

CHILDREN'S HEALTH AND DEVELOPMENT

New research directions for Australia



Edited by Ann Sanson



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Professor Graham Vinpani is Head of the Discipline of Paediatrics and Child Health at the University of Newcastle. He has a background in community paediatrics and a longstanding interest in promoting child development through social justice strategies and early intervention programs that address the support needs of families with young children. His research interests have spanned childhood injury prevention, child protection, the impact of lead on child development, the evaluation of home visiting, health outcomes in adolescent boys, and the links between socio-economic inequality and child health. As well as being a member of several national paediatric committees, he is chairman of the Board of NIFTeY Australia (the National Investment for the Early Years) – a cross-sectoral advocacy body designed to promote greater awareness of the importance of the early years of life – and a member of the Ministerial Partnership for the Stronger Families and Communities Strategy and the Australian Council for Children and Parenting. He is also a member of the Steering Committee of the Research Alliance for Young Australians (RAFYA). He says the three months he spent in Alice Springs at the end of his training as a paediatrician changed his life.

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Introduction: The child cannot wait

Ann Sanson

The quote from United Nations Secretary General and Nobel Peace Prize winner, Kofi Annan, reminds us of the critical importance of attending to the needs of children, not only for their own sakes in the here and now (as “beings”), but also as the “becomings” of the future.

The papers in this volume are developed from those first presented at a workshop held at the Australian Institute of Family

Studies in February 2001. The purpose of that meeting was to explore the possibility of establishing a national multidisciplinary research partnership focused on the needs of Australian children. Participants at the meeting shared the common conviction that a new era of interdisciplinary, intersectoral work is needed if we are to address the research and policy issues affecting child wellbeing in this rapidly changing society.

“Tomorrow’s world is already taking shape in the body and spirit of our children.”

– Kofi Annan

The first two papers here make the case for why this is so: first, because the causal pathways leading to problem outcomes are complex, and no one discipline is going to be able to provide the answers about how to reverse or avoid them; and second, because many indicators of adjustment suggest that child wellbeing is declining, and that the roots of problems are often in early childhood. The third paper argues for the importance of longitudinal research as a critical element of the evidence base on child and adolescent development, and outlines some of the criteria for a longitudinal study which can effectively guide initiatives in policy and practice.

Over some years and from a wide range of research perspectives, there has been a groundswell of concern about the lack of progress, and often decline, on many indices of the health and wellbeing of children. Researchers were frustrated by their incapacity to turn this around, and recognised that one limitation was that they were working in disciplinary “silos”. Evidence has been accumulating of the critical importance of the early years of a child’s life for their later development, and for the greater efficacy of interventions early in life and early in problematic developmental pathways. At the same time, what is becoming very evident is the complexity of causal pathways to problem outcomes, involving every level of analysis from the child’s biological inheritance, through their family and school environments, to the broader social, economic and political context.

All this implies that researchers from a wide range of disciplines need to work together to tackle what some have labelled the current “developmental crises”. However, research alone cannot effect change. The need for researchers and policy makers to find better mechanisms for communicating and facilitating the translation of research into evidence-based policy was another theme at the workshop.

Hence the group of 35 key researchers in children's health and development met at the Australian Institute of Family Studies on 22–24 February 2001. The meeting was organised by a steering committee comprising Professor Graham Vimpani (University of Newcastle), Professor Fiona Stanley (Institute for Child Health Research in Perth), Professor George Patton (Centre for Adolescent Health, Melbourne), Professor Brian Oldenburg (School of Public Health, Queensland University of Technology), Dr Wayne Smith (National Centre for Epidemiology and Population Health, Canberra), and myself (Ann Sanson of the Australian Institute of Family Studies, Melbourne).

As an institution with a keen interest in promoting the welfare of children in their family and community contexts, the Australian Institute of Family Studies hosted the meeting.

The expertise of those attending the meeting reflected the multitude of interacting factors impacting on children's wellbeing and development, ranging from the biological to the socio-cultural. Participants included experts in antenatal development, infant development, parenting, child care, education, children with disabilities, and adolescent development, as well as research methodology, biostatistics, epidemiology, and social policy research. A number of the key institutions around Australia with an interest in children were represented (see Sanson 2001 in *Family Matters* no. 58, pp. 68-69). This rich mix ensured that discussion was lively and stimulating.

Themes

The first paper, *"New causal pathways thinking for public health"* by Fiona Stanley, Ann Sanson and Tony McMichael, argues for why interdisciplinary research is now so crucial. We know that the complex intersecting influences on children's development fall into the province of medical researchers, psychologists, educators, sociologists, economists and others, and input from all is needed if we are to understand truly the causal pathways to good and poor developmental outcomes.

The second paper is *"The relevance of child and adolescent development for outcomes in education, health and life success"* by Graham Vimpani, George Patton and Alan Hayes. It makes the case for the importance of experiences and environments in the early years for outcomes across the lifespan, and for the effectiveness of early intervention. It also isolates some directions for future Australian research.

These papers set the scene for why a partnership was needed. Over the course of the three-day meeting, the consensus grew that a partnership could have a critical role in facilitating a new era in research in human development, and that researchers could indeed work together effectively. It was decided that Professor Fiona Stanley should be the interim Chair of the partnership for the next 12 months, with the committee which organised the workshop continuing as the interim partnership steering committee.

One immediate possible role for such a partnership was to facilitate a collaboration of researchers to bid for the contract to plan and implement the Longitudinal Study of Australian Children (LSAC). The Federal Government's announcement of funding for this major new study, as part of its Stronger Families and Communities Strategy, provided a further catalyst for researchers to get together and discuss ways of working together more effectively. The research community had been calling for such a study for some time, and LSAC

represented the most substantial commitment ever by an Australian government to research aimed at building the evidence base for a broad gamut of child-related policy and practice. Researchers from many fields wanted to ensure that the opportunity was not squandered.

The third paper at the workshop and in this volume, *“Longitudinal studies of children and youth: Implications for future studies”* by Jan Nicholson, Ann Sanson, Lynn Rempel, Diana Smart and George Patton, helps to frame the role of the proposed new study by summarising existing longitudinal research on children in Australia and overseas. It identifies the strengths and limitations of various longitudinal designs, the contributions made by existing studies, and opportunities for new ones.

At the workshop there was a strong feeling that LSAC offered a unique opportunity for ground-breaking research which could guide policy on children and families in the immediate and longer term, and that its impact would be far greater if researchers covering a range of disciplines, perspectives and geographical areas collaborated on the project, rather than competing with each other. It was agreed that a consortium headed by the Australian Institute of Family Studies and including eight other member institutions of the partnership should develop and submit an Expression of Interest in conducting the study.

Developments 2001–2002

Between the time of the February 2001 meeting at which these papers were first presented and the publication of this volume in June 2002, events have proceeded apace.

Australian Research Alliance on Children and Youth

A great deal of energy and activity has surrounded the concept of the proposed research partnership. A name has now been chosen for the partnership – it is to be known as the Australian Research Alliance on Children and Youth.

Presentations have been made to a large number of audiences including the Prime Minister’s Science, Engineering and Innovation Council (PMSEIC), peak research organisations and philanthropic bodies. For example, presentations to the Ian Potter Foundation, Baker Foundation, the Western Australian Lotteries Commission, and the Western Australian Government have raised seed funding to enable the establishment activities of the new entity. In May 2002, the Government Taskforce for Early Childhood Development and Wellbeing, set up in response to the PMSEIC presentation, committed Commonwealth funding to assist the Alliance build an inclusive network and develop a national research agenda. Numerous discussions have been held with policy makers and service providers across Australia, and considerable coverage has been given in the media. Almost without exception, wherever the idea has been mooted, it has been greeted with great enthusiasm.

The interim steering committee has grown and now includes those with expertise in policy making and service delivery (see Table A). Philanthropic trusts have provided generous seed funding. A second meeting, with a much larger and broader group of participants than attended the original workshop at the Australian Institute of Family Studies, was held in Brisbane in November 2001.

At the time of going to print, a constitution is being finalised which will establish the Alliance as an incorporated company with a Board, specialist Board sub-committees as required, a Governing Council, and two Advisory Councils, including a Scientific Research Committee. The Alliance promises to be an important force in ensuring that the research community contributes as effectively as possible to addressing the needs of Australia's children now and in the future.

Longitudinal Study of Australian Children

There has also been a great deal of activity and progress as far as the Longitudinal Study of Australian Children is concerned. The LSAC Consortium of nine member institutions of the partnership (see Table B), established at the February 2001 meeting, developed an Expression of Interest in conducting the study. This process was led by a working group comprising Ann Sanson, Judy Ungerer, Jan Nicholson and Steve Zubrick. The consortium was subsequently invited to submit a proposal.

Table A Australian Research Alliance on Children and Youth Interim Steering Committee

Professor Fiona Stanley
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Director
Telethon Institute for Child Health
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Dr John Ainley
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Australian Council for Educational
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Dean and Head of Division
Australian Centre for Educational Studies
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Professor Ross Homel
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Senior Medical Adviser
National Centre for Disease Control
Department of Health
Woden ACT 2606

Professor Graham Vimpani
Director
Child Adolescent and Family Health
Service
Hunter Area Health Service
Wallsend NSW 2287

The process of developing this proposal did much to cement the working relationships among consortium members. The writing of the proposal was led by the same working group but with active contribution from all members. The proposal named the Australian Institute of Family Studies as the lead organisation in the consortium, and the Institute's Ann Sanson was nominated as the Project Director who would be the direct point of contact with the Government's Department of Family and Community Services.

In September 2001 the consortium was notified that it was the successful tenderer. The contract between Department and the Institute has been signed, and the study launched by Ministers Amanda Vanstone and Larry Anthony at a ceremony in Canberra in March 2002. Work is proceeding on refining the study design and developing the data collection instruments. It is anticipated that the first wave of data collection will take place in 2003.

Through maintaining a close partnership with government and a continuing process of consultation with stakeholders across the policy, practice and research communities, the LSAC Consortium will ensure that the Longitudinal Study of Australian Children addresses the critical policy-relevant questions regarding children's development, health and wellbeing. The interdisciplinary nature of the consortium is already proving to be a rich resource in ensuring that the study will be at the cutting edge in its conceptualisation and methodology.

Table B **Longitudinal Study of Australian Children**
Members of the LSAC Consortium Advisory Group as at June 2002

Day-to-day management of the Longitudinal Study of Australian Children (LSAC) is the responsibility of the Project Operations Team housed at the Australian Institute of Family Studies. The team is supported by a LSAC Consortium Advisory Group consisting of representatives of each of the nine member organisations of the Consortium, as well as four other consultants.

Professor Steve Zubrick (Chair)
 TVW Telethon Institute for Child Health
 Research

Dr John Ainley
 Australian Council for Educational
 Research

Dr Donna Berthelsen
 Queensland University of Technology

Dr Michael Bittman
 Social Policy Research Centre
 University of New South Wales

Dr Dorothy Broom
 National Centre for Epidemiology and
 Population Health
 Australian National University

Dr Linda Harrison
 Charles Sturt University

Dr Jan Nicholson
 Queensland University of Technology

Associate Professor Ann Sanson
 Australian Institute of Family Studies

Professor Michael Sawyer
 University of Adelaide

Professor Sven Silburn
 TVW Telethon Institute for Child Health
 Research

Associate Professor Judy Ungerer
 Macquarie University

Professor Graham Vimpani
 University of Newcastle

Dr Melissa Wake
 Murdoch Childrens Research Institute

While all members of the consortium are also members of the Alliance, the scientific expertise and advocacy role of the Alliance will also be exploited through its membership on an LSAC Scientific and Policy Advisory Group. It is anticipated that the Longitudinal Study of Australian Children will become a vital evidence base for child-related policy well into the future, and will provide a model for future Alliance research collaborations.

Children – today and in the future

It is hoped that this volume will help to document the importance of creating interdisciplinary partnerships to address the complex issues surrounding the development and wellbeing of children in Australia today and into the future. The urgency of this task is illustrated in the words of Chilean poet Gabriela Mistral.

**“Many things we need can wait, the child cannot.
Now is the time his bones are being formed,
his blood is being made,
his mind is being developed.
To him we cannot say tomorrow,
his name is today.”
– Gabriela Mistral**

1

New ways of causal pathways thinking for public health

Fiona Stanley, Ann Sanson and Tony McMichael

This paper is written as a background to the concept of establishing a national research collaboration to enable better and more constructive research to underpin public policies which aim to improve family, child and adolescent health and wellbeing. It was initiated from an epidemiological perspective with input from a behavioural scientist interested in developmental psychopathology. It concludes that multi-disciplinary approaches are required to properly address complex pathways to a variety of outcomes, only some of which are specifically health related.

There is currently a debate (mostly in the United States literature) about causal thinking which is yet to have an impact on much of mainstream epidemiology and public health and certainly on government departments who may be setting policy. And certainly it is far away from the view of the media who continue to love simple answers and single risk factors. To paraphrase H.L. Mencken: "To every complex problem there is always a simple answer – and it is always wrong."

The paper is also written to encourage broader thinking around what kind of study or studies are needed to advance best a national research and policy agenda for families in Australia.

"States of health exist in people; people form societies; any study of the attributes of people in relation to health outcomes is also one of the manifestations of the form, structure and processes of social forces."

– *Susser 1973: 6*

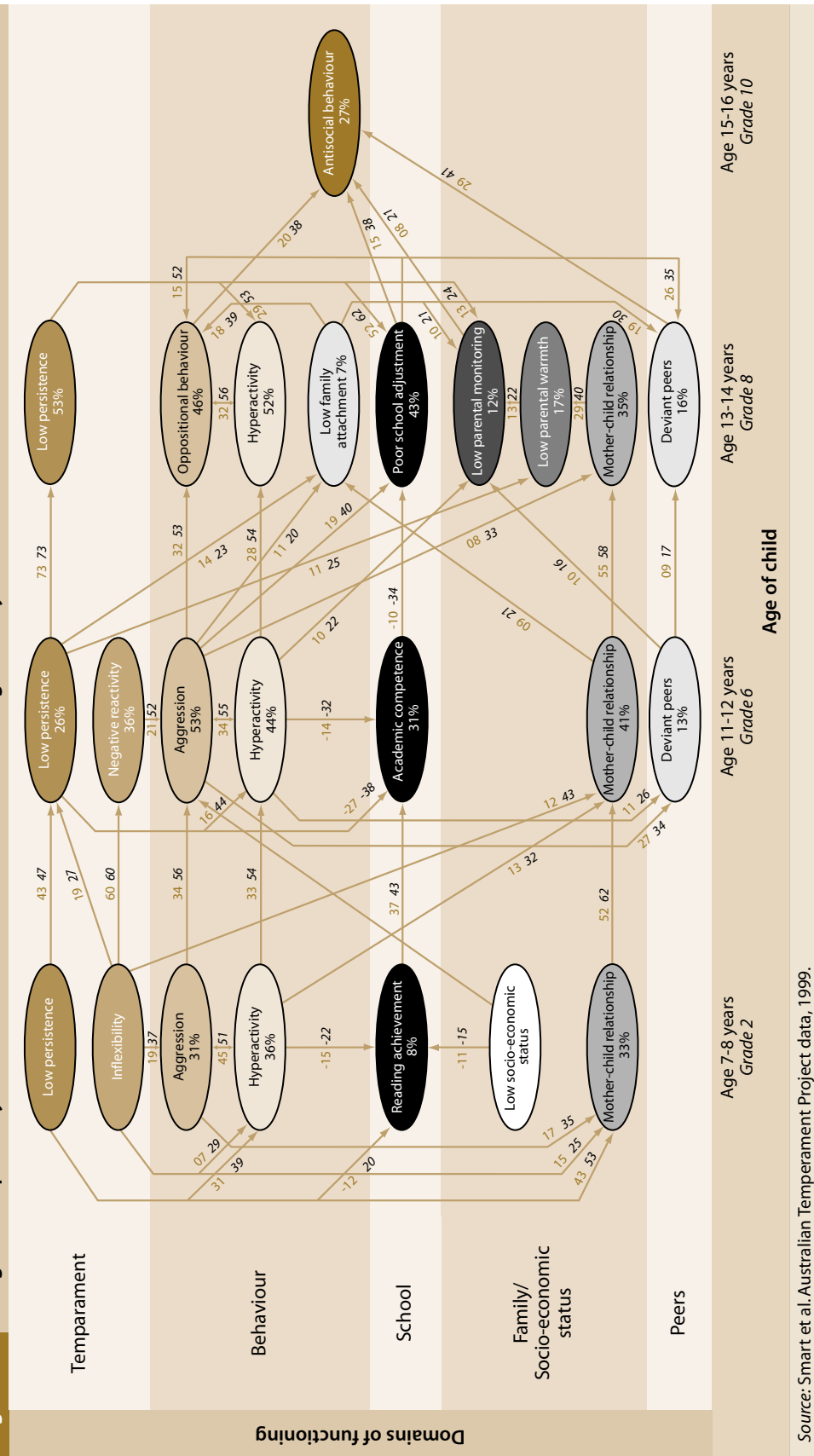
"Modern epidemiologists still do studies in populations, but they do so in order to study decontextualised individual risk factors, rather than to study population factors in their social and historical context."

– *Pearce 1996: 680*

Multi-disciplinary approaches for complex pathways

Epidemiology is one of the main scientific disciplines underpinning public health. Modern epidemiology arose in response to the epidemics in developed (economically rich) countries of so-called chronic diseases of the 20th century such as cardiovascular disease, lung cancer and peptic ulcer. It employs a fairly rigid paradigm of analyses of risk factors in individuals, using cohort and case-control studies, without considering how and in what contexts such risk factors might have developed. There tends to be an underlying naive assumption that there are true universal individual level risk factors that transcend culture, class and context (McMichael 2000).

Many papers have described the associations of disease outcomes with social or economic circumstances, and have then proceeded to control for them in analyses which focus on more proximal risk factors in the causal pathway.

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

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

Indeed, some of these risk factors could be thought of as early signs of the disease. There has been intense methodological development of criteria to judge whether a risk factor may be causal, and sophisticated mathematical techniques to sort out the independent effects of proximal risk factors – all essentially in isolation from a thoughtful causal pathway model.

Modern epidemiologists seem to have forgotten that to understand the causes of disease in a population it is important to study its historical and social context and how diversity or cultural norms influence pathways. Mathematical models concentrating on proximal risk factors (that is, those close to the individual and/or close in time to the onset of the disease) actually preclude causal pathway analyses that involve more distal risk factors (that is, those more distant from the individual, such as social or cultural factors, and/or occurring earlier in time). This is because in a multi-variate model proximal risk factors are usually so powerful (strongly associated) that the more distal risk factors do not appear significant (Stanley, Blair et al. 2000). By “controlling for confounding” we not only ignore the earlier part of the causal path, we also often ignore the causal sequences and interactions which may be so important.

As Susser (1998) has so forcefully pointed out, it seems we have a myopic over-emphasis on proximal causes of disease and a concomitant neglect of upstream or distal factors that culminate in the final causal chain.

This situation does not apply only to physical health outcomes. The significance of distal influences in causal pathways leading to behavioural and emotional maladjustment is equally evident and (at least until recently) equally neglected. The complexity of interactions between factors at different levels of analysis poses methodological and statistical challenges to attempts to understand the pathways. An example from the Australian Temperament Project of pathways to antisocial behaviour (Figure 1.1) illustrates some of the complexities (Smart et al. 1999).

In the Figure, “proximal” and “distal” refer to a time dimension – here, from Grades 2 to 10 (bottom of Figure), as well as type of influence (left of Figure). An example of a proximal influence is oppositional behaviour at Grade 8. An example of a more distal influence is family/social context at Grade 2. The arrows indicate the direction of effects. The first numbers on the arrows show the standardised beta weights, indicating the strength of the direct relationship between the two variables. Those in italics show the univariate correlations, indicating the total between-variable relationships (including both direct effects and effects exerted through indirect pathways). Only significant paths are shown.

Attention to only the proximal influences on antisocial behaviour, namely prior behaviour problems, school difficulties, parental monitoring, and deviant peer associations at Grade 8, ignores the complex interactions between these and other factors at this relatively late stage. Furthermore, the pathways by which these characteristics have become entrenched in earlier years, and which involve a variety of factors at all four levels of influence, are ignored.

This particular analysis ignores a great deal: first, biological components, and influences in the very early childhood years; and second, the fact that all these factors are embedded in a rapidly changing socio-cultural context. These broader contextual factors (such as high levels of family stress and insecurity, increased unemployment and poverty, a rise in racist sentiments, and so on) undoubtedly contribute directly and/or indirectly to antisocial outcomes. An even more complex diagram than Figure 1.1, and a research paradigm of challenging complexity, would be required to elucidate this more complete picture.

Individual risk factor epidemiology ignores how significant societal changes have created ecologically adverse environments which are having, and will continue to have, profound effects on global health and human development. Thus, modern epidemiology has failed to address the complex and ever-changing social, behavioural and ecological pathways. Only recently has it started to realise that molecular and genetic markers could be used to advantage to help elucidate these pathways, rather than being rejected as basic biomedicine and nothing to do with “proper” epidemiology or public health.

At a conceptual level, developmental psychology has undergone a similar paradigm shift to that being promoted here for epidemiology. Up to 1970s, there were two apparently incompatible paradigms, a mechanistic (behaviourist/environmental) one which saw an individual’s development as being shaped by the environment (“nurture” being all important and the individual being viewed as basically passive); and an organismic (biological/trait) model which saw development as the unfolding of genetic/biological makeup (“nature” is dominant and the environment is passive).

In the last 30 years an integration and expansion of these has occurred which mirrors newly emerging epidemiological paradigms, and builds on the earlier opposing views. The new paradigm, most commonly referred to as a transactional model, posits ongoing interactions between influences intrinsic and extrinsic to the child across time as the driver of development. The newly emerging field of developmental psychopathology adopts this model as its theoretical foundation in seeking to understand the complex pathways to psychological adjustment and maladjustment. However, it remains methodologically and analytically poorly equipped to account for the influence of the broad political, social, cultural and ecological environment, and thus continues to shed little light on the influence of powerful distal factors such as poverty and exclusion.

Towards a new research paradigm

These criticisms have profound implications for both research and prevention agendas. Modern epidemiologists would argue that there have been many successes with the individual risk factor approaches in prevention and treatments (vaccination, smoking and lung cancer in males, incidence of heart disease, peptic ulcer management, folic acid and spina bifida, cot death and sleeping position).

However, the success of risk factor epidemiology has been more limited than many claim. For example, on a global basis the achievement of the public health movement has been to shift the problems (such as smoking-related illnesses) from rich to poor countries, or from the rich to the poor within countries. This is a direct effect of the limitations of an epidemiology based on individual factors (for example, tobacco smoking) rather than on population factors (for example, tobacco production, advertising and distribution, and socio-economic influences on consumption) (Pearce 1996). As another example, concentrating all of our efforts on reducing the use of illegal drugs by individuals to prevent suicide and mental ill-health in young people, while ignoring the complex chains of population influences, will ensure that drug taking and other poor outcomes will continue to rise, particularly in the most disadvantaged groups in our societies.

Thus we are suggesting that modern epidemiology as currently practised is unable to solve the socially based public health problems. Since much of public health is socially influenced, current epidemiological research is failing public health.

The elucidation of the code for the human genome and the proliferation of genetic and molecular biomedical research makes this situation of more concern (McMichael 2000). Not only is there a huge international push to explain most diseases and risk factors as “genetic” – “the gene for achieving social support!!” – but if such new research is done and applied in complete ignorance of the global societal-cultural impacts it could have, and of the marked economic inefficiency of molecular genetic screening as a population strategy (Vineis et al. 2001), then we are more likely to be hindered by this new knowledge than helped by it. Biological determinism always appears to be popular in eras of political conservatism.

As our own studies in Western Australian child health and the Australian Temperament Project have shown, the social, community, family, biological and economic influences identified for complex disease pathways appear similarly important for a range of other educational, psycho-social, behavioural and criminal outcomes (Zubrick et al. 2000; Prior et al. 2000). Causal pathways thinking opens up the concept of multiple outcomes from single pathways (multifinality) and multiple pathways to single outcomes (equifinality). The fact that these influences mostly act in complex cumulative and interactive ways poses enormous challenges for both research and policy.

This situation is becoming more urgent as the social, biological and ecological environments in which we live have been changing rapidly over the last two to three decades. While some of these changes have obviously been beneficial, we have observed increases in various major disease categories and disabilities (except for infectious diseases other than HIV, cancers and some causes of intellectual disability) (Stanley 2001). These include mental health disorders, asthma and allergy, diabetes and neurological problems such as the cerebral palsies. The increases have been so substantial that the levels of morbidity can only really be tackled by preventive strategies since the health and psycho-social care system cannot meet the demand for treatments and services, and, in any case, for many of these diseases we do not have many really effective treatments.

The great changes which have occurred in the social and demographic structures of communities and populations and in the environment add further complexity and a sense of urgency to our work. Changes in work patterns, family structure, and the social security system, the consequences of globalisation and environmental degradation, the rise of racist sentiments: all these and more have potential to adversely affect developmental health and wellbeing. Simplistic research paradigms which ignore the multilevel and complex nature of pathways, and policies and interventions which focus on a limited number of “risk factors” at some point along these pathways, are not going to serve us well. Hence we need to move rapidly, but carefully.

It is evident that an era of truly collaborative inter-disciplinary research paradigms is urgently needed. The United States National Institutes of Health have called for “new research that is multi-disciplinary, longitudinal, and that embraces an ecological approach to the study of child development” (their workshop participants included developmental psychologists, economists, educational researchers, evolutionary biologists, medical epidemiologists and sociologists) (NIH RFP 2000: 5).

We envisage a large research agenda. For example, for social issues to be researched, we need to tackle conceptual issues (what are the relevant attributes of groups?) and practical ones (how do we create data sets with sufficient level specific detail or

power?); the theoretical (what is the appropriate unit(s) of analysis? how best to analyse causal pathways?) and the methodological (how can lag times between exposure and health status be incorporated into the analysis, while at the same time allowing for changes over time in status or circumstance?). The difficulties in accurately measuring such things as societal changes and other distal risk factors may explain why they have been excluded from aetiological models.

We need to be challenged to tackle problems at higher levels of aggregation. This issue is crucial as we think about how best to use existing data bases and embark upon new cohort studies. So instead of dividing our disciplines into narrower, competing ones (to use the example of epidemiology, into social, infectious disease, molecular and genetic epidemiology, and so on), we need to bring in new approaches that serve the endeavours of all the collaborating disciplines.

The implications here are considerable. We need to look at this with the eyes of those with whom we want and need to collaborate – psychologists, sociologists, economists, environmental scientists, neuroscientists, geneticists, educational researchers. This represents a chance, not only for epidemiologists, but for all of us, to begin a dialogue and the process of learning to “see through others’ eyes” in the cause of improving child health and wellbeing.

These issues are also of profound importance to the development of policy and where best to put efforts and resources to make the greatest improvements. Causal pathway thinking opens up many more possibilities for prevention, many of which may be more effective and cheaper than more proximal solutions which may be too close to the disease outcome to influence it significantly. For example, the most effective preventive strategies for improving low birth weight and infant death rates in Indigenous mothers may be to tackle the disempowerment, despair, discrimination and dislocation of Indigenous communities, rather than going into such communities with an anti-smoking or nutrition program targeted at women, who may feel further victimised and undermined.

Reigel (1990) describes the process of development as occurring through an ongoing dialectical interaction between four levels of analysis – the inner-biological, the individual-psychological, the outer-physical, and the socio-cultural. At present, each discipline adopts one of these levels as its province and, at best, attempts cursory analysis of the other levels. Yet, with our current state of knowledge and in our own particular “socio-cultural context”, it is apparent that we cannot well serve public health on our own. Coming together will not only enable each discipline to better serve public health, but working together will ensure that the social and medical sciences are used appropriately to influence a social policy agenda that includes health, wellbeing and education.

Conclusion

In summary, when we take a causal pathways perspective, it becomes clear that we need to establish a national partnership on developmental health and wellbeing for a variety of reasons.

We now know that pathways to many health, educational and psycho-social outcomes are similar to each other, and similar in their complexity; and that most poor health, educational and psycho-social outcomes are strongly associated with measures of social distress.

It is also clear that effective, enduring solutions will only be developed with the sorts of paradigms which have been proposed here, in which different disciplines bring the expertise needed to develop the most important questions and suggest the most appropriate methodologies to answer them. Further, existing Australian databases and studies (such as record-linked population data, cohort studies, surveys) which have been established by the different discipline groups are at the moment under-used, and could be made available to researchers across all disciplines to inform new research. By working collectively and adopting a “consortium” approach, researchers in a national partnership could increase the capacity for research and government funding.

Finally, a national partnership has the potential to bring together the best minds nationally to underpin the planning for studies of Australian children with broader and better research agendas than those presently available. A partnership of this sort holds the promise for contributing to better outcomes for Australian children in the future.

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2 The relevance of child and adolescent development for outcomes in education, health and life success

Graham Vimpani, George Patton, Alan Hayes

There has been a broadly-based renewal of interest in the importance of early human development over the past few years. A range of factors has contributed to this renaissance.

First, there have been concerns across many disciplines about deteriorating indices of the adjustment of children and young people, presumably in response to social and family changes (Fukuyama 2000). It has also been increasingly recognised that the influence of socio-economic inequality on a range of adverse life outcomes begins in the early years of life, through its impact on environmental experiences such as stress, parenting and nutrition. As well, it is becoming apparent that many of the problems of adult mental health, addictive behaviour, and crime have their roots in the experiences and environments encountered during early childhood, the most rapid period of human development.

Similarly, there is growing awareness of the importance of fetal programming in creating increased risks of adverse outcomes in adult life. Evidence has emerged from long-term follow-up studies that early childhood and adolescent intervention programs can have positive cost-benefit ratios, indicating the value of prevention and early intervention. Finally, a number of key reports have recently been published which highlight the importance of renewed social investment in the early years (McCain and Mustard 1999; Shonkoff and Phillips 2000).

This chapter summarises this background and flags the way in which a research partnership could advance our knowledge of the interplay between individual biology, experience, and environmental exposures, and could inform the policy debate on directions that might be taken to enhance early human development.

The “great disruption”

There have been improvements in many health indicators – for example, falling perinatal and infant mortality, continuing increases in life expectancy, and reductions in death rates from many conditions as a result of technological advances (such as leukemia) or environmental interventions (road trauma). Despite this, other indicators of social health are less comforting. Examples include evidence of a relatively high rate of mental disorders and dysfunction in the recent mental health survey of Australian children and young people (Sawyer et al. 2000), the high rate of youth suicide, rising notification rates of child maltreatment, and concern about rising crime rates in young people.

Fukuyama (1990) has called the contemporary progression from an industrial to information and service-based society “the great disruption”. This has been marked by many rapid changes in families and society that have been accompanied by deteriorating indicators of what Keating and Hertzman (1999) have termed “developmental health and wellbeing”.

Some of the frequently cited social changes, and some of the deteriorating indicators of health and wellbeing with which they have been associated, include:

- the changing role of government, with greater reliance on market solutions to complex social problems;
- demographic changes in family formation – for example, an increased rate of lone-parent families and decreased fertility, with the decline being more noticeable in the well-off;
- the changing roles of women;
- increased unemployment;
- increased income inequality;
- increased time pressure within families;
- decreased levels of trust between individuals and in institutions – a symptom of declining social capital;
- weakening ties within families, and between families and communities, associated with a growth in individualism;
- conflicting views on the balance of roles and responsibilities between families and society as a whole (as reflected through government policy and programs) for child health, development and wellbeing;
- a loss of “corporate memory” of parenting practices within families;
- the television and internet becoming principal sources of information and entertainment for children from a very young age;
- increased reporting of child abuse and neglect;
- increased reports of disruptive behaviour;
- declines in literacy in some populations – and a strong association between low literacy and crime;
- increased youth suicide;
- increased maternal depression (post-natal and during children’s early years);
- increased addiction to gambling and illegal substances;
- increasing disregard for rules and hierarchical authority; and
- increases, both real and perceived, in community violence.

The impact of the “great disruption” has perhaps been felt most acutely in deteriorating indices of children’s and young people’s health and wellbeing. Because young children’s development reflects an interplay between genetic constitution and environmental experience, and is occurring more rapidly than at any other time in life, changes in their health and wellbeing indicators can serve as a warning to the rest of the community – not unlike the miners’ canary – that humankind is not having a trouble-free adaptation to these changed societal conditions.

Some problems of developmental health and wellbeing

There is a range of health problems that affect children and young people disproportionately. Two of these – accidental injury and mental health – are among the six National Health Priority Areas identified by the Commonwealth, State and Territory governments.

The National Health Priority Areas initiative is Australia’s response to the World Health Organization’s global strategy on health reform. The initiative recognises that strategies for reducing the burden of chronic disease should work across the continuum of care, from prevention through to treatment and management,

and be supported by a strong evidence base. These specific national health priority areas focus national collaboration on chronic diseases that: have potential for health gains and improved outcomes for consumers; pose a significant burden of disease; and have the support of all jurisdictions. The other four national health priority areas are asthma, cancer control, cardiovascular health, and diabetes mellitus.

Accidental injury

Injury, one of the National Health Priority areas, disproportionately affects young people – in particular, young males (NHMRC 1997). Accidents are the leading cause of death in 12–24-year-olds (60 deaths per 100,000 population at risk). Prevalence of injuries in young people is higher than in any other age group, and (apart from the 75 years and older group) death and hospitalisation rates are higher than for any age group. Injury deaths have dropped by around 60 per cent in two decades largely as a result of falling motor vehicle deaths. However, motor vehicle deaths and other transport accidents still remain overwhelmingly the commonest cause of accidental injury and death. Death from injury is around four times commoner in young males than young females.

Mental disorders and suicide

Mental health is another of the National Health Priority areas, and mental disorders also disproportionately affect young people. They are frequently associated with longstanding impairment and emotional and behavioural problems, and are therefore of great relevance to future health.

A 12-month survey of the practice profile of paediatricians in the Barwon region of Victoria in 1996–1997 found that 10 per cent of the childhood population had consulted a paediatrician practising in the community over this period. Thirty-five per cent of children seen had behavioural problems, with 76 per cent of these relating to Attention Deficit Hyperactivity Disorder, which was the most common diagnosis overall (Hewson et al. 1999).

The best available Australian information on 18–24-year-olds derives from the recent National Survey of Mental Health and Wellbeing (ABS 1999). In that survey the prevalence of mental disorders was 27 per cent in young adults, higher than in any other adult age group. Among young males, the commonest disorders were substance abuse disorders, affecting 22 per cent of 18–24-year-olds. For males aged 18–24 years, the commonest forms of substance dependence were alcohol dependence (12 per cent) and cannabis dependence (6.8 per cent). For females, point prevalence rates of depression were 14 per cent, with rates of 10 per cent for both anxiety and substance abuse disorders. Eating disorders may be viewed as a primarily adolescent disorder with an onset rarely after the age of 20 years. Anorexia nervosa has a prevalence of around 0.5 per cent and bulimia around 1 per cent of young women aged 15–25 years.

Among young people, mortality patterns associated with mental disorder have shifted in recent decades. Australia's male suicide rates have been consistently high over the past decade, with 1997 rates for males aged 12–24 being 24 suicides per 100,000, the fifth highest in the world. The highest rates in any age group are for males in their early to mid twenties (40 suicides per 100,000 per year). Mortality due to drug dependence has also increased markedly in the past 20 years in males and is now at the rate of six deaths per 100,000 in the 12–24 year age group.

Other health risks

There is also a range of adolescent health risks with major implications for future health.

- *Tobacco* use is the most important preventable cause of future disease related morbidity and mortality. It is overwhelmingly a problem that begins during adolescence. The proportion of young Australians using tobacco has remained consistently high. In 1998, 16 per cent of 14–19-year-olds were regular smokers, with no difference in rates between males and females. Rates for those aged 20–24 years were 31 per cent. These rates are similar to those reported in the mid-1970s and are particularly disappointing in the light of an apparent downward shift in youth smoking rates in the mid-1980s (Hill et al. 1999). Given the particular health risks associated with smoking for females, the high rates of tobacco use among young women are of great concern.
- *Alcohol* is widely used by young people as a recreational drug from the age of 15 upwards. Heavy alcohol consumption is associated with a diverse range of health problems across the National Health Priority areas. Heavy alcohol consumption is commoner in males. 1.4 per cent of males aged 16–24 years drink more than 5 standard drinks every day and a further 11.2 per cent on most days. The comparable figures for females are 0.1 per cent and 1.1 per cent. Binge drinking appears to have become a commonly accepted part of the youth subculture.
- *Illicit drug use*: Marijuana is the illicit drug most commonly used by young Australians (Hill et al. 1999; AIHW 1998). According to the 1998 National Drug Strategy Household Survey which gathered information from over 10,000 persons aged 14 years and over, 34.6 per cent of 14–19 year-olds reported recent use – up significantly from 28.7 per cent in 1995. Amphetamines were recently used by 11.5 per cent, hallucinogens by 11 per cent, ecstasy by 8 per cent, and sedatives by just under 5 per cent of 16–24-year olds respectively. The proportion using heroin recently was low (1.4 per cent), in contrast to the common perception that heroin is the major drug problem affecting youth.
- *Physical inactivity*: Available data derive from the 1995 National Health Survey. Young males (22 per cent) were twice as likely to report vigorous exercise as females (10 per cent). Rates of physical inactivity increased markedly across the teens. The proportion of young males who reported little or no recreational exercise increased from 40 per cent in 15–17-year-olds to almost 60 per cent in 20–24-year-olds. The equivalent figures for females were 60 per cent to 70 per cent.
- *Obesity*: There has been growing concern about the increasing levels of obesity and lack of physical fitness in children and young people in Australia. In 1985 just 4 per cent of boys and 6 per cent of girls were classified according to their Body Mass Index as being overweight. A more recent study (Booth et al. 2000) found that about 25 per cent of children aged 7–18 years in Sydney and Melbourne were overweight, practising sedentary lifestyles and consuming a diet high in fat and low in the intake of fruit and vegetables. It is of some concern that around a third of children under 12 years do not eat any fruit or fruit products and more than 1 in 5 do not eat any vegetables or vegetable products.

Importance of developmental health and wellbeing

Keating and Hertzman (1999) coined the term “developmental health and wellbeing” to describe the developing human organism’s response to experiences and environmental circumstances. They contend that the “physical and mental health, wellbeing, coping and competence of human populations arise in large part as a function of the overall quality of the social environment” (p. 3). They go on to argue for the existence of a strong base of evidence for the phenomenon of “biological embedding of early experiences through sculpting of early brain development with impacts on the body’s immune system and its response to stress” (p. 4).

Shonkoff and Phillips (2000) identified ten core concepts of early human development from a distillation of the findings of several generations of interdisciplinary developmental science research.

- *Human development is shaped by a dynamic and continuous interchange between biology and experience – children affect their environments at the same time as their environments are affecting them.* No two children share the same environment, and no environment is experienced in exactly the same way by two different children. As Siegel (1999) maintains, an individual’s personality is created from the continual interaction of genetically determined constitutional features and experiential exchanges with the social environment. Although genetic factors may influence the underlying vulnerability, environmental factors play a critical role in the ultimate expression of symptoms.
- *Culture influences every aspect of human development and is reflected in child-rearing beliefs and practices designed to promote healthy adaptation.* Culture provides the template for how to rear children and establishes the expectations about the roles to be played by parents, extended family and others. The role of cultural influences has received scant attention in traditional child development research.
- *The growth of self-regulation is a cornerstone of early childhood development that cuts across all domains of behaviour.* Self-regulation refers to the capacity of a child to manage and moderate their own behaviour, thoughts and feelings. Individual differences in regulatory capacities are rooted in both biological endowment and life experience.
- *Children are active participants in their own development, reflecting the intrinsic human drive to explore and master one’s environment.* There are powerful inborn tendencies towards mastery – this inborn thrust is facilitated to the extent that a child’s environment provides opportunities and supports for growth.
- *Human relationships, and the effects of relationships on relationships, are the building blocks of human development.* Throughout life, intimate and caring relationships are the fundamental mediators of successful human adaptation. Many developmental or behavioural disturbances in infants and toddlers are embedded in disturbances of the caregiver–infant relationship. Successful interventions, whether therapeutic or preventive, are based in part on facilitating that relationship and helping the child and caregiver learn to adapt successfully to each other’s individuality. The recent National Longitudinal Study of Adolescent Health in the United States (Resnick et al. 1997) has also shown that low levels of “attachment” or connection to family and school are important risk factors for many health outcomes in adolescents (for example, emotional distress, suicidal behaviour, violence, and substance abuse).

- *The broad range of individual differences among young children often makes it difficult to distinguish normal variations and maturational delays from transient disorders and persistent impairments.*
- *The development of children unfolds along individual pathways whose trajectories are characterised by continuities and discontinuities, as well as by a series of significant transitions.* Developmental transitions are times when change is pervasive and enduring and are important periods of psychological reorganisation. They provide useful opportunities for intervention.
- *Human development is shaped by the ongoing interplay among sources of vulnerability and sources of resilience.* Risk factors may be found within the individual (difficult temperament, genetic abnormality) or the environment (poverty or family violence). Similarly, protective factors may be individual (good health) or environmental (strong social networks). The cumulative burden of more risk is associated with greater vulnerability, whereas the cumulative buffer of more protective factors is associated with greater developmental resilience. Developmental characteristics that are embedded in deeply chiselled trajectories are less amenable to environmental modification (more canalised). Ultimately, the extent to which any existing pathway can be modified or redirected is determined by both biological and environmental influences as well as the child's own expectations and those of significant others. There is evidence that secure relationships in multiple settings (school, home, peers), the adoption of clear health and social values, and the acquisition of good interpersonal skills are protective against many of the important adverse outcomes in young people. Other potential protective factors that have been targeted in programs promoting "life skills" include empathic understanding, critical thinking, strategies for coping with difficult emotions, and good communication skills.
- *The timing of early experiences can matter, but more often than not, the developing child remains vulnerable to risks and open to protective influences throughout the early years of life and into adulthood.* The concept of developmental plasticity refers to the capacity of the brain to reorganise its structure or function in response to a specific event or perturbation. While genetically modified, it varies inversely with maturation. More multipotentiality exists in the early than later years. Major alterations in person–environment relationships at developmental transitions provide important opportunities for understanding this phenomenon.
- *The course of development can be altered in early childhood by effective interventions that change the balance between risk and protection, thereby shifting the odds in favour of more adaptive outcomes.* When the environment supports a child's sense of agency, his or her motivation to act on the world flourishes, whereas when experience fails to support or punish such action, a child's motivation diminishes, shifts, or finds problematic outlets. When opportunities for agency are limited, psychological growth is more likely to be compromised.

Consilience – the unity of knowledge

One of the phenomena of the last quarter century has been the convergence of evidence from many professional domains about the impact of early life settings on developmental health outcomes. For example, poorer cognitive, behavioural and emotional outcomes for children are associated with parental mental illness, especially maternal depression, and child abuse and neglect (Shonkoff and Phillips 2000). Many problem outcomes have their roots in early childhood

experiences – risks for emotional and behavioural problems, and poor competence and coping, throughout the life cycle are established in early life; early disruptive behaviour is associated with greater risks of early and prolonged delinquency (National Crime Prevention 1999); and substance abuse risks are often related to early life experiences of parenting and disadvantage (Shonkoff and Phillips, 2000). Socio-economic gradients are well recognised in areas such as health, literacy and numeracy, and appear to be established early in life (Fonagy 1996; McCain and Mustard 1999).

Further, it is now widely accepted that the risks of some adult diseases (non-insulin dependent diabetes, hypertension, coronary heart disease) may have their origins before birth (Barker 1998). Studies have shown that measurements made at birth, including length and weight at birth, body proportions and placental weight, are related to increased risks of either later incidence of these diseases or to risk factors for them such as glucose intolerance, or hyperlipidaemia. It has been suggested that these associations are due to fetal programming: a programming stimulus in fetal life is proposed to lead both to changes in size at birth and also to altered homeostatic mechanisms, such as blood pressure regulation or insulin sensitivity, which in turn result in susceptibility to disease in later life (Barker 1998). There is good evidence that nutrition can be an important and potentially central programming stimulus (Harding 2001).

This convergence of understanding from many different fields has been termed “consilience” by popular science writer E.O. Wilson (1998). It derives from an old English word meaning “the unity of knowledge”. This is characterised by a “joining together” of knowledge across disciplines by the linking of facts and fact-based theory to create a common groundwork of explanation. In the field of early human development, researchers, policy makers and practitioners from the social sciences, neuroscience, developmental psychology, early childhood, child health, mental health, public health and criminology are increasingly recognising the benefits of partnership in exploring causal pathways and developing and introducing interventions that will serve a mutuality of interests.

Impact of environmental experience on early brain development

The emerging field of developmental neuroscience is beginning to explore the extent to which the associations between early life and later adverse outcomes are mediated by experiential and environmental impacts on early brain development. However, the nature of the balance between the enduring significance of early brain development and the brain’s impressive continuing plasticity remains controversial in the debate about the effects on the brain of early experience.

While abusive or neglectful care and growing up in a dangerous or toxic environment (for example, lead, alcohol) are manifest risks for healthy brain development, beyond these extremes the nature and boundaries of the environmental conditions necessary for healthy human brain growth are less well known (Shonkoff and Phillips 2000). Animal research on rats (Francis and Meaney 1999) and non-human primates (Suomi 1999), recent medical imaging studies in humans (De Bellis et al. 1999; Bremner and Narayan 1998), and follow-up studies of Romanian orphans reared in European homes (Gunnar et al. 2000) are pointing towards long-term psychological, structural and

physiological changes related to the experience of early trauma and stress. What does seem important in the non-human studies is that caregivers' capacity to moderate the impact of stressful and fear-inducing circumstances on the infant's developing stress system has long-term benefits.

An important finding from longitudinal research on topics such as the emergence of criminal behaviour is that multiple opportunities exist for effective interventions at key developmental transition points (National Crime Prevention 1999). This is consistent with what we know of neural plasticity – namely, that the brain remains open to experiences across broad periods of development. However, what happens in early life is important, especially if sensory deficits impair the development of intact neural pathways (for example, vision). While animal research has shown that rats benefit from enriched environments, and that younger brains react more rapidly and strongly to environmental variation than older brains, the research evidence on human infant brains does not yet allow us to translate these findings into specific recommendations for early interventions for children (Shonkoff and Phillips 2000).

Key issues in understanding and promoting developmental health

While we have learned much about the ingredients for good developmental health outcomes, a range of unanswered questions persist. More coherent Australian policies and practices to promote better outcomes for children and young people need to be better informed by joined-up research across a range of disciplines. Research needs to address the causal pathways to good developmental health as well as the evaluation of what works under what conditions in Australian contexts. It is unlikely that in a diverse society such as our own, one size will fit all.

Need for more integrated and longitudinal research

Those concerned with promoting the science of prevention in developmental health need to learn lessons from the breakthroughs in biomedical science (for example, on the effective treatment of leukemia) which have involved multidisciplinary collaborations. To create the environmental circumstances that will impact on development, health and wellbeing outcomes, we need to learn from one another's research.

The observations made with respect to the prevention of substance abuse could be equally well applied to other outcomes. As Kumpfer et al. (1998: 79) state: "Although more researchers are attending interdisciplinary conferences and reading journals of other fields, academically-based researchers tend to associate with colleagues from similar academic departments. Each discipline tends to view family problems from its own biomedical, psychological or sociological perspective. Researchers are all examining the multiproblem family, yet insights, findings, and solutions are rarely shared. In such cloistered circumstances, cross-fertilisation of ideas is reduced, as is the application of different theories and methodological approaches to solving the growing real-life problems facing families in society . . . Researchers and practitioners specialising in substance abuse, rarely interact with prevention researchers in other fields (for example, delinquency, child abuse and neglect, special education, teen pregnancy, HIV/AIDS, runaway and homeless youth, child welfare, family support and early childhood education)."

Interventions aimed at improving developmental health need to be based on a sound theoretical basis, and longitudinal data are needed to monitor their impact. It is argued that one of the reasons for the growing awareness of the value of early intervention amongst funding bodies has been the emergence over the last decade of the results of some cost-benefit analyses based on long-term follow-up of individuals who had been exposed to interventions in the early years (Károly et al. 1998) – see later.

Interactions of nature and nurture

The evidence emerging in neurosciences clearly points to the importance of both nature and nurture. Nurture affects genetic expression and the environment of cells influences which of the tens of thousands of genes are expressed to affect cell characteristics. As Shonkoff and Phillips (2000: 41) emphasise: “It is time to reconceptualise nature and nurture in a way that emphasises their complementarity, not their distinctiveness: it is not nature *versus* nurture but nature *through* nurture.” High heritability does not mean low malleability: “environmental interventions can significantly improve developmental outcomes, even though individual differences in those outcomes may be strongly influenced by genetic processes” (p. 46).

Developments in molecular genetics and in the understanding of gene–environment interactions will not only increase understanding of the genetic basis for childhood disorders, but also indicate how genetic susceptibility may increase an individual’s sensitivity to specific environmental influences. Those with a propensity to the development of a disorder may be buffered from its emergence if their environments are made more protective, for example, supportive, non-stressful family, school and community environments.

Role of parenting

Parenting style plays an important part in shaping developmental health outcomes. Sensitive and responsive parenting is fundamental to the establishment of a strong attachment relationship between children and their caregivers. The role of parenting and parent–child relationships is being increasingly recognised. Parenting is directly related to child maltreatment. Coercive parenting is associated with disturbances in the development of self-regulation, increased risks of conduct disorder and later substance abuse. Authoritative, warm, consistent, communicative parent–child interaction and watchful monitoring provides the scaffolding to enable children to self-regulate their behaviour and feelings in a growing number of arenas (Shonkoff and Phillips 2000).

Parenting style also affects the development of literacy. There are clear class-related and cultural differences in parenting style, with Australian and British research both finding that coercive parenting is more common in lower socio-economic families (Zubrick et al. 1995; Fonagy 1996; Catalano and Hawkins 1996). There is anecdotal evidence of widespread ignorance about the vulnerability of young children to family circumstances, with some parents believing that the preverbal child is relatively immune to domestic upheavals like interspousal violence.

The “goodness of fit” manifested when parenting style takes into account individual children’s variability is also important. In view of the broad

ramifications of parenting style for health and developmental outcomes, it is not surprising that some public health experts have claimed parenting is the “major public health problem confronting modern societies” (Hoghughli 1998: 1545). However, while there is a range of promising interventions designed to promote sensitive and effective parenting, the universality of the parenting experience encourages the view that everyone is an expert, and many parents are reluctant to participate in programs that could increase parenting capacity.

Cultural influences

Culture has a major impact on early childhood development. Shonkoff and Phillips (2000) note that much of the research in the area is tied to values and personal beliefs, and identify a critical need for ongoing rigorous research in the area. Australia, with its mix of indigenous and immigrant cultures, provides a rich context for the study of cultural influences on developmental health and wellbeing.

Impact of non-parental care

The emergence of care and educational options beyond the family has been part of a revolutionary set of changes to the context of child development. Over 1.5 million Australian children under 12 years of age, or almost half of their age group, experience some type of formal or informal non-parental child care. Twenty per cent of children experience formal care. For many families, non-parental care is their only option in meeting their role in the workforce. The prevalence of child care suggests that the key focus of concern should not be on the possible adverse effects of child care, but rather on the consequences of not providing high quality care to children. The outcomes of child care are related to the quality of care received and how care settings link with the other contexts in which children develop (NICHD 1996).

The most striking characteristic of existing child care provisions is its diversity, meaning that children’s care experiences vary markedly in content and quality. High quality care can enhance socioemotional functioning, cognitive abilities and school performance (Andersson 1989, 1992). Concerns have been raised, however, that early and extensive child care poses risks for infants on the basis of the theory that healthy development requires stable and continuous caregiving from one adult caregiver (Belsky and Rovine 1998). McGurk et al. (1993:19) have argued that a critical aspect of the ecology of the child care experience is the “social, political and moral zeitgeist within which child care is embedded”. Again this highlights the importance of considering social context in understanding children’s development.

Development is multiply determined by characteristics of the child, the family and care environment, and factors in the child’s larger social environment. These factors operate in a complex and integrated fashion in influencing children’s development. Child care is thus one of a complex of interacting influences.

Developmental outcomes of care reflect the inter-relationships among children’s home environments, their individual differences, and non-parental care (Richters and Zahn-Waxler 1998; Howes et al. 1998). Recent research findings from the Competent Children Project (Wylie et al. 1997) found early child care services and home resources play complementary roles with regard to children’s competency levels: “Early childhood education service experience appears to nourish children’s social, communicative, and problem-solving competencies in

particular, while family resources may be important for children's cognitive competencies, as well as their social skills. Home activities were also associated with higher levels of cognitive competencies."

In the United States and Canada socio-economic status has been linked with the type of care parents choose for their children (McKim et al. 1996). However in Sweden, where political support has led to the creation of a publicly subsidised daycare system of exceptionally high quality (Wessels et al. 1996), there is less correlation between the quality of care received and the socio-economic background of children (Howes et al. 1992). Cross-national comparisons highlight the importance of accounting for cultural and social influences on the child care experience.

In sum, child care occurs in the context of family circumstances and events as well as the overall pattern of care. Each context affects the other and can only be understood with reference to each other.

- *Attachment outcomes.* Recent results from the NICHD Study of Early Child Care (for example, NICHD 1997) have indicated that child care alone may be not simply a risk or a beneficial factor for the development of infant-mother attachment. Findings from the study indicate that the effects of child care on attachment depend on the complex interplay of the characteristics of the child care setting, the duration of exposure, the gender of the child, and children's prior relationships outside the context of child care. The recency and methodological strengths of the study (NICHD 1994), and its control for family selection effects, provide strong support for the argument that attachment security is not directly related to child care arrangements.
- *Socioemotional development.* There have been mixed results from research into the short- and long-term effects of early child care experiences on children's social and emotional development. Very few studies have attempted to distinguish between the outcomes for children exposed to child care at various ages. While infancy has been a particular focus, the years from toddlerhood through to school age have been somewhat neglected. In a study of the social competencies of New Zealand children, Wylie et al. (1997) showed that family income and mother's educational qualifications were the strongest predictors of children's social adjustment.
- *Cognitive and language development.* A number of studies have assessed the short- and long-term effects of exposure to child care on cognitive and language development and have found small but detectable gains in children's academic performance, from infancy through to the high-school years (for example, Andersson 1992). Social class is an important variable in understanding the findings for cognitive and language development of children in care. Studies of at-risk and economically disadvantaged samples in high quality care interventions show heightened cognitive performance in children exposed to early childhood education compared with children who did not have this experience (Berrueta-Clement et al. 1984).

Influence of socio-economic inequality

There is a considerable body of research in Australia and overseas pointing towards the relationship between both poverty and socio-economic inequality, and adverse outcomes in developmental health and wellbeing. The extent to which these outcomes can be influenced by proximal interventions (such as

intensive home visitation) as opposed to more global macrosystem changes requires further research. These have been explored in depth in a paper by Nicholson et al. (2000) for the Health Inequalities Research Consortium.

Impact of adverse community conditions

Neighbourhoods characterised by cultural diversity, high population turnover and physical deterioration produce cultural and social disorganisation which, allied to the easy availability of illicit substances, increases youths' vulnerability to substance abuse (Elliott and Menard 1996). Those communities marked by poor parental supervision are associated with higher rates of crime (Weatherburn and Lind 1997), and those marked by weaker connections between families and others in the community are associated with higher rates of reported child maltreatment (Vinson et al. 1996).

Challenge of educating policy makers and the public

The growing awareness of the importance of early human development for later life outcomes is reflected in some of the policies and strategies emerging at a state and commonwealth level, as well as among some of the more influential political thinkers (for example, Latham 2000). State programs such as Families First in New South Wales, Parent CARE in Queensland, and Building Blocks in Western Australia, and the Commonwealth's Stronger Families and Communities Strategy, are injecting new resources into measures to strengthen families and communities at a neighbourhood level.

There is a degree of policy dissonance between strategies such as this and more macro-level policies such as those pertaining to non-parental care. For example, the importance of non-parental care as a program to boost child development and improve educational and socioemotional outcomes especially for disadvantaged families, rather than just as a workforce support program, is not yet reflected in the level of support it receives from government and other sections of the community.

Much remains to be done to convince members of the general community, including many parents, that the family life experiences encountered by children in their early years have lasting impacts. There is also need for a better appreciation of the kinds of learning experiences that benefit children in their early years – learning the alphabet before school entry and access to expensive educational toys and software are far less important than the need for participation in self-directed exploratory play with peers, and the development of secure relationships with caregivers.

Perry (1996) argues that there is a serious mismatch between the paucity of social investment given to promoting optimum development during the early years, and the level of resources invested in later life to deal with the downstream problems of developmental health and wellbeing gone awry.

Capacity building within communities and workforces

It appears that the changes in community life associated with the "great disruption" have meant that families with young children are facing many challenges alone (Fukuyama 1990). New support structures are needed to help communities confront the loss of social capital and community infrastructure associated with changes in the rural economy, workforce patterns, family structures and globalisation. Some of those incorporated in new government strategies offer much promise, but there has been little evaluation of their impact in the Australian setting.

The professional workforce is also challenged with the need to develop new operational paradigms – in health care, for example, from being “the expert” and prescriber of therapeutic action, to facilitator and coach as well as evaluator and interpreter of diverse sources of information. A common challenge across many professional groups is the operational embodiment of the principles of consilience – the need for effective interprofessional and intersystemic collaboration at the local level to facilitate improved developmental health and wellbeing outcomes.

As Sawyer et al. (2000: xii) emphasise in relation to adolescent mental health: “Adolescents with mental health problems do not have problems that are limited to a single aspect of their lives. Rather, their problems are wide-ranging and include suicidal ideation, smoking, alcohol and other drug use and abuse. There is constantly a need to develop joint policies and strategies across the different services that provide help to young people with mental health and related problems (for example, school-based services, paediatricians, family doctors, mental health services, and drug and alcohol services).” Similar needs, across different sets of services, exist for infants, toddlers, preschoolers and primary school aged children.

Shonkoff and Phillips (2000) have identified a need for decision-makers to take bold actions to design and implement coordinated, functionally effective infrastructures to reduce the long-standing fragmentation of early childhood policies and programs. They have also urged a comprehensive analysis of the professional development challenges facing the early childhood field.

Recognising continuities and discontinuities in development

The balance between cumulative risk and protective factors in early childhood establishes the bottom line for successive developmental transitions. At each stage of development, possibilities exist for intervening to minimise risk or enhance protection. For example, enhanced attachment can be promoted between mothers and temperamentally difficult infants (van den Boom 1994), parenting skills can be enhanced for toddlers and older children by skill-based behavioural programs such as Triple P (Sanders and Markie-Dadds 1996), and in older children the risks of some adverse outcomes can be minimised by programs that aim to increase social skills and attachment to schools (Hawkins et al. 1992). Somewhat like immunisation, “one shot” programs in children with an accumulation of risk are unlikely to be successful – “booster” programs at key developmental transitions are beneficial (National Crime Prevention 1999), and many families need ongoing support.

Adolescence is a time when one can look both backwards to the impact of risk and protective factors on current health status and forward to their likely impact in adult life. Whether one follows children and young people prospectively or examines their progress retrospectively, it is clear that risk does not equate to destiny.

Thus, it is important to adopt developmental approaches which do “not see life as marked by one steady march toward adulthood that is set early in life, or one steady line of change, either for better or for worse” (National Crime Prevention 1999: 8), and to acknowledge that “what occurs is a series of phases, a series of points of change, a series of transitions. These phases and transition points are where intervention can occur most effectively” (National Crime Prevention 1999: 8).

Adolescence is a particularly important transition point. This is the period in which several behaviours with the potential to have a long-term adverse impact on health (for example, tobacco use) often become established. For too long these behaviours have been viewed as part of the normal turbulence of adolescent development. It has been assumed that adolescents will mature out of health risk behaviours in young adulthood.

It is only in the past two decades that adolescent health risk-behaviours have attracted the attention they deserve. It is now clear that many aspects of health initiated in the teens are carried into adulthood where their persistence contributes ultimately to the burden of disability and mortality. Examples include common mental disorders characterised by depression and anxiety where most recurrent disorders have a first onset before the age of 25 years. Continuities in tobacco use, dietary choice and patterns of physical inactivity also appear very strong, whereas for illicit drug and alcohol use, and sexual risk taking, social transitions in young adulthood appear influential. (Chen and Kandel 1995).

The case for investing in early intervention

A growing body of knowledge is accumulating, predominantly from North American research, of the benefits of early intervention to maximise developmental health and wellbeing (Shonkoff and Meisels 2000; National Crime Prevention 1999; Karoly et al. 1998). There is a small body of Australian data which also demonstrates the impact of a limited range of programs such as home visitation in infancy (Armstrong et al. 1999) or behavioural approaches to enhanced parenting (Williams et al. 1998). Doing nothing is a choice that Keating (1999) argues will lead to the development of a technological and cognitive elite separated from an increasingly marginalised mass population in which the problems of developmental health and wellbeing will be over-represented.

Cost effectiveness of early intervention

Early intervention means intervention early in the pathway, which may or may not mean early in life. A developmental approach is characterised by “a pervasive emphasis on pathways and on aspects of time and timing. Pathways are roads through life that fork out in different directions at the kinds of crucial transition points that mark new experiences or relationships” (National Crime Prevention 1999: 9).

The concept of multifinality encapsulates the notion that similar risk and protective factors contribute to a range of adverse outcomes. For example, Table 2.1 summarises a range of potentially modifiable social, family and individual developmental risk factors for a range of adverse adolescent outcomes that have ongoing implications for later health education and wellbeing. A similar table outlining the risk and protective factors in the early years is shown as Table 2.2 (Huffman et al. 2000).

These matrices of associations carry important implications for the development of early intervention strategies whether they have health, social, educational or criminal behaviour outcomes in focus. On this basis, there have been calls for intervention approaches that target important risk determinants that cut across multiple health and wellbeing issues. Broadly based strategies targeting a range of risk and protective factors will benefit a number of outcomes.

Table 2.1. Potentially modifiable social and developmental risk factors for adolescent health and social problems with major implications for later health and education

		Substance abuse	Antisocial behaviour	Sexual risk taking	School drop-out	Depression	Suicidal behaviour
Risk factors	Community factors						
	Availability of means/opportunity	✓	✓	✓			✓
	Favourable community norms and laws	✓	✓	✓			
	Media portrayals	✓	✓				✓
	Transitions & mobility	✓	✓		✓		
	Low neighbourhood attachment & community disorganisation	✓	✓				
	Extreme economic deprivation	✓	✓	✓	✓		
	Family factors						
	Family history of problems	✓	✓	✓	✓	✓	✓
	Parental style	✓	✓	✓	✓	✓	✓
	Family conflict	✓	✓	✓	✓	✓	✓
	Family attitudes to behaviour	✓	✓		✓		
	School factors						
	Antisocial behaviour in school	✓	✓	✓	✓		
	Academic failure/learning problems	✓	✓	✓	✓		✓
	Lack of commitment to school	✓		✓	✓	✓	✓
	Individual factors						
	Rebelliousness	✓	✓		✓		
	Friends' behaviour	✓	✓	✓	✓		✓
	Early initiation of behaviour	✓	✓	✓	✓	✓	✓
	Constitutional factors	✓	✓			✓	✓
	Homelessness	✓	✓	✓	✓	✓	✓
	Indigenous status						
Protective factors	Healthy standards	✓	✓	✓	✓		✓
	Social skills	✓	✓	✓	✓		
	Healthy attachments	✓	✓	✓	✓	✓	✓

Source: Adapted from Toumbourou et al. 2000.

This approach is dependent on an understanding of the relationships and risk processes that exist in between the type of determinant shown in Table 1 and the ultimate health, social and educational outcomes. At the current time, that understanding is largely dependent on information from overseas studies that may not be invariably applicable in the Australian context.

What is clear from this research in both children and young people is that the costs of early intervention strategies are frequently far less than the costs of the later management of the problems they are designed to prevent. For example, the Perry Preschool Program, which provided four half-day sessions of structured preschool experience for disadvantaged 3–4-year-old African Americans combined with weekly home visits to their families, returned savings

Table 2.2. Risk and protective factors for preschool children identified in the literature by Huffman et al. 2000	
Risk factors	Protective factors
Individual level Low birth weight and neurodevelopmental delay Other medical problems Psychophysiological problems (eg. problems in brain or other organs that limit child's cognitive and self-regulatory capacities) Early cognitive deficits Difficult temperament and personality (eg. hyperactivity or aggressive behavior) Early behavior and adjustment problems	Child's self-confidence Higher cognitive functioning Easy temperament and personality Early history of positive functioning
Microsystem level (family, peers, daycare, school) Family composition (eg. divorce and remarriage) Low level of maternal education Parental substance abuse Problematic maternal relationship history Parental psychological problems Poor parenting practices Maltreatment Insecure attachment in early years Difficulties with peer relationships Child care by someone other than the mother (eg. child care facility) Negative characteristics of kindergarten and first grade classes (eg. large class sizes, fewer parent-teacher meetings) Poor relationships with teachers	Residence with both parents or remarriage after divorce Higher level of maternal education Stable, organised, and predictable family environment Cooperative parental coping Social support, internal perceptions of control (girls) Secure attachment in early years Larger number of classroom friends High-quality child care at an early age (for children who have insecure attachments to a primary caregiver) or emotional support from an alternative caregiver Warm and open relationships with teachers
Exosystem level (neighborhood and socio-economic status) Immigrant status Minority status Low socio-economic status	Higher socio-economic status
Macrosystem level (cultural beliefs and values) No risk or protective factors reported	
Source: ABS 1999.	

over the subsequent 27 years of more than US\$6 for each \$1 invested (Weikart and Schweinhart 1992). Similarly, the prenatal and infancy nurse home visitation program in Elmira (New York), which involved regular home visitation from the third trimester of pregnancy until the child's second birthday, also returned savings in the most disadvantaged group of single, poor, teenage first-time mothers of around \$6 for every dollar invested over the next 15 years, by achieving better outcomes in both mothers and children (Karoly et al. 1998; Olds et al. 1997).

Costs of maintaining the status quo

To do nothing about ameliorating the impact of the “great disruption” on the lives of children would ill-equip Australia to play a prominent role in the global community as a knowledge-based economy. Keating and Hertzman (1999: 15) assert that: “The ability to ‘apply labour’ with skill and judgement presumes that high levels of health, competence and coping exist in the population so that human resources are available for use in knowledge-based economies that rely on an innovation dynamic. The larger the proportion of the population able to participate productively in such economies the greater the likelihood of increased economic prosperity.”

Keating and Hertzmann (1999: 15) go on to argue that: “The wealth of nations in the Information Age depends heavily, perhaps primarily, upon their ability to promote the developmental health of their populations.” As in the United States, it is likely that in Australia: “Striking disparities in what children know and can do are evident well before they enter kindergarten. These differences are strongly associated with social and economic circumstances, and they are predictive of subsequent academic performance. Redressing these disparities is critical, both for the children whose life opportunities are at stake and for a society whose goals demand that children be prepared to begin school, achieve academic success, and ultimately sustain economic independence and engage constructively with others as adult citizens.” (Shonkoff and Phillips 2000: 5)

Universal versus targeted service provision

There is much debate about the proper balance of efforts at improving developmental health and wellbeing outcomes. The universalists and the advocates for targeted solutions both argue their case on the basis of a better return on investment. The universalists point to a gradient in outcomes across the whole socio-economic spectrum and emphasise the sheer size of the middle range of the population who could benefit from interventions known to improve outcomes. They also argue that universal approaches are less stigmatising and are more likely to enlist higher needs families in service provision.

The advocates for targeted solutions point to the limited amount of funding usually available for intervention and the dilution of impact that is likely to ensue if it is spread across the whole population, and the historical evidence of the ability of the middle-class to capture welfare programs that are likely to have particular relevance for higher needs families. They fear that, because of the great difficulty in engaging high needs families compared with those who are more receptive to intervention, resources will never trickle down to those with the greatest need – inequality could actually be worsened. There is also some evidence that while there is a gradient, the magnitude of differences in outcomes experienced at the bottom end of the distribution warrant more attention being given to selective or indicated interventions.

Australia and some other countries, such as the United Kingdom, have tended to reach a compromise position – for example, in urban renewal projects where universal interventions are offered in localities of high need identified on the basis of selected indicators of developmental health and wellbeing. Targeting advocates nevertheless point to the fact that most of the disadvantaged in a country don't live in such areas and miss out on such locality-based interventions, particularly if funding available for spreading across the rest of the community is limited and unlikely to resource the additional efforts required to reach high needs families. In New Zealand and Victoria, maternal and child health nurses are funded to provide additional services to high needs families, but this may have a stigmatising effect for families known to be receiving more than basic services.

Offord and colleagues (1999) provide an excellent summary of the debate concluding that, with respect to the mental health problems, the jury is still out on the best mix of clinical, targeted and universal interventions.

Contemporary Australian understandings

There have been notable attempts to translate the research evidence into policy and practice in Australia. For example, the Stronger Families and Communities Strategy attempts to introduce a range of early intervention strategies into disadvantaged communities across Australia. But our efforts are frequently poorly informed by evidence of program efficacy in our own context. The establishment of a dynamic research partnership between researchers, policy makers and practitioners could begin to address this gap more effectively than at present.

What do we know in Australia?

There is a growing body of cross-sectional data of risk factor prevalence and on developmental health and wellbeing outcomes at a state and national level. These include state (Silva et al. 1999; Zubrick et al. 1995; Vinson 1999) and national reports on the health status of Australian children and young people (Moon et al. 1998, 1999; Sawyer et al. 2000). Western Australia is uniquely placed in having a variety of population registers, such as the Western Australian congenital malformations and cerebral palsy registers (Bower and Stanley 1983; Stanley and Watson 1985).

There has, however, been a dearth of longitudinal studies of developmental health and wellbeing in Australia. Amongst the exceptions are: the Mater study in Brisbane (Najman et al. 1997) which among other things has examined the impact of socio-economic disadvantage on developmental health outcomes; the Raine study in Perth (Silva et al. 1999) which has focused more on physical health outcomes; the Australian Temperament Project (Prior et al. 2000) which investigates pathways to positive and problematic adjustment and the contribution of child, family and environmental factors to successful functioning; and the Port Pirie cohort study (McMichael et al. 1992) that examined the impact of pre- and post-natal lead exposure on child development (see Nicholson et al. in Chapter 3 of this volume for more details).

While Australia has some early intervention programs that are based on home visiting (for example, Vimpani et al. 1996), parent training (for example, Sanders and Markie-Dadds 1996), and ecological intervention for aggressive behaviour and bullying (for example, Rigby 1994), there have been few

longitudinal evaluations of their outcomes. They have, however, alerted policy-makers to the importance of prevention, and the place of community development projects in providing the necessary supports to families to reduce the level of developmental risk to their children.

What we don't know in Australia

Throughout this chapter, the lack of outcome data on the effectiveness, in the Australian context, of early intervention programs that are based on overseas models, has been stressed repeatedly. The impact on children and young people of broadly-based community and economic interventions is often not addressed; some have called for the development of child impact statements as a way of monitoring the impact of such interventions. Moreover, there is a need for more broadly-based intersectoral research examining the impact of risk and protective factors from a variety of perspectives – for example, by establishing collaborations involving policy-makers, practitioners and academics from multiple disciplinary backgrounds, to examine the impact of issues like non-parental care on developmental health and wellbeing outcomes.

The recent interprofessional literature review by Homel's team for National Crime Prevention (1999) is one helpful paradigm. The experience of the Canadian Institute of Advanced Research Human Development group (Keating and Hertzmann 1999) indicates how much can be gained by deliberate efforts to forge ongoing linkages between what are complementary but often disconnected research traditions.

Shonkoff and Phillips (2000) identify a research agenda that includes: enhanced understanding, detection and treatment of early precursors of psychopathology; improved preventive and ameliorative interventions for women and children who are exposed to biological insults and adverse environmental conditions, as well as for children with identifiable disabilities; the identification of modifiable mechanisms that link impoverished family resources to both adverse outcomes for individual children and persistent disparities across groups of children in learning skills and other developmental capacities; and (of particular relevance in Australia) refined understanding of how interventions and the staff that implement them can work effectively with families that differ along dimensions defined by race and ethnicity, immigration status, religion, or other cultural characteristics.

There are other research needs that we also share with other countries, including the integration of child development research with neuroscience and the emerging field of molecular genetics.

According to Shonkoff and Phillips (2000: 13): "Enormous potential exists at the intersection of child development research, neuroscience, and molecular and behavioural genetics to unlock some of the enduring mysteries about how biogenetic and environmental factors interact to influence developmental pathways. These include: (a) understanding how experience is incorporated into the developing nervous system and how the boundaries are determined that differentiate deprivation from sufficiency and sufficiency from enrichment; (b) understanding how biological processes, including neurochemical and neuroendocrine factors, interact with environmental influences to affect the development of complex behaviours, including self-regulatory capacities, prosocial or antisocial tendencies, planning and sustained attention, and adaptive responses

to stress; (c) describing the dynamics of gene-environment interaction that underlie the development of behaviour and contribute to differential susceptibility to risk and capacity for resilience; and (d) elucidating the mechanisms that underlie non-optimal birth outcomes and developmental disabilities.”

Importance of linking research to policy and practice

“Science is focused on *what we do not know*. Social policy and the delivery of health and human services are focused on *what we should do*” (Shonkoff 2000: 182). Scientists are trained to ask questions and to be guided by facts, whereas policymakers are governed by political and economic forces that emanate from society; service providers are more akin to policy makers in needing to “act” before all the data are in. Shonkoff calls for a commitment to “cross-cultural” translation among these three groups as a means for reconciling these differences and increasing the use of knowledge to improve the lives of children and families.

A recent volume of *Development and Psychopathology* was devoted to the social policy implications of developmental psychopathology, and in making a plea for increasing sophistication of research so that it might better inform public policy, its editors (Cicchetti and Toth 2000: 553) argue for courage amongst young investigators to grapple with complex issues and tackle research with policy implications: “The development of research agendas that address normal and abnormal development across psychological and biological domains throughout the life course is critical if policy is to be formulated in the best interest of society. Such well-designed and well-planned investigations are necessary to avoid unwarranted assumptions and the misuse of research data.”

Cicchetti and Toth (2000: 554) conclude that: “The 21st century presents us all with a unique opportunity to translate rhetoric into action and to truly achieve a research-informed policy agenda that will benefit the welfare of all.” The authors of this chapter fully endorse this sentiment.

Australia is at a challenging moment in the development of more “joined up” policies and programs to address contemporary problems of developmental health and wellbeing. It is clear that the “silos” that have emerged to provide our current mix of services are ill-equipped to provide the integrated sets of programs that children and young people need for optimum development.

Similarly, research is needed that brings together different disciplines that can address the foundations of developmental health and wellbeing and the causal pathways to dysfunction. Furthermore, an integration of quantitative and qualitative methodologies will be needed to help unpick not only what works or doesn’t work, but how and why this might be so. A virtuous cycle of growing understanding and improvement would be a welcome outcome.

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3

Longitudinal studies of children and youth *Implications for future studies*

Jan Nicholson, Ann Sanson, Lynn Rempel, Diana Smart, George Patton

Over recent decades, some indicators of the health and wellbeing of children and young people in Australia have improved. However, in other areas, the evidence suggests that children's outcomes have remained constant, or have even declined.

There are areas of particular concern. Mental health problems affect up to 20 per cent of young people, and when persistent, are associated with poor educational outcomes, relationship difficulties, high rates of welfare dependence, delinquency and criminality. Suicide rates in Australia are among the highest in the western world, especially for young men in rural settings. The wellbeing of marginalised groups such as children in protective care, juvenile offenders, the young homeless and those who drop out of school are cause for concern. There are atopic and chronic health problems such as asthma, obesity and myopia which are affecting growing numbers of young people, and which have been described as the "new plagues" of modern western societies. And preventable injuries during childhood and harmful health risk behaviours (such as substance abuse) during adolescence remain prevalent despite the introduction of a range of national health promotion and prevention initiatives.

These problems are distributed unequally within the Australian population and are more prevalent for children disadvantaged by low income, poor parental education, rural location, and single parent and Indigenous family status (see Nicholson, Tully and Vimpani 2000; Turrell et al. 1999; Vimpani et al. in this volume).

It has been argued that the changing nature of Australian childhood environments accounts for these patterns. A significant evolution has occurred in the structure and functioning of Australian families, the types and extent of child care services employed, physical environments, and the broader social and economic climate of the nation. Such societal changes and the resulting disruptions experienced by families and communities have been "sudden, dramatic and of unprecedented scope" (Keating and Hertzman 1999: 2), and show every sign of continuing at a similar pace.

The long-term impact of our rapidly changing society on young people and families is not well understood. Research is needed to identify the complex interactions between the resources of individuals and their families, the pressures exerted by their environments and social structures, and how these factors determine the wellbeing and health of future generations of Australians. Such information will be essential for developing social, health and other policies and preventive services to encourage the full and positive participation of young people and families in community life.

Longitudinal study designs

Our understanding of human development and wellbeing has been informed through the use of a range of research methodologies. Large cross-sectional studies are useful for providing data representative of populations (for example, prevalence rates, age differences). However, such studies do not track changes within individuals over time, and are therefore limited in their capacity to build causal models to explain outcomes (Bergman et al. 1989). Randomised controlled trials (RCTs) are one of the most powerful tools for identifying causal relationships. However, practical and ethical constraints (such as those associated with withholding interventions) may limit their usefulness, and RCT designs are generally restricted in the range and number of variables that can be explored simultaneously (Bergman et al. 1989). Longitudinal study designs have long been recognised as important vehicles for obtaining high quality evidence about the determinants of development across the lifespan (Farrington 1991; Rutter 1994).

According to Farrington (1991) and Rutter (1994), the advantages that longitudinal approaches have over other research designs include their ability to:

- track patterns of development over time including continuities, discontinuities and transition points;
- develop and test models of causal relationships between early events or characteristics and later outcomes;
- model and establish developmental sequences and pathways;
- identify different manifestations of the same underlying theoretical construct at different ages;
- identify “critical periods” in human development for exposures and risks, and establish optimal times for intervention to interrupt maladaptive pathways; and
- tease out the relative contributions of the multitude of factors that impact on development.

Longitudinal studies come in a variety of shapes and sizes each of which have strengths and weaknesses (Loeber and Farrington 1994; Magnusson et al. 1994; Menard 1991). The key designs are illustrated in Table 3.1 using hypothetical studies of early childhood. For each design, examples of the ages of the study cohorts are shown at various waves of data collection.

Single-cohort studies

The most common longitudinal study design is a single-cohort design in which a sample of a defined age is recruited at one point in time and followed up at subsequent intervals (or data collection waves). Especially in early childhood, the age range within each cohort is typically narrow (less than one year). The time intervals between data collection waves vary across studies. Ideally, these are determined by the research questions, but also often by convenience and available resources. As with all longitudinal studies, this design enables the prospective collecting of data and thereby minimises retrospective reporting biases.

The single-cohort design has the advantage of simplicity, and allows tracking of developmental pathways for the group involved. Since cohort members move simultaneously through major developmental periods, the need to introduce new measures and undertake data collection within new settings (for example,

Table 3.1. Longitudinal study designs					
Design	Cohorts (C)	Illustrative ages for cohorts at four assessment points			
		1	2	3	4
Single-cohort	C1	birth	2 years	4 years	6 years
Cross-lagged	C1	birth	2 years	4 years	6 years
	C2		birth	2 years	4 years
	C3			birth	2 years
Cross-sequential	C1	birth	2 years	4 years	6 years
	C2	2 years	4 years	6 years	8 years
	C3	4 years	6 years	8 years	10 years
Single-cohort, multiple-age		0 years	1 year	2 years	3 years
		1 year	2 years	3 years	4 years
		2 years	3 years	4 years	5 years
		3 years	4 years	5 years	6 years

Source: The authors, 2002.

when the child commences school) occurs simultaneously for all study participants. This makes data collection changes easier to implement in a practical sense than for the other designs described below.

However, in single-cohort designs, age effects, cohort effects, and time-of-measurement effects are confounded and cannot be distinguished. Age effects refer to developmental changes associated with the age of the cohort members (for example, from infancy to toddlerhood). Cohort effects are changes that arise from characteristics unique to the particular cohort examined (for example, a cohort born in 1990 versus one born in 2000). Time of measurement effects reflect changes in the broader social or environmental influences that occur at the times at which data are collected (for example, changes in unemployment rates, political events, environmental conditions).

As an illustration, consider the case of an observed increase in computer literacy over time in a particular cohort. This trend may be due to: the maturation of cohort members; or the specific conditions experienced by the cohort (for example, rapid increase in children's exposure to computers over the lifespan of the cohort); or the specific times at which computer literacy is assessed (for example, the waxing and waning popularity of computer-based activities); or any combination of these. This confounding limits the degree of confidence with which findings from single-cohort studies can be generalised to other (earlier or later) cohorts (Farrington 1991).

Another limitation of the single-cohort design is that these studies are relatively slow at producing results on long-term or later life outcomes. Researchers need to be patient and wait for the cohort to mature before findings about the impact of early factors on later development are available. Because of the time lag involved, there is the danger that changes in policy and social environments will reduce the relevance of findings for current policy and practice. In addition, measurement techniques may become obsolete over time, and measures that were introduced at the start of the study may no longer be cutting edge as the study progresses.

Despite these limitations, single-cohort longitudinal study designs remain popular. As discussed below, single-cohort studies have made an impressive contribution to our knowledge of children's health and development. Studies such as the Australian Temperament Project, the Christchurch Health and Development Study, the Dunedin Multidisciplinary Health and Development Study, and the Mater-University Study of Pregnancy (see Table 3.2) have remained influential information sources into their second and third decades of data collection.

Cross-lagged studies

A cross-lagged (or "cohort-sequential") design is one of a class of "accelerated longitudinal" or "longitudinal sequence" designs (Schaie 1965). In this design, one cohort is recruited at the initial age of interest and followed forward for one or more assessments, at which time a second cohort is recruited at the initial age of interest and followed forwards simultaneously. Further cohorts can be added in a similar manner at later time points, as shown in Table 3.1.

With this design, data are available from two or more cohorts at the same age, but from different times of measurement. Therefore, the design makes it possible to distinguish between age effects and time-of-measurement or cohort effects, although it is still not possible to differentiate fully between the latter two. If these latter effects are not evident, it is also sometimes possible to combine data collected from the different cohorts at the same age for specific analyses. This increases the overall sample size, improving analytic power and facilitating the investigation of rare events. As with the single-cohort design, the introduction of new assessment methods is staggered by the age of the first cohort, which eases the demands on the researchers (when compared with cross-sequential designs, below). However, the time lag remains, and this design does not provide any more rapid answers to issues about the long-term outcomes than is the case for single-cohort studies.

Cross-lagged designs have been employed relatively infrequently in Australian research on the development of children and youth. One of the few local examples of this design is the Youth in Transitions Study (Fleming and Marks 1998) which examines early adulthood outcomes for four nationally representative age cohorts that were each recruited during adolescence (see Table 3.2).

Cross-sequential and single-cohort, multiple-age studies

A further elaboration of "accelerated longitudinal" or "longitudinal sequence" designs is a cross-sequential design. In this design, two or more cohorts of differing ages are selected at the start of the study, and each is followed forwards, as shown in Table 3.1. For a time-limited study, a cross-sequential design may involve the second cohort being the same age at the beginning of the study as the first cohort is at the end of the study (see Farrington 1991).

This design provides data on all target age groups in a shorter space of time. For example, cohort one may be followed from 0 to 4 years, cohort two from 4 to 8 years, and cohort three from 8 to 12 years, effectively providing data over a 12-year developmental period from only four years of data collection. An alternative approach is shown in Table 3.1, where data on a ten-year age period is collected in six years and all cohorts run forward for as long as research needs and funding dictate.

A variation on this design is a single-cohort, multiple-age design. In this design, a single sample covering a broad age range is recruited, and cohort members of all ages are followed forwards (Table 3.1). For example, the National Longitudinal Survey of Children and Youth conducted in Canada has recruited children ranging in ages from birth to 11 years. Due to its very large sample size (more than 22,000), this cohort can be divided into age groups, and analyses conducted that treat each age group as a separate cohort (Table 3.3).

The Promoting Adjustment in Schools cohort is a local example of a single-cohort, multiple-age design (Table 3.2). Respondents were recruited from schools in two waves one year apart, with stratification by school year, and recruitment across preschool and Years 1 to 3, and followed forwards for three years. Analyses may be conducted for the whole sample, or by recruitment wave, year cohort, age group, or some combination of these.

Both the cross-sequential and single-cohort, multiple-age designs are complex and challenging to execute, especially at the start-up phase. Recruitment methods and assessment instruments for each age group need to be developed and administered simultaneously, and measurement approaches need to remain consistent across waves in order to retain comparability across samples.

However, they also hold substantial advantages over simple single-cohort designs. In the case where there is considerable overlap in the ages of children in the different cohorts at various follow-up points, these designs allow for separate assessments of age effects, time-of-measurement effects, and cohort effects. Again, where time-of-measurement and cohort effects are minimal, the data from multiple cohorts collected at the same age can be combined to increase sample size and hence analytic power.

This design has the further advantage of providing data on later developmental periods and pathways without needing to wait for a single cohort to mature. Because results are produced more quickly, there is less concern that theories, instruments and policy issues will be out of date before the results are available. Importantly, follow-up of more than one cohort (or age group) increases confidence in the generalisability of results.

These advantages help to explain why these designs are increasingly being employed in current longitudinal research both within Australia and internationally.

Review of longitudinal studies involving children and adolescents

Tables 3.2 and 3.3 summarise major longitudinal studies conducted in Australia and New Zealand, and internationally, respectively. The tables are not comprehensive, but aim to provide an overview of most influential studies. Studies were included if they met the following criteria: they commenced no earlier than 1970; data were collected prospectively on at least three occasions; and sample size exceeded 500.

In general, the studies included have involved representative samples, and either no intervention or the intervention component has not been a major focus of the study. However, we have allowed ourselves to include some exceptions to these criteria when the studies are useful illustrations of alternative designs, and/or when they have been high-impact studies. The tables do not include

details of studies that are in development or have commenced recently, since three waves of data collection were needed to count as an actual longitudinal study. However, information on some of these new studies is given in the text.

Information on studies was collected from published information and websites, as well as through personal contacts of the authors. In addition, for some studies, two of the authors (JN and LR) obtained responses to a brief survey from study investigators which included a series of open-ended questions about the strengths and limitations of the study, study outputs, and funding issues.

Australian and New Zealand studies

Table 3.2 lists 14 Australian and New Zealand longitudinal studies of childhood and/or adolescence. The table summarises the key characteristics of the studies, including sample sizes, research foci, and frequency of data collection. Single-cohort studies are presented first followed by cross-lagged, cross-sequential or single-cohort, multiple-age studies. As illustrated by the table, Australian and New Zealand researchers have clearly established themselves as world leaders in longitudinal studies, with a predominance of single-cohort studies commencing in early life. Some interesting differences appear between the types of studies conducted in the two countries, and these are described below.

New Zealand has produced two of the most internationally well-recognised birth cohort studies – the Dunedin Multi-Disciplinary Health and Development Study (Silva and Stanton 1996), and the Christchurch Health and Development Study (Fergusson et al. 1989; Horwood and Fergusson 1998). Both are broadly focused epidemiological studies, one with annual measurement throughout childhood (Christchurch) and the other with biennial but more comprehensive assessments (Dunedin). The studies have reduced the frequency of data collection as the cohorts have entered early adulthood to every five and six years (Christchurch and Dunedin respectively). Both studies have been prolific and influential, and have maintained exceptional levels of cohort participation. The Dunedin study has produced in excess of 800 publications over nearly 30 years, and the Christchurch study has produced more than 250 publications in nearly 25 years.

These two studies provide an interesting contrast in management and funding models.

The Christchurch study has been funded almost exclusively from New Zealand research funding sources, and is the product of a small, stable core team of three to four researchers. Collaborative publications with researchers outside the core team have been more common in recent years, but are still rare. It has been suggested that this approach produces a high degree of focus and consistency in the research questions and data analytic strategies employed (Fergusson, personal communication, June 1999). The quality of the publications from this study (primarily in top ranking, international journals) suggests that the narrow control has not detracted from the relevance and importance of the data produced.

While the Dunedin study was initially funded by New Zealand research funding sources, it diversified in later years to also receive substantial international funding. Data collection is intensive, and correspondingly costly. For example, the 26-year follow-up involved the assessment of four people per day in the laboratory, with biological samples collected, and participants paid for their time (Poulton 1999). This type of research exceeds the funding typically

Table 3.2. Australian and New Zealand longitudinal studies of children and young people commenced since 1970 with sample size > 500									
Study	Location	Year began	Sample size	Special criteria	Foci	Age at start	Follow ups	Age at last follow up	Data collection *
<i>Sigle-cohort studies</i>									
Aboriginal Birth Cohort (Sayers & Powers 1997)	Darwin, Northern Territory, Australia	1987	686	Aboriginal ethnicity	Relationship between birth antecedents, peri-natal indices and a range of growth, nutritional and health outcomes	Birth	Multiple	10-13 years, ongoing	MR; HR; HP; DA
Australian Temperament Project (Prior et al. 2000)	Victoria, Australia	1983	2,433	Representative of Victoria	Temperament, emotional/ behavioural developmental pathways	4-8 months	12	18 years, ongoing	MR, HP; EP; SR, OR
Christchurch Health and Development Study (Fergusson et al. 1989)	Christchurch, New Zealand	1977	1,265	Representative of Christchurch	Epidemiology of child health and wellbeing; family studies; health services research	Birth	20	21 years, ongoing	MR; HR; EP; SR; PR; OR
Dunedin Multidisciplinary Health and Development Study (Silva & Stanton 1996)	Dunedin, New Zealand	1972	1,037	Representative of Dunedin	Development and epidemiology of developmental disorders and health problems, and health behaviours	Birth	11	26 years, ongoing	MR; EP; SR; HR; DA
Mater-University of Queensland Study of Pregnancy (Bor et al. 1993; Najman et al. 1997)	Brisbane, Queensland, Australia	1981	8,556	All births in a single hospital	Determinants of health and wellbeing; health inequalities; obstetric outcomes; mother's health	Pregnancy	5	21 years, ongoing	MR; HR; DA; SR
Plunket National Child Health Study (Alison et al. 1993)	National New Zealand	1990	4,286	Stratified by Maori/non-Maori	Health care practices and services in early childhood	Pregnancy	9	4 years	MR
Port Pirie Cohort Study (McMichael et al. 1992; Tong et al. 1996)	Port Pirie South Australia	1979-1982	723	Focus on lead exposure	Effects of pre-natal and post-natal lead exposure on neuropsychological development	Birth	10	13 years	MR; DA; HR

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Tasmanian Infant Health Study (Dwyer et al. 1995; Ponsonby et al. 1994)	Tasmania, Australia	1988-1995	10,562	Focus on Sudden Infant Death Syndrome	Causal factors in fetal and infant determinants of childhood disease	Birth	4	8 years, follow-up with partial samples, ongoing	MR; HR; DA
WA Pregnancy Cohort (Raine) Study Newnham et al. 1993; Blake et al. 2000	Perth, Western Australia	1989	2,860	Initially an RCT to test ultra-sound during pregnancy	Currently examining factors influencing language development, learning and behaviour	Pregnancy	5 pre-natal and 6 post-natal	10 years, ongoing	MR; DA; HP
Cross-lagged, cross-sequential and single-cohort, multiple-age studies									
Australian Youth Survey (DEET) 1991	National, Australia	1989	5,500, + 4 annual samples of 1200	Representative samples, one multi-aged (1989); 4 additional single-age, new samples of 16-year-olds; cross-lagged design	Causes and consequences of educational participation	16-19 years	9	19 - 27	SR
Longitudinal Surveys of Australian Youth (www.acer.edu.au/research/vocational/isay/intro.html)	National, Australia	1995 1998	6,000	Two representative year level cohorts, cross-lagged design	Influences on patterns of participation in education, training and employment	Year 9	6 3	21 18, ongoing	SR, EP
Promoting Adjustment in Schools (PROMAS) Nicholson et al. 2002.	Brisbane Queensland, Australia	1998, 1999	1,024	Representative random sample, dis-advantaged communities, stratified by age and gender	Influences of family risk factors on mental health and receipt of school-based interventions	Preschool, Years 1-3	4-8	6-10 years	PR; EP
Victorian Adolescent Health Cohort Study (Patton et al. 1998)	Victoria, Australia	1992-2001	2,032	Stratified sample by school type; clustered by school class	Adolescent mental disorder, substance abuse, antisocial behaviour, social outcomes	14-15 years	7	20-21 years, ongoing	SR, ParR
Youth in Transition Cohorts (Fleming & Marks 1998)	National, Australia	1978 1981 1985 1989	6,000	4 representative samples, variation on cross-lagged design	Influences on patterns of participation in education, training and employment	17 16 15 14	17 15 11 13	33 30 25 26	SR; EP
Note: * BS = biological samples; DA = direct assessment; EA = environmental assessments (physical measures); EP = education professional; FR = father report; HP = health professional; HR = health records; MR = mother report; Obs = Observation; OR = other records (e.g. Justice); PR = partner report; ParR = Parent Report; PeerR = Peer report; SR = self report. Source: The authors, 2002.									

available from local research sources. The study's policy has been to engage in collaborations in which research agendas of mutual interest are negotiated, allowing external researchers to "buy in" to future data collections (Poulton 1999). The research team is large, varied and located internationally, necessitating a complex governance structure. The study has had considerable international input and impact, and high productivity.

Most Australian studies have differed from the New Zealand studies by having larger cohorts, a more narrowly defined initial focus, and evidence of greater challenges in attracting stable ongoing funding. Two health studies which commenced with a narrow focus have made significant international contributions. The Port Pirie Cohort Study examined the effects of pre-natal and post-natal lead exposures for a pre-birth cohort followed to age 13 years (Table 3.2). The Tasmanian Infant Health Study was initially designed to identify risk factors for sudden infant death syndrome (SIDS) but expanded to explore other causes of infant morbidity and mortality, and determinants of childhood diseases such as asthma. It has followed children for 12 years to date (Table 3.2). These two studies have been highly successful in meeting their initial aims. They have been influential in changing public health knowledge and practices, and have produced in excess of 30 publications each in leading international journals.

In common with the Tasmanian study, several other Australian studies commenced with a relatively narrow focus, but have evolved to examine new areas or have been informative to areas outside the original focus.

As noted in Table 3.2, the WA Pregnancy Cohort (Raine) Study was established as a randomised controlled trial to identify any adverse effects of ultrasound during pregnancy. No effects were found, and the study has continued to follow the initial birth cohort to look at a range of developmental outcomes.

The Australian Temperament Project (Table 3.2) was initially established to examine the relationship between temperament and emotional and behavioural development. However, its foci broadened over time to include social, school-related and emotional problems as well as positive developmental outcomes such as social competence and civic mindedness. The study has tapped a wide range of child, family, school and social predictors and outcomes, with a focus on risk, resilience and developmental pathways (Prior et al. 2000), and is now addressing transitions to work, relationship formation, and intergenerational issues. Over 70 publications have arisen from the study.

Two other large single-cohort studies have been established in Australia (Table 3.2). The Mater-University of Queensland Study of Pregnancy involved a cohort of over 8,000 Brisbane-born children from pregnancy to early adulthood and has examined determinants of a range of health and wellbeing outcomes. The Victorian Adolescent Health Cohort Study commenced with a cohort of over 2000 14–15-year-olds and has addressed continuities and social consequences of psychosocial disorders of youth including emotional and behavioural disorders, suicide risk, accidental injury and obesity.

New Zealand funding bodies have shown commitment to supporting large, broadly focused longitudinal studies, including studies of Indigenous and other high risk ethnic populations across early childhood, such as the Plunket National Child Health Study (Table 3.2). A new study that commenced in 2000 is the Pacific Islands Families Study, which is recruiting a cohort of

approximately 1400 children of Pacific Island ethnicity in Auckland to be followed throughout childhood. This latter study will examine a range of health, psychological and family/cultural factors.

In Australia, three smaller studies of high risk populations have been conducted (two of which are not included in Table 3.2 due to small sample size). The Aboriginal Birth Cohort Study (Table 3.2) studied the health of Indigenous children up to age 10–13 years. While data collection from the 686 participants was only collected at one follow-up time, the study has involved ongoing collection of health record data. The Brunswick Family Study was a study of 304 families drawn from a multi-ethnic, low socioeconomic community in Melbourne, Australia (Williams and Carmichael 1990). Data collection finished in 1991 at age 11 years, and involved assessment of a range of determinants of health, educational and psychosocial outcomes. The Life Chances Study, undertaken by the Brotherhood of St Laurence, has followed up 167 children born in Melbourne in 1990 to examine the influence of low family income on life opportunities and outcomes for young people (Taylor and MacDonald 1998); data have so far been collected up to age ten years.

Investigators from these Australian studies have reported challenges in attracting funding for continuing data collection at older ages and for maintaining sufficient staff to analyse data and produce outputs in a timely fashion.

We are not aware of any New Zealand longitudinal studies of children or young people that have used designs other than single cohorts. In Australia, relatively few studies have used other than a single-cohort design, but among these, the studies conducted by the Australian Council for Educational Research predominate (Table 3.2). The Council's Youth in Transition study involved four cohorts of adolescents born in 1961, 1965, 1970 and 1975, contacted initially in school at 17, 16, 15 and 14 years of age respectively, and then by mail. It thus adopted a variation of a cross-lagged design, allowing analysis of changing patterns of participation in education and the labour force, and transitions within and between education and work. The Australian Youth Survey and its predecessor, the Australian Longitudinal Survey, were conducted by Commonwealth education authorities, but the data are now held at the Council. They involved a nationally representative multiple-aged sample of young people aged 16–19, augmented by the addition of four new groups of 16-year-olds at annual intervals. The focus of research is on the causes and consequences of educational participation among different groups in the Australian population, and how these patterns have changed over time.

In 1995 both the Youth in Transition and Australian Youth Survey were brought together as the Longitudinal Surveys of Australian Youth which operates with larger samples and with a broader research focus. Using a cross-lagged design, nationally representative samples of Year 9 students from almost 300 schools were recruited in 1995 and 1998. Data include reading and numeracy test results, adolescent self-reports, and school-based information about curricula, school climate and school organisation. It is planned to continue to follow these cohorts until members are approximately 25 years of age, as well as adding new cohorts, so that the study retains relevance for policy development.

Another new study using a cross-lagged design is the International Youth Development Study. This comparative longitudinal study of 6000 participants is being conducted in the states of Victoria in Australia and Washington in the

United States. It addresses the social determinants of substance abuse in youth and has intakes at Year 5 (9–10 years), Year 7 (11–12 years), and Year 9 (13–14 years) (Toumbourou et al. 2002). Thus both cross-national and cross-cohort analyses will be possible. This study is not included in Table 3.2 since only one wave of data collection has been completed to date.

In considering these Australian and New Zealand studies, the concentration on single-cohort, early childhood studies is notable. This in part reflects recognition of the importance of early years of life for later development. Although a range of data sources are employed in these studies, parental report is generally the key source of information, and family factors are investigated as critical influences on the child's development.

Coverage of later childhood and adolescence developmental outcomes arises via two methods. First, the long-term nature of several of the large-scale studies described above which have followed their cohorts through adolescence (for example, the Australian Temperament Project and the Christchurch and Dunedin studies) has allowed them to investigate adolescent-relevant pathways and outcomes such as substance use, delinquency, civic mindedness and occupational choice. Second, some studies have enrolled their samples in adolescence (for example, Youth in Transition, Longitudinal Surveys of Australian Youth). These have tended to focus on educational and occupational outcomes, and more recently on mental health issues. Among the adolescence-focused studies, school and peers are seen as prime contextual influences of interest and there has been less emphasis on family context. Sampling and data collection has typically been based on schools, with teachers and the adolescents themselves as the key informants.

Collectively the studies in Table 3.2 illustrate the tremendous potential that exists for longitudinal cohort designs to examine a great variety of factors influencing the health and development of Australian children and their families. The studies are expensive to establish, but once they have commenced, they have the potential to produce a wealth of information beyond that envisaged at the outset (National Centre for Epidemiology and Population Health 1999). Indeed, it appears to be the exception rather than the rule for studies, having collected three waves of data, to fail to continue indefinitely. To our knowledge the only studies in Table 3.2 that do not have follow-ups planned for the future are the Port Pirie and Plunket studies which ran for 13 years and four years respectively.

The impact of these longitudinal studies on the provision of services and development of policy is hard to determine. The most easily recognisable influence on policy and practice has come from two health studies focused on specific issues – the Port Pirie study of lead exposure and the Tasmanian Infant Health Study. For example, findings from the Tasmanian study contributed to changed recommendations for infant care practices, notably infant sleeping position. Thus studies designed to address specific research questions with direct policy and practice implications can influence health and other policies and practices to the benefit of population health and wellbeing.

At other times, initially unplanned analyses have resulted in findings whose implications have been taken up in policy and practice. For example, Australian Temperament Project findings on the strong relationships between reading acquisition and pre-existing child behavioural problems led to increased focus on the “whole child” in determining readiness to learn and early school progress.

More generally, all the studies following cohorts from early childhood have demonstrated the early origins of many later problematic outcomes, and have contributed to the recognition of the importance of the early years, and hence of early intervention and prevention, by policy makers and service providers.

International studies

Table 3.3 summarises some of the influential international studies meeting similar criteria to the Australian and New Zealand studies listed in Table 3.2. In general, the international studies have all commenced since 1970, involved representative samples of at least 500 children or young people, involved prospective data collection across at least three time points, and either no intervention was provided or this is not the primary focus of the study. However, we have included some exceptions to these criteria when the studies have been informative and influential. Information on some more recently established studies is provided separately in the text.

The studies reviewed in Table 3.3 include a number of cross-lagged and cross-sequential designs, although single-cohort studies still predominate. It is not possible to describe comprehensively all studies in the text, so we have chosen to discuss a few selected studies to illustrate general trends in international studies, key designs, strengths and issues which need further attention in the Australian research context.

The National Institute of Child Health and Human Development Study (NICHD) Study of Early Child Care (Table 3.3) is an example of a multiple cohort study initiated in 1989 to answer fundamental scientific and social policy questions about the effects of early childhood experiences on children's development. In 1991, a team of researchers working cooperatively to design and implement the study recruited a single birth cohort of 1364 children at ten locations across the United States. Researchers are assessing the children's development at frequent intervals from birth through their sixth year in school. The sampling has been designed to ensure adequate representation of major socio-economic niches.

An example of a study using a cross-sequential design (although not with a representative sample) is the Pittsburgh Youth Study (Table 3.3), which investigated patterns of and risk factors for youth delinquency, mental health problems and substance use (see overview in Loeber et al. 1998). The study commenced in 1987–1988 with the enrolment of three samples of inner-city boys in Grades 1, 4 and 7, oversampling for boys initially high in antisocial behaviour. There were approximately 500 boys in each sample. Five waves of data were collected at six-monthly intervals on all three samples, thus allowing assessment of behavioural trajectories from Grades 1 to 10 within three years. After this point, there were varying numbers and intervals of follow-up for each sample up to the age of 20 years. A further strength of this study has been its use of parallel instruments to a number of other large ongoing longitudinal studies conducted at other sites (for example, Rochester, Denver), leading to the compilation of across-study findings and facilitating value-adding, replication and increased statistical power.

Also listed in Table 3.3 is the Canadian National Longitudinal Survey of Children and Youth (NLSCY). Commenced in 1994, this is principally a single cohort study, but two samples of infants were added in the second and third waves, allowing it to be considered as a cross-lagged design. Further, it has potential to

Table 3.3. Some influential overseas longitudinal studies									
Study	Location	Year began	Sample size	Special criteria	Foci	Age at start	Follow ups	Age at last follow up	Data collection *
<i>Sigle-cohort studies</i>									
Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC) Golding 1990; Mumford 1999 www.ich.bris.ac.uk	England	1991	14,893		Environmental, social, psychological, biological and genetic influences	Pregnancy	18	9 years	MR; FR; SR; HP; HR; DA; BS; EA
The Baltimore Study Kellam et al. 1994	USA	1985-1986	1,197	2-year intervention component for approximately half the sample	Early aggression and adolescent mental and behavioural disorders	Grade 1 (5.0 - 9.7 years)	5	11 - 16 years	EP; PeerR; SR; Obs
Chicago Longitudinal Study Reynolds 1999	USA	1985-1986	1,539	High poverty neighbourhoods; 93% African-American; Intervention focus	Individual, family and school factors promoting educational success	Preschoolers	10	14 years	ParR; EP; SR; OR; Obs
Finnish Family Competence Study Hyssala et al. 1993	Finland, single province	1986	1,443	Stratified randomised cluster sample	Health behaviours and outcomes of young Finnish families and children	Pregnancy	10	6 years	FR; MR; DA; HP
Kauai Longitudinal Study Werner & Smith 1992	Kauai, Hawaii	1955	698	Ethnically diverse sample, about half living in poverty	Biological factors, environmental adversity and development	Birth	6	32 years, ongoing	MR; EP; SR; OR; DA
Montreal Longitudinal-Experimental Study Tremblay et al. 1992	Canada	1984	1847	Over sampled low SES areas and disruptive children; includes intervention	Health risk behaviour, antisocial behaviour	Grade 1	6	16 years	MR; EP; SR; PeerR; OR

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National Institute of Child Health and Human Development Study (NICHD) Study of Early Child Care http://www.nichd.nih.gov/about/od/secc/index.htm	USA	1991	1,364	10 sites across USA	Relationship between child care and child outcomes	Birth	11	3 years	MR; SR; DA; EP; PR if contact > 10hrs per week
Simmons Longitudinal Study Carbonell et al. 1998	USA	1975	763	Kindergarten sample, from one US school district	Emotional and behavioural development, mental disorders, risk and resilience	4 years	6	22 years	SR, MR, TR, OR
Seattle Social Development Project Hawkins, Catalano et al. 1992	USA	1981	808	Over sampled high crime areas; includes intervention	Risk and protective factors for delinquency and substance use	Grade 1	11	21 years	ParR; EP; SR,
Single-cohort studies, multiple ages at recruitment									
National Longitudinal Survey of Youth – Child Supplement (NLSY – CS) Baydar & Brookes-Gunn 1991; Garrett et al. 1994	USA	1986	4,953		Children of women in the NLSY	Children age from less than 1 year to 15 years	8	22 years	MR; SR; DA; HR; HP; EP; PR
National Longitudinal Survey of Children and Youth (Canada) NLSCY Canada 1999 www11.hrdc-dhrc.gc.ca/edd/NLSCY.shtml	Canada	1994	22,861	Multi-aged sample	Range of factors influencing child growth and development, with reports from multiple sources	0-11	4	6 – 17 years	PR; MR; EP; HP; DA
Zuid, Holland; Verhulst, et al. 1993	Holland	1983	2,076	Multi-aged sample	Behavioural and emotional disorders, stability and change, risk factors, comorbidity	4 -16 years	3	10 to 22 years	ParR; DA; EP; SR

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Table 3.3 continued

Some influential overseas longitudinal studies									
Study	Location	Year began	Sample size	Special criteria	Foci	Age at start	Follow ups	Age at last follow up	Data collection *
<i>Cross-lagged or cross-sequential studies</i>									
Carolina Longitudinal Study Cairns & Cairns 1994	USA	1981-1983	695	Cross-sequential design	Development of antisocial and prosocial behaviour	2 cohorts; Grade 4 and Grade 7	7 or 9 waves	24 years	EP; SR; PeerR; IR; OR
Durham, North Carolina Coie et al. 1992	USA	1984, 1985	1,147	African-American sample, cross-lagged design	Early peer relationships aggression and adolescent disorders	2 cohorts, Grade 3	3	Grade 10	ParR; PeerR; SR
Oregon Youth Study Patterson et al. 1992	USA	1983-4; 1984-5	206	Cross lagged design	Individual and family contributions to maladjustment	2 cohorts; 9-10 years	6	23-24 years	MR; EP; SR; PeerR; DA; Obs
Pittsburgh Youth Study Loeber et al. 1998	USA	1987-1988	500	Cross-sequential design, inner city, half were antisocial	Protective and risk factors for delinquency	3 cohorts; Grades 1, 4 and 7	6	Grades 4, 7 and 10	ParR; SR
<i>Linked studies</i>									
European Longitudinal Study of Pregnancy and Childhood (ELSPAC) http://www.ich.bris.ac.uk/ELSPAC/	Greece, Britain, Czech Republic, Isle of Man, Russia, Slovakia, Ukraine	Various 1991-1995	Various From about 1,300 to 14,000		As for ALSPAC. Collaboration of studies, including ALSPAC, using same study design. Under umbrella of WHO, coordinated from Bristol.	Pregnancy	As for ALSPAC Some variation by study site	Various	As for ALSPAC Some variation by study site
Note: * BS = biological samples; DA = direct assessment; EA = environmental assessments (physical measures); EP = education professional; FR = father report; HP = health professional; HR = health records; MR = mother report; Obs = Observation; OR = other records (e.g. justice); PR = partner report; ParR = Parent Report; PeerR = Peer report; SR = self report. Source: The authors, 2002.									

be treated as a cross-sequential design because the wide age range of child participants at recruitment (newborn to 11 years) and large sample size (more than 22,000) will permit the examination of age, stage and time-of-measurement effects (although no such analyses appear to have been published as yet). The survey uses biennial assessments and aims to develop a national database of Canadian children's development and life experiences, and to examine the influence of various biological, social and environmental factors on development from birth to adulthood. It is designed to be large enough to capture national trends, as well as to provide sufficient power to support state or community level analyses, or analyses of particular sub-groups (Statistics Canada 1996).

One notable feature of these studies is the focus on maladjustment and poor health outcomes and this was also true of most of the studies in Table 3.2. Antisocial behaviour has been a very common focus, particularly in the United States. Few studies have seriously addressed developmental pathways to positive psychosocial outcomes, which can provide valuable knowledge about healthy environments and protective processes. An exception is the Kauai study (Werner and Smith 1992, see Table 3.3), which was ground-breaking in its attention to resilience in the face of adversity.

It is also notable that some studies, such as the Oregon Youth Study (Table 3.3), have adopted a more microanalytic methodology that has sacrificed breadth (sample size) for depth (intensive multi-method data collection). Arguably these studies have contributed as much to theory and practice as large-scale but less intensive studies. However, these studies are only informative about the determinants of relatively common outcomes, and the extent to which their findings can be generalised remains problematic. Ideally, funding should be sufficient to allow intensive data collections (depth) to occur with sufficiently large samples (breadth).

As with the Australian and New Zealand studies, international studies starting in later childhood or adolescence have often used schools as the sampling location. This has proved efficient and appropriate for some outcomes (for example, educational). However, school-based cohort studies do not lend themselves easily to data collection from multiple sources outside the school context (such as parents or communities), which is desirable both to establish validity and to tap the multiple contexts of a child's life.

It is also notable that some of these studies are examining areas that have not been well-addressed in Australian and New Zealand studies. These include: first, an examination of the role of fathers on child health and development, with direct data collection from fathers (for example, the Avon ALSPAC, the Finnish Family Competence Study, and the NICHD child care study); and second, more extensive measurement of environments outside the family home to determine the influence of these environments on health and development (for example, the NICHD child care study, and the Canadian National Longitudinal Study of Children and Youth).

While some Australian and New Zealand studies have incorporated collection of biological samples to analyse genetic influences (such as DNA) fairly late in the life of the study (for example, the Australian Temperament Project, and the Christchurch and Dunedin studies), some of the newer international studies are including a focus on this issue from the start (for example, the Avon ALSPAC). The last-mentioned study is also including collection of physical samples from

child-rearing environments (for example, measures of air quality) to examine the effects of specific exposures, something that has only been done locally in the narrowly-focused Port Pirie study.

New international studies

Some large scale birth cohort studies just getting underway in Scandinavia and the United Kingdom are also instructive regarding the future directions of overseas research. Planning for the Scandinavian studies began in the early 1990s. These studies include the Danish Birth Cohort Study, the Norwegian Mother and Child Cohort Study, and the Swedish Olive Tree Project.

Data collection for the Norwegian Mother and Child Cohort Study began in 1999. It is intended that 100,000 families will be recruited, representing about one-third of the eligible population (Wiik, personal communication, February 2001), and that it will cover the entire life span. The multidisciplinary team of investigators includes epidemiologists, statisticians, public health and primary health care researchers, and the project is administered by the Norwegian National Institute of Public Health. The overall aim is to identify environmental and biological factors that singly and jointly contribute to, or protect from, disease, adopting the perspective of gene/environment interactions. Biological samples and maternal and paternal interviews comprise the initial data. Although the research agenda is primarily biological and health focused, parental lifestyle measures will allow questions of environmental influences on psychosocial outcomes to be addressed at a broad level. A large number of sub-projects (69), including nested case-control studies, are to be embedded within the larger cohort study. Any research group with relevant questions is able, in principle, to participate (Lie, personal communication, February 2001).

The linked Danish Birth Cohort Study also has a proposed sample size of 100,000 families, recruited when women are 12 weeks pregnant. It has similar aims to the Norwegian study, namely the identification of environmental and biological determinants of health and disease. At last report 65,000 women had been recruited. Data so far comprise blood samples and interviews with mothers during and after pregnancy, and the emphasis is again on health outcomes.

While a Swedish study which was initially planned to be linked to these two did not eventuate, a similar project (named The Olive Tree Project to reflect the long time between “planting” and “harvesting”) is now in the planning stages, involving researchers from medicine, psychology and sociology (Lie, personal communication, February 2001).

In the United Kingdom, a new Millennium Cohort Study commenced in 2000–2001 (Kelly, personal communication, October 2000). This study involves researchers from the Department of Epidemiology and Public Health at the University College of London, in association with several other research centres, and is funded under a tender from the Economic and Social Research Council. The study aims to recruit 15,000 infants over a 12-month period from England, Scotland, Wales and Northern Ireland, with oversampling from the latter two countries. The sample is being drawn from national birth records at age eight months, using stratified sampling at the community level. Follow-ups are planned for ages two and four years. The study aims to examine a range of factors affecting child health and development with a focus on deprivation and community-level influences.

Discussion

From these reviews, it is possible to draw some lessons for the current Australian context. While the gains from the “first generation” of Australian and overseas longitudinal studies have been substantial, their contributions to current understanding of children’s health and wellbeing have been limited in a number of ways.

Generalisability and breadth of the research

Generalisability can be limited by sample characteristics and by time of measurement and cohort effects. In terms of sample characteristics, most of the Australian and New Zealand studies involve samples from specific geographical locations, with the only national studies being the short-term Plunket Study in New Zealand and the studies conducted by the Australian Council for Educational Research in Australia which have focused on youth educational and employment outcomes. In Australia, where different states and territories can have quite different policy and service provision environments, the results from studies based in one location may be criticised for having limited or unknown generalisability to the rest of population.

This problem is being addressed in a number of the large overseas studies. The Canadian National Longitudinal Survey of Children and Youth, for example, has been specifically designed to address regional differences and influences. The European Longitudinal Study of Pregnancy and Childhood group have taken a unique approach to this by attempting to link a series of studies with common designs but independent research teams across several countries. The new Millennium Study in the United Kingdom may also be informative for the Australian context as it faces the challenges of working across countries within the UK with different policy and health service environments.

The second concern is that findings from single-cohort designs may have limited relevance by the time the data are available. This is lessened with the more complex designs such as cross-sequential designs which can control for time of measurement and cohort effects. These designs have been under-exploited in Australia, but they offer substantial advantages in terms of providing timely policy-relevant information which is still informed by across-time data, and also providing a check of generalisability through comparisons of the various cohorts involved.

Financial constraints

Compared with United States, New Zealand, Canadian and Scandinavian studies, Australian studies have suffered from deficiencies and vagaries of funding. For many Australian studies, investigators reported that follow-up contacts occurred at intervals that were as much determined by funding availability as by scientific merit, and for some studies (for example, the Tasmanian study) funding was only obtained for follow-ups with partial samples. Funding limitations and lack of guaranteed continuity have created challenges in providing continuous employment for core researchers and other staff. In turn, this has resulted in problems retaining expertise, and has been reported by investigators to have severely limited the use of the data.

It is notable that four studies in Table 3.2 have achieved substantially higher publications rates than any of the other studies, regardless of duration. These are the Australian Temperament Project, the Christchurch and Dunedin studies,

and Longitudinal Surveys of Australian Youth, which to our knowledge are the only studies in the listing to have had ongoing funding for one or more core staff positions.

Funding issues are likely to become more critical for future longitudinal studies. Changes to the culture of modern Australian tertiary institutions are resulting in researchers with academic appointments having less time available to devote to long-term research activities (despite increasing pressures to undertake research). Future studies will benefit to the extent that their funding includes ongoing support for senior staff to undertake study coordination, data management, data analysis and writing.

Lack of studies addressing modern families and environments

The New Zealand and Canadian research communities (and funding bodies) in particular have shown an ongoing commitment to longitudinal studies commencing in early life. For instance, the original New Zealand studies that commenced in the 1970s have been supplemented by two new cohort studies, commencing in 1990 and 2000, although neither are national in scope. In contrast, in Australia, all the early childhood studies commenced within one decade (1979–1989) with no large new studies initiated since then.

More recent Australian studies have all commenced with older age groups, and the lack of studies commencing around school entry and the primary school years is notable (the exception being the Promoting Adjustment in Schools Study). Given the considerable changes occurring in family lives and child-rearing environments, the relevance of existing studies to future Australian generations will become increasingly limited. It is interesting to note here that a number of the large new overseas studies, including the Scandinavian and European studies, have a significant biomedical focus and may collect comparatively limited data on families and social environments.

Lack of power to detect complex interactions

Many of the overseas studies listed in Table 3.3 have considerably larger sample sizes than the Australian and New Zealand studies. This is particularly true of the new Scandinavian studies now underway. While many of the research questions that could be addressed by longitudinal designs do not require very large samples, increasingly our understanding of the complex etiology of childhood problems is leading in the direction of very large samples. Large samples are also required to gain insight into developmental pathways for rare outcomes.

However, with fixed funding, the breadth (sample size and representativeness) needs to be balanced against depth (intensiveness of data collection). Some methods of data collection are very costly, and where the researchers are interested in simple associations and relatively common events, data collection may not be required for all participants. In such instances, nested studies involving data collection from a sub-sample of the main study cohort may prove the most cost-efficient approach.

Lack of a broad, multi-contextual perspective

As discussed, many studies, especially the Australian studies, have tended to be relatively narrow in their initial focus. Few of the studies adequately measure influences across multiple domains, which is necessary if, for example, a biopsychosocial or transactional view of the developmental process is accepted. Among the current Australian studies initiated in early childhood, data collection

has focused primarily on individual child, parent and family factors, with few studies collecting substantial data from or about other sources of influence including fathers, child care settings, school settings, and communities, let alone broader socio-cultural influences. As noted, the adolescence-oriented studies have focused on the school and peer group as influences. Inclusion of intergenerational influences and the development of methods for assessing variability in influences across the lifespan are areas identified as requiring more consideration in the development of new studies (Lynch and Kaplan 2000).

A focus on the whole child in their whole social environment implies that the research team needs to be multidisciplinary, which brings with it a particular set of organisational and intellectual challenges. However, some of the new international studies (for example, the Canadian National Longitudinal Survey of Children and Youth) are providing models for how this can be accomplished.

Failure to fully exploit the longitudinal nature of the data

In the last decade there have been several notable advances in statistical techniques for analysing longitudinal data which can shed light on developmental patterns and pathways (for example, latent growth modelling, multilevel analysis) (Hair et al. 1995; Stoolmiller 1995). Understandably, relatively few of the studies to date have fully exploited the opportunities offered by these techniques. Given current understandings of the complexity of causal pathways and the multiple trajectories that children can follow, new studies should be designed to take advantage of these analytic opportunities, supported by a research team possessing the statistical expertise to use the analytic techniques effectively.

Failure to make systematic comparisons across studies

Most of the studies reviewed have operated in isolation from each other, hence there are too many non-replicated findings which may be cohort-specific. Close coordination across studies would be highly advantageous. For example, recent comparison of data in the Dunedin study and the Australian Temperament Project (McGee et al. in press), where there has been overlap on several measurement domains, has demonstrated replication of findings across the two studies. The NICHD multi-site study, the Pittsburgh Youth Study, and the European Longitudinal Study of Pregnancy and Childhood are international examples of the deliberate use of common instruments and methodologies to allow testing of replicability.

Opportunities for greater cross-study comparison may be facilitated by making the study design details and measurement instruments publicly accessible. Several international studies (for example, the Canadian National Longitudinal Survey of Children and Youth, the Avon ALSPAC, and the NICHD child care study) have made their instruments available on the web (see Table 3.3 for addresses).

Conclusion

Notable lessons that can be learned from the new international studies include:

- the long time required for planning theoretically well-grounded, relevant, large-scale research (as illustrated by the Scandinavian studies);
- the extremely large sample sizes required to study the development of low-prevalence outcomes and to model multiple determinants across the life-course;

- the value of matching data collection approaches across studies to enable analysis of replicability;
- the recognition of the importance of a partnership of researchers across a broad spectrum of disciplines to address the complex research questions now confronting us; and
- the challenges of covering all domains adequately and of coordinating multidisciplinary, cross-sectoral research teams, demanding strong central leadership.

Several additional observations can also be made. First, the particular research questions to be addressed by a study should be the drivers in determining where the balance between depth and breadth should lie. For some questions, intensive investigation of small samples has been very effective in providing policy-relevant information. Similarly, studies with intervention components have been able to contribute to knowledge effectively. Second, the research questions of interest, the demands of the policy environment, and the resources available should drive decisions about the appropriate longitudinal design to adopt. Finally, creativity and attention to theory are needed in deciding on the most useful outcomes to study. The typical focus on “things that go wrong” has often blinded researchers to the lessons to be learnt from “things that go right” – that is, on the requirements for healthy development and resilience.

Well-designed and well-funded longitudinal studies have consistently proved to be invaluable information resources for tracking changes in health and wellbeing across the lifespan, and for identifying the factors (and combinations of factors) that cause poor outcomes or that protect individuals from harm. While relatively few in number, past Australian longitudinal studies have made important contributions to our knowledge of the factors that influence health and wellbeing. Moreover, these studies have been ongoing over a longer period of time, and have collected a breadth of data beyond that envisioned at the outset, informing social and public policy across a range of welfare, health, education and other domains.

In conclusion, Australia has not had a broadly focused, *national* study that has tracked the developmental health and wellbeing of young Australians and their families over time. It appears timely that we embark on such a study. International experience is providing valuable pointers regarding “who” should conduct such a study (a well-coordinated multidisciplinary and cross-sectoral team), “how” it should be conducted (on a large scale, taking a long-term perspective, and with appropriate resources), and “what” should be the foci (a broad range of positive as well as problematic health and developmental outcomes).

Given the major changes in Australian society in recent years, and recent advances in scientific thinking and methodologies, a study of this sort could promise to deliver valuable new knowledge about developmental processes which can guide and inform policy.

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<http://www.ich.bris.ac.uk/ELSPAC/>

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www.acer.edu.au/research/vocational/lsay/intro.html

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National Longitudinal Survey of Children and Youth (NLSCY)
<http://www.hrdc-drhc.gc.ca/nlscy-elnej/home.shtml>

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