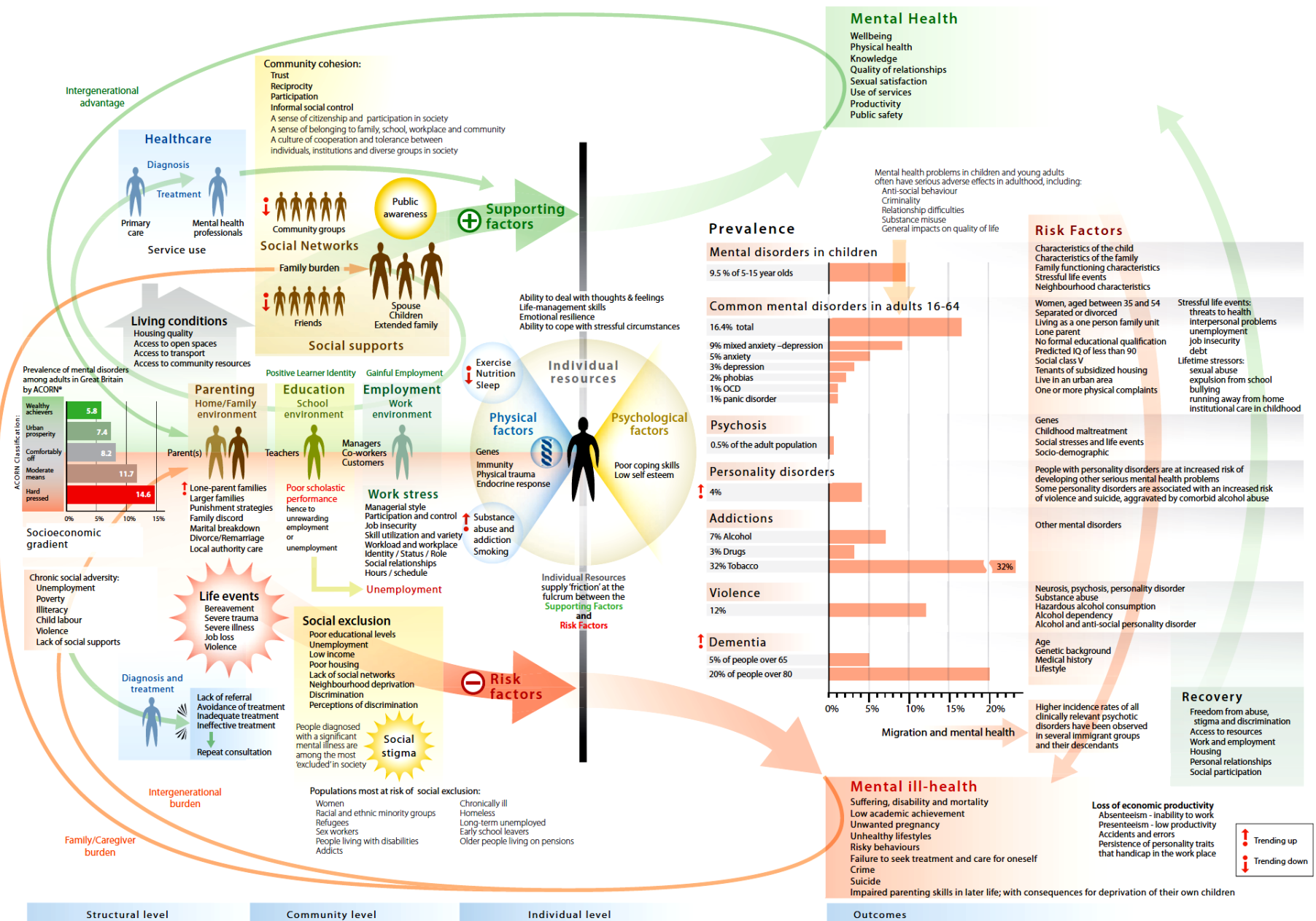
^aStunting refers to a height for age score of –2 standard deviations or less below the average height according to recognized norms. DQ, Developmental quotient; SD, standard deviation; Hb, hemoglobin; PTSD, post-traumatic stress disorder.

Life course – Pathways to **MENTAL CAPITAL**

Mental capital through life – conceptual overview



Mental health – conceptual overview



LEARNING DIFFICULTIES

Learning difficulties – conceptual overview

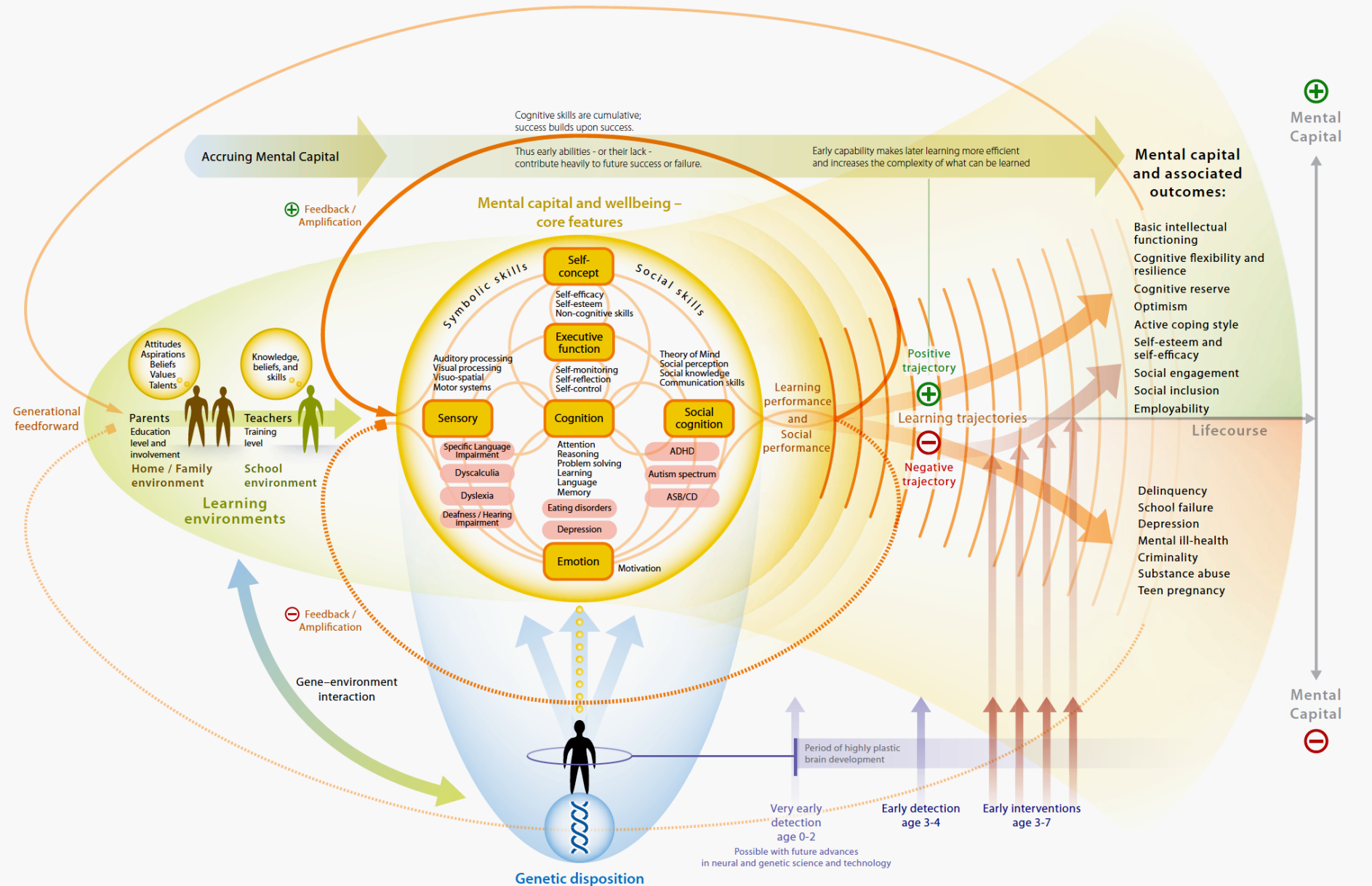
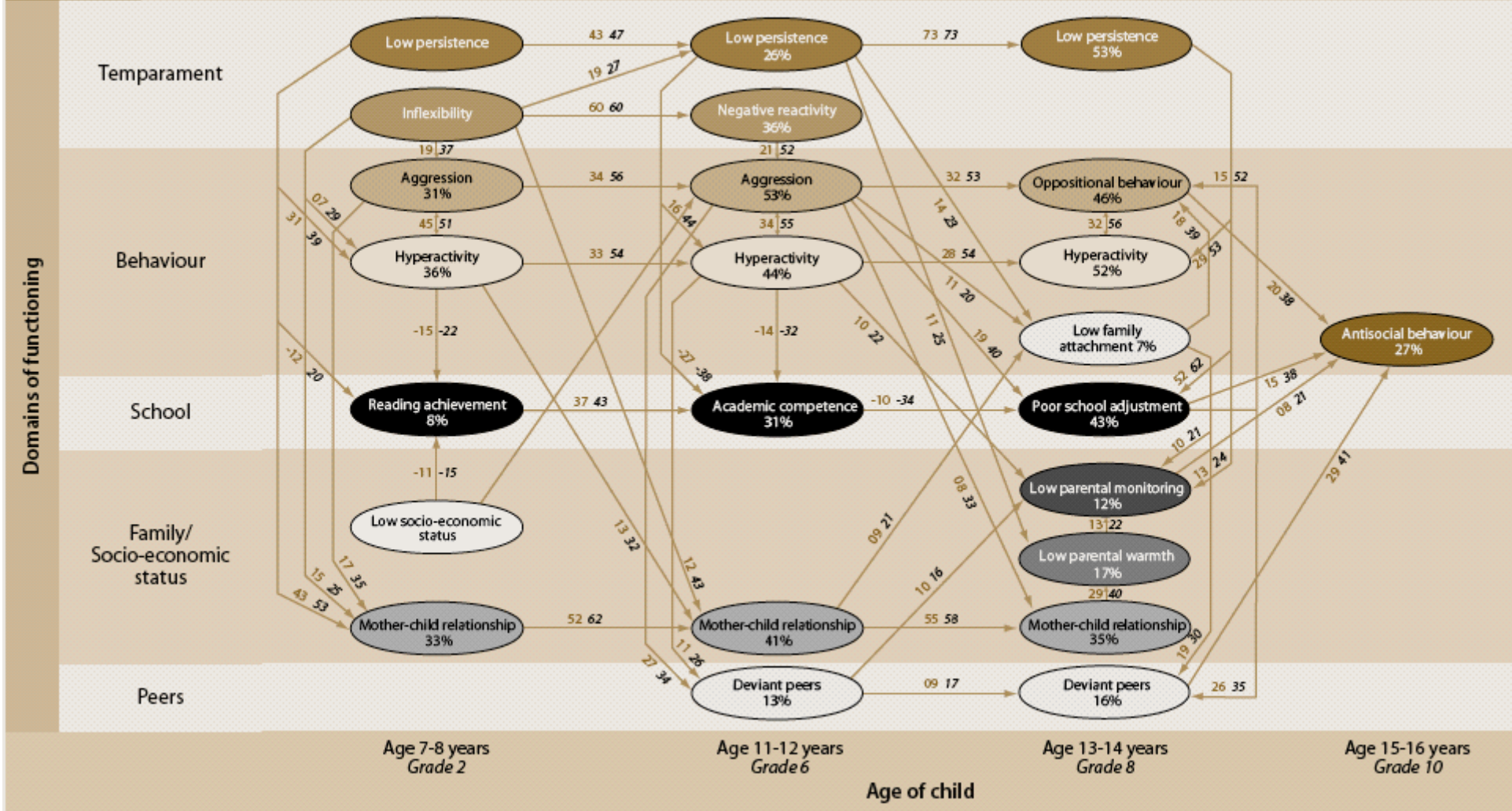
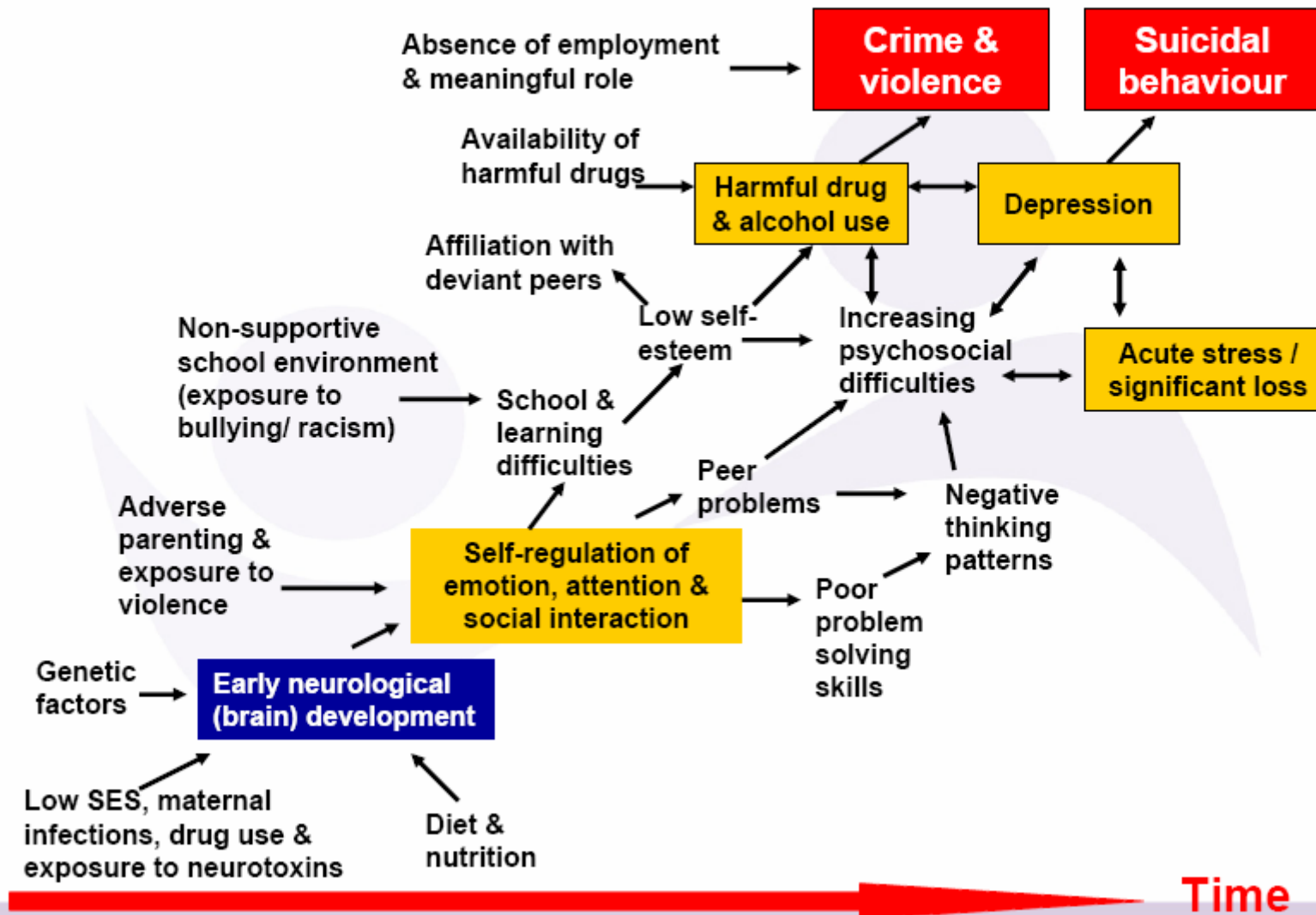


Figure 1.1 Longitudinal pathways to adolescent antisocial behaviours at age 15-16 years



Source: Smart et al. Australian Temperament Project data, 1999.

Pathways into Suicide



ADVERSE EXPERIENCES — CHILD ABUSE, DOMESTIC VIOLENCE, CONFLICTS, LOSS...

If all of these experiences could be eliminated

- Drug abuse would drop by an estimated 50%,
- Current depression by 54%,
- Alcoholism by 65%
- Suicide attempts by 67%, and
- Intravenous drug use by 78%
- (Chapman et al., 2004; Dube et al., 2003).

Sensitive periods and delayed effects

3-5 yr : hippocampal volume – memory consolidation and retrieval, PTSD or depression, borderline personality or dissociative identity disorder

9-10 yr: corpus callosum – information super-highway between left and right hemisphere causing dramatic shifts in mood and personality

14-16 yr : prefrontal cortex – attention, executive function, working memory, motivation and behavioural inhibition



TECHNOLOGY OF LIFE SKILL FORMATION

TABLE 1. Comparison of different investment strategies

Status	Baseline	Early childhood intervention: moving children from the first decile of family investment to the seventh decile	Adolescent intervention: moving investments in adolescence from first to ninth decile	Changing initial conditions and performing a balanced intervention
High school graduation	0.4109	0.6579	0.6391	0.9135
Enrollment in college	0.0448	0.1264	0.1165	0.3755
Conviction	0.2276	0.1710	0.1773	0.1083
Probation	0.2152	0.1487	0.1562	0.0815
Welfare	0.1767	0.0905	0.0968	0.0259

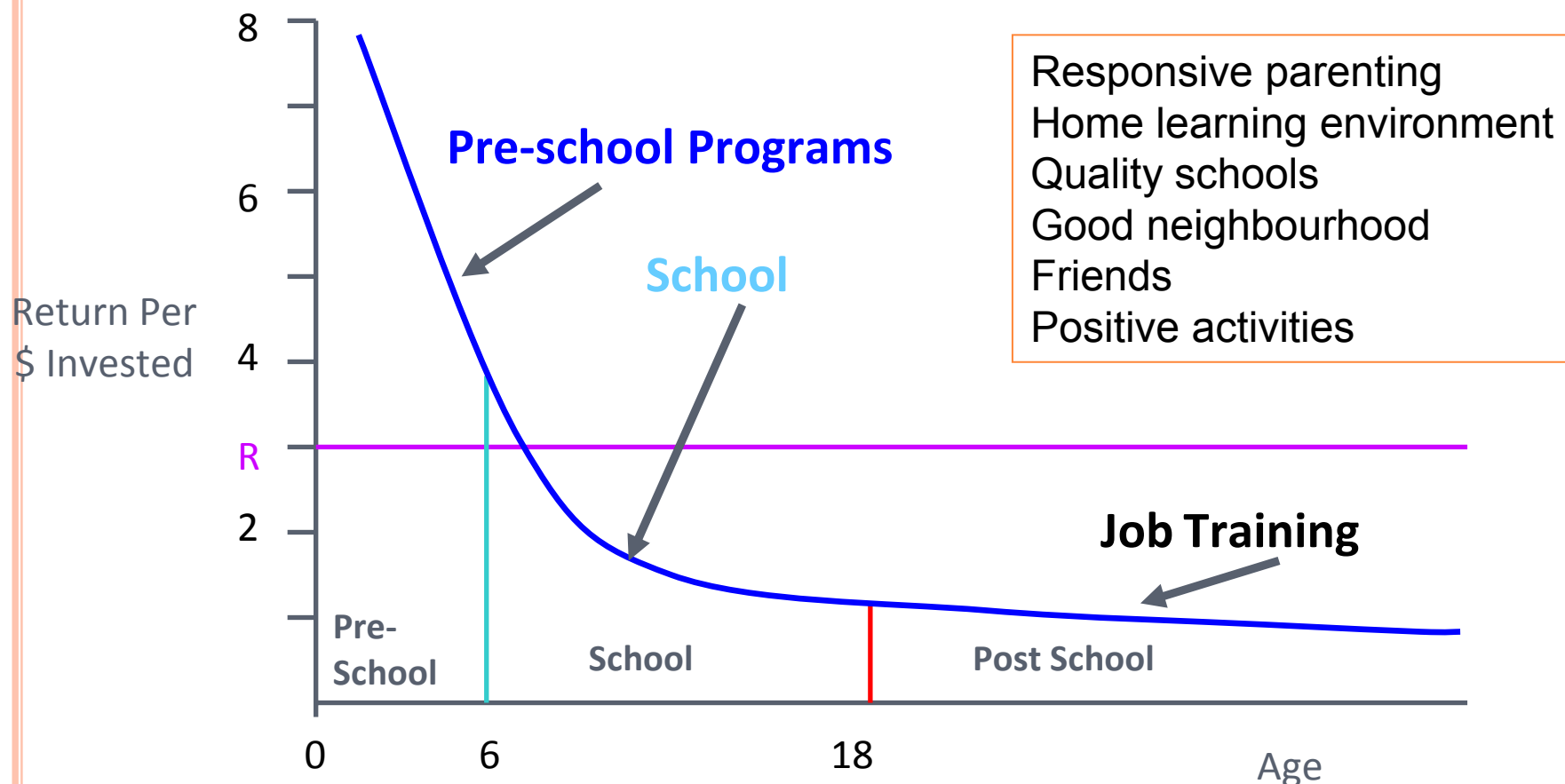
Disadvantaged children: first decile in the distribution of cognitive and noncognitive skills at age 6.

Mothers are in first decile in the distribution of cognitive and noncognitive skills at ages 14–21.

Note: The adolescent-only and balanced intervention programs cost 35% more than the Perry program intervention.

Source: Cunha and Heckman (2006).³⁷

RATES OF RETURN TO HUMAN DEVELOPMENT INVESTMENT ACROSS ALL AGES



The need to invest early
The need for longitudinal study

Pedro Carneiro, James Heckman, Human Capital Policy, 2003

CHALLENGE INTERVENTIONS TO REVERSE THE INCREASING SOCIAL GRADIENT THAT OCCURS POST-14 THROUGH EACH OF THE DRIVERS IDENTIFIED.

Where Policy
Intervenes

