EARLY BRAIN & BIOLOGICAL DEVELOPMENT: A SCIENCE IN SOCIETY SYMPOSIUM

Summary Report

MAY 31 TO JUNE 4, 2010 – BANFF, ALBERTA, CANADA

Alberta family wellness initiative

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About the Rapporteur

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Purpose Of Report

This summary report is designed for three primary audiences:

1. The participants of the Symposium, to be used as a review of the experience, a summary of the key scientific content and knowledge-transfer communication strategies, and a resource document to encourage further study and collaboration with colleagues;
2. The participants of the Recovery From Addiction Symposium, sponsored by the Norlien Foundation in the Fall of 2010, as a content primer;
3. The Norlien Foundation, as a record of the event to share with others.

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Executive Summary

Introduction – The Alberta Family Wellness Initiative (AFWI) was created in 2007 by the Norlien Foundation, a proactive private foundation with offices in Calgary and Edmonton, Alberta. The AFWI's mission is to connect with emerging research about experience-based brain and biological development as it relates to early childhood development and its lifelong impact on addiction and other negative health outcomes. Since its inception, the AFWI has funded and initiated a multitude of activities in early childhood development and addiction meant to ultimately bring about change in policy and practice for the benefit of Alberta and its families.

Although scientists now know that children's early experiences lay the groundwork for all of the brain development that follows, this knowledge is not always reflected in policy and practice. Through activities in networking, applied research, knowledge translation and dissemination, professional development and training, and evaluation, the AFWI is continually seeking to bridge the gap between "what we know" in science and "what we do" in policy and practice. The AFWI is committed to providing Alberta's science, policy, and practice communities with a common framework of scientific understanding.

Leading Initiatives – To advance this work, the AFWI, in partnership with Alberta Health Services and Alberta's Safe Communities Secretariat, has launched two, three-year interdisciplinary knowledge-mobilization strategies in early childhood and addiction. Together, these strategies serve as an innovation platform to provide knowledge competencies and engagement that will build integrated capacities among and between researchers, policy makers, and practitioners. The launch of these inter-related strategies is marked by two, five-day Symposia: the first on early brain and biological development and the second on recovery from addiction. This report serves as a summary of the 2010 Early Brain & Biological Development: A Science in Society Symposium.

2010 Symposium – The Early Brain & Biological Development Symposium was designed to facilitate a greater awareness and understanding of the current scientific evidence in early brain and biological development in children and to connect this knowledge back to the many different areas of policy, services, training, and research represented among the participants. Over 100 people from various organizations in Alberta attended this event at The Banff Centre in June 2010. Participants were carefully selected through a competitive application. The participants encompassed a diverse range of backgrounds, perspectives, and professions including: policy makers, program developers, health practitioners, clinicians, researchers, residents in training, students, members of the judicial system, advocates, and funders, in addition to numerous professional bodies

and organizations. The learning environment featured plenary presentations in the mornings followed by afternoon sessions that focused on understanding and learning to communicate the science. More applied learning tasks, including considerations in communicating the Symposium content to colleagues, were accomplished in small groups and as individuals. On the last day, groups made presentations to senior-level guests from academic, health care, policy, and judicial policy areas in Alberta on how they planned to continue working together after the Symposium.

Foundational Science – The Content Faculty was composed of 11 distinguished scientists from universities across Canada and the United States. A different theme in early brain and biological development was explored each day: Monday covered the basics of brain development and child development; Tuesday introduced the social and biological environment; Wednesday addressed child and adolescent mental health; and Thursday brought these messages together with an examination of the later life implications of all these factors, including the intergenerational transmission of the effects of toxic stress on brain architecture. An anchoring principle was that early experiences establish the foundation for the development, learning, and health that follows later in life. The necessity to buffer children's exposures to toxic stress – which is caused by disruptive, long-term, unprotected, and overwhelming experiences – was viewed as a critical implication of the science for program and policy development.

Communicating Science – The public thinks about child development issues, like other issues, in ways that are influenced by their previous experiences, their daily conversations, and their exposure to the mass media. If scientific information is not conveyed in ways that explain the science in concrete analogies drawn from their life experience, then new scientific information has little chance of penetrating their thinking. The FrameWorks Institute is a non-profit research organization that uses research from the social and cognitive sciences to translate scientific information for non-scientists. Each afternoon, results from new research in Alberta were shared and the participants worked with researchers from FrameWorks to gain insight on how best to communicate the core scientific knowledge to their colleagues and stakeholders. The goal was to create a common framework of understanding among policy makers, program developers, and practitioners. An important realization was that practitioners are becoming the main conduit of information to the public.

Implications of the Science – Three key priorities were identified by the Content Faculty to help support long-term health, well-being, and prosperity for Alberta. These were: 1) identify the best methods for supporting early life success; 2) reduce toxic stress factors; and 3) support parents and families. One of the major goals of the Symposium was for participants to become familiar with the scientific evidence that supports these priorities, to effectively communicate this evidence with others, and then begin using it to improve decision-making, policy, program design, and clinical practice in Alberta. Over time, this will help create more consistency and coherence within the province's systems that support early development.

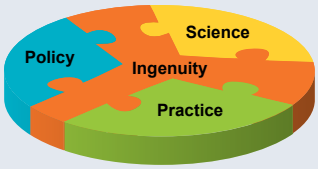
Resources and Opening the Door – An online web portal has been created so participants can continue to access video recordings of the Content Faculty and FrameWorks presenters and other supporting resource documents, and stay in touch with other participants. The site also offers a suite of resources participants can use to help communicate the science of early brain and biological development to their colleagues and stakeholders. Major organizations and researcher-recommended knowledge-translation reports are presented in the appendices of this report to encourage further learning about the science of early brain and biological development. A key resource includes a collection of current Working Papers from the National Scientific Council on the Developing Child.

Further Engagement – Symposium participants will reconvene in the spring of 2011 to report back on their personal and group progress and engage in further knowledge development.

Welcome

"Together, we have a pivotal role to play in shaping our future and the world we leave behind for future generations of Albertans." **Nancy Mannix,** Chair & Patron, Norlien Foundation

The future prosperity of any society depends on its ability to foster interdependent communities and the health and well-being of the next generation. When a society collectively invests wisely in children and their families, the next generation will pay that back through a lifetime of productivity and social responsibility. The Alberta Family Wellness Initiative's vision is to be a catalyst for concrete action that will result in more effective services for children and their families by changing the way Albertans understand and approach early childhood development and its lifelong impact on addiction and other negative health outcomes. The science, policy, and practice gap can only be filled if these three inter-related communities work together to form a common framework of scientific understanding that will result in new innovations for the province of Alberta.



Albertans are paying more attention to early brain and biological development because they believe new approaches and solutions could promote our children's well-being over the long term. This is the lesson from the Early Brain & Biological Development (EBBD) Symposium held at The Banff Centre in 2010. The foundational ideas summarized in this report offer an exciting road map for change in Alberta.

Emerging research across a wide range of disciplines provides compelling evidence that what happens during the first few years of life influences health outcomes, behaviour, social adjustment, and learning over the long term. Early development thus sets the course for health and well-being not only in early childhood, but throughout life. The science presented at the Symposium shows that early brain and biological development is influenced by the interplay of experiences occurring before and after birth on a child's genetic code. Full appreciation of the scientific facts opens up a variety of potential interventions that can become important opportunities for programmatic and policy innovations.

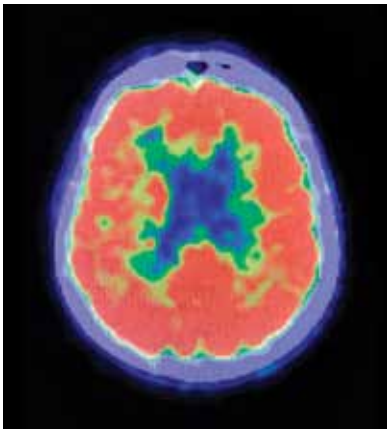
"We have laboured for too long under the misconception that the things that happen to young children are basically outgrown. These experiences in early life have effects not just on disease outcomes over the longer term, but actually fundamentally affect the development of the brain, the biological maturation of the child, and really determine the biological processes that guide the fate and development of the individual for the rest of his or her life."

Dr. W. Thomas Boyce

Knowledge Provides New Opportunities for Action

Today there is a large body of scientific knowledge to draw upon concerning what factors influence early brain and biological development. A research-based understanding of epigenetics, developmental neuroscience, and behavioural neuroscience will shift the way we approach support for early childhood development and will redirect clinical treatment and prevention activities for many diseases. We can use these results to take action in many areas and apply what has been learned to better inform what can be done at the policy and practice levels.

The intent of the Symposium was to create a place and a process to begin to bridge the gap between the science experts and those responsible for policy, programs, and services. To apply the science to policy and practice not only helps children and families but also yields a higher return on investment for all Albertans, as the financing of these programs and services contributes to stable communities where children can grow to make a contribution. When children grow up healthy it makes for a more prosperous society for everyone.



GUIDING PRINCIPLES FOR THE NORLIEN FOUNDATION:

There is a connection between early brain development and addiction.

Addiction is more than drugs, alcohol and gambling; it can also include food, sex, and other human behaviours.

Brains can change.

The Norlien Foundation

Created in 1997, the Norlien Foundation is a proactive private foundation with offices in Calgary and Edmonton, Alberta. The Foundation is active in knowledge translation and transfer, applied research, evaluation, and networking. It has established partnerships with numerous national and international organizations working in the areas of childhood development, addiction, and mental health. The Foundation initiates strategic projects to enhance the quality of life for all Canadians, particularly those living in Alberta.

Alberta Family Wellness Initiative

In 2007, the Norlien Foundation created the Alberta Family Wellness Initiative (AFWI). Based on a framework of epigenetics and developmental and behavioural neurosciences, the AFWI creates opportunities to better understand and apply scientific knowledge to factors influencing child development and its relationship to addiction and other mental health outcomes. It is hoped these efforts will encourage more informed decision-making to create, deliver, and fund a wide variety of appropriate services, programs, and policies that support healthy families in Alberta.

EBBD Symposium and Strategy

The Alberta Family Wellness Initiative formulated a three-year, inter-disciplinary knowledge-mobilization strategy in early brain and biological development designed to improve the lives of children and their families in Alberta. The EBBD Symposium was launched as the first major part of this strategy.

Symposium Event

The Symposium was held May 31 through June 4, 2010, at The Banff Centre in Banff, Alberta. The strategy also includes two future week-long Symposia in 2011 and 2012. The collective experience from these events will provide participants with the foundational knowledge and the tools and skills needed to apply this knowledge in real-world settings. In addition to attending the Symposia, participants will have the opportunity to participate in mid-year activities designed to enhance their learning and skills.

Symposium Sponsors

The Symposium was made possible by several regional and national organizations, from both the private and public sectors, which sponsored the event. The sponsors of the Symposium included the following:

- Norlien Foundation
- Government of Alberta
- TransCanada Corporation
- Women & Children's Health Research Institute
- Alberta Children's Hospital Research Institute for Child and Maternal Health

Symposium Development and Management

The Symposium involved a number of dedicated people in its development, planning, and delivery. See Appendix 1 for a listing of the members of the Senior Leadership Team, the Participation Committee, the Design Committee, the Resources Committee, and the Norlien Foundation staff who supported this event.

PART 1

Symposium Experience

This part of the report examines the Symposium's objectives, themes, participants, presenters, learning process, and host environment.

Objectives

This multidisciplinary event was designed to fulfill a number of key objectives for the participants:

- Identify connections between early brain and biological development and the prevention of negative health and social outcomes across the lifespan, including addiction; (Knowledge)
- Dialogue with a multi-disciplinary community to broaden perspectives and increase personal and professional knowledge of early brain and biological development; (Comprehension)
- Examine scientific literature and theories pertaining to early brain and biological development and recognize connections to real-world situations; (Application)
- Generate new ideas to integrate and apply scientific literature and theories of early brain and biological development within professional spheres to generate awareness and support change; (Analysis)
- Create personal learning objectives for knowledge translation and integration within a personal disciplinary and work setting. (Synthesis)

Daily Themes

Each day of the Symposium offered a unique theme corresponding to primary areas of research in early brain and biological development.

Participants

Over 100 people were selected to attend the Symposium as active participants (see Appendix 2). The participants encompassed a diverse range of backgrounds, perspectives, and professions, including many from Government of Alberta Ministries, Alberta Health Services, and Alberta's research-intensive universities. The participants included: policy makers, program developers, members of the judicial system, health practitioners, clinicians, researchers, psychiatric residents in training, students, advocates, and funders, in addition to numerous professional bodies and organizations. Each person brought a wealth of experience to the event.

The participants all agreed to remain engaged in the initiative over the course of the next three years. During this period, the participants will spend approximately three hours per month of their time communicating with their co-participants and taking advantage of additional mid-year learning opportunities. The employers of the participants have agreed to support the initiative by incorporating these activities into the job responsibilities of the participants during this period.

DAILY CONTENT THEMES

Day 1
The Frameworks of Early Brain Development

Day 2
Early Adversity Changes the Brain

Day 3
Addressing the Enduring Challenges of Toxic Stress

Day 4
Stress and the Biology of Development

Day 5
Where Science Meets Real Life

Presenters

CONTENT FACULTY

The Content Faculty was comprised of 11 distinguished professors from major university research programs in Canada and the United States. Many of the presenters were also available during the week to respond to questions and talk with participants. Photographs and profiles of these individuals are featured on the next three pages.

W. Thomas Boyce, MD

Professor of Pediatrics and the Sunny Hill Health Centre/BC Leadership Chair in Child Development, College for Interdisciplinary Studies and Faculty of Medicine, University of British Columbia (Vancouver, BC). He is a member of the National Scientific Council on the Developing Child and a Fellow of the Canadian Institute for Advanced Research's Experience-Based Brain and Biological Development Program.

Jacob Burack, PhD

Professor of School Psychology and Human Development, Department of Educational and Counselling Psychology, McGill University (Montreal, PQ). He is founder and director of the McGill Youth Study Team, a research consultant at Hospital Rivière-des-Prairies, and a co-investigator on three networks funded by the Canadian Institutes for Health Research in the areas of autism, resilience, and Aboriginal mental health.

Matthew Hill, PhD

Postdoctoral Fellow, Laboratory of Neuroendocrinology, Rockefeller University (New York City, NY). Dr. Hill earned his undergraduate degree in biological psychology and his doctoral degree at the University of British Columbia. He currently works with Dr. Bruce McEwen and is investigating structural and functional changes within the brain following chronic stress that relate to the development of anxiety and fear.

Bryan Kolb, PhD, FRSC

Professor of Psychology and Neuroscience and Principal Investigator, Canadian Centre for Behavioral Neuroscience, University of Lethbridge (Lethbridge, AB). He has published five books (including Fundamentals of Human Neuropsychology and Introduction to Brain and Behavior) and over 300 research reports. Dr. Kolb is a Fellow of the Royal Society of Canada and is a Fellow of the Canadian Institute for Advanced Research's Experience-Based Brain and Biological Development Program.

Ruth Lanius, MD, PhD, FRCPC

Professor of Psychiatry, London Health Sciences Centre, University of Western Ontario (London, ON). She established and directs the Traumatic Stress Service, which specializes in the treatment and research of Posttraumatic Stress Disorder (PTSD) and related comorbid disorders. Dr. Lanius is a Fellow of the Royal College of Physicians of Canada.

Pat Levitt, PhD

Provost Professor of Neuroscience, Psychiatry, Psychology and Pharmacy, and Chair of the Department of Cell and Neurobiology at the Keck School of Medicine, Director of the Zilkha Neurogenetic Institute, University of Southern California (Los Angeles, CA). He also serves as Director of the Marino Autism Research Institute and is also the Scientific Director of the National Scientific Council on the Developing Child. Dr. Levitt is a Fellow of the American Association for the Advancement of Science.

Harriet MacMillan, MD, FRCPC

Dan Orford Chair in Child Studies and Professor in the Departments of Psychiatry, Behavioural Neurosciences, and Pediatrics, McMaster University (Hamilton, ON). She was the founding Director of the Child Advocacy and Assessment Program (CAAP) at McMaster Children's Hospital, a multidisciplinary program committed to reducing the burden of suffering associated with family violence. Dr. MacMillan is a Fellow of the Royal College of Physicians of Canada.

Glenda MacQueen, MD, PhD, FRCPC

Professor and Chair of the Psychiatry Department, University of Calgary and Regional Clinical Department Head of Psychiatry for Alberta Health Services for the Calgary Zone (Calgary, AB). She received the 2008 Innovations in Research Award from the Canadian College of Neuropsychopharmacology. Dr. MacQueen is a Fellow of the Royal College of Physicians of Canada.

Linda Mayes, MD

Arnold Gesell Professor of Child Psychiatry, Pediatrics, and Psychology in the Yale Child Study Center, Yale University (New Haven, CT). At Yale, she also directs the Developmental Electrophysiology Laboratory and coordinates the Anna Freud Centre. With two colleagues, she oversees a new Master's program in psychodynamic developmental neuroscience that is offered collaboratively between the University College London (England) and the Yale School of Medicine. Dr. Mayes is a member of the National Scientific Council on the Developing Child.

Charles Nelson, PhD

Professor of Pediatrics and Neuroscience at Harvard Medical School and the Richard David Scott Chair in Pediatric Developmental Medicine Research, Children's Hospital Boston, DMC Laboratories of Cognitive Neuroscience (Boston, MA). He served on the National Academy of Sciences panel that wrote From Neurons to Neighborhoods. He has published over 180 journal articles and book chapters and has edited or written 10 books. Dr. Nelson is a Fellow of both the American Psychological Society and the American Association for the Advancement of Science. He also sits as a member of the National Scientific Council on the Developing Child and on the Advisory Committee of the Canadian Institute for Advanced Research's Experience-Based Brain and Biological Development Program.

Stephen Suomi, PhD

Chief of the Laboratory of Comparative Ethology, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health (Bethesda, MD). He has published over 350 scientific articles and chapters. He also holds Research Professor appointments at the University of Virginia, the University of Maryland, College Park, and The Johns Hopkins University. Dr. Suomi is a Fellow of the American Psychological Association and an Associate of the Canadian Institute for Advanced Research's Experience-Based Brain and Biological Development Program.

JUNIOR FACULTY

The Junior Faculty included five early career scholars from research universities. The role of these faculty members was to answer questions from individual participants, to offer expert guidance during the group cohort sessions, and to provide ad-hoc support for the Learning Teams. Faculty members included:

Robyn Bluhm, PhD, Assistant Professor, Philosophy and Religious Studies, Old Dominion University (Norfolk, VA)

Andrea Gonzalez, PhD, Postdoctoral Fellow, Psychiatry and Behavioural Neurosciences, McMaster University (Hamilton, ON)

Ryan Van Lieshout, PhD, Psychiatrist and General Scholar, Psychiatry and Behavioural Neurosciences, McMaster University (Hamilton, ON)

Jelena Obradovic, PhD, Assistant Professor, Developmental and Psychological Sciences, Stanford University (Palo Alto, CA)

Margaret Sheridan, PhD, Research Fellow in Pediatrics and Robert Wood Johnson Foundation Health and Society Scholar, Harvard University (Boston, MA)

COHORT GROUPS

FOCUS CHALLENGES:

Evening Learning Teams Research Priorities (Teams 1 & 2)

Coordination of Education, Justice, and Health and Human Services (Teams 3, 4 & 5)

Collaboration Between Academia and Policy & Practice Areas (Teams 6 & 7)

Child Mental Health Policy and Practice (Teams 8 & 9)

Child and Family Primary Care Practice (Team 10)

Early Childhood Intervention and Development Services (Teams 11 & 12)

Training and Development for Clinicians and Professionals (Team 13)

THE BANFF CENTRE FACULTY

Four professional facilitators from The Banff Centre's Leadership Development Program led the Cohort Workshops and Learning Team activities. This faculty included:

Laurie Maslak, PhD, MA, President & Senior Consultant, Maslak & Associates (Calgary, AB)

Ed McKenzie, MA, President, Learning by Heart Consulting (Banff, AB)

Ian Prinsloo, MFA, Experiential Learning Coordinator, Enviros (Calgary, AB)

Karen Ryan, MSW, President, Dynatrends Consultants (Calgary, AB)

FRAMEWORKS INSTITUTE FACULTY

Four researchers from the FrameWorks Institute (all located in Washington, DC) led scientific translation exercises during the afternoon Cohort Workshops. Their expertise helped the participants understand and apply knowledge-transfer and communication techniques to the technical information covered by the Content Faculty. The FrameWorks Faculty included:

Susan Nall Bales, MA, Founder and President

Diane Benjamin, MA, Senior Associate

Nathaniel Kendall-Taylor, PhD, Senior Associate and Project Director

Moira O'Neil, PhD, Senior Researcher

Learning Processes

The learning process was enacted through three distinct kinds of environments during each full day of the Symposium.

MORNING PRESENTATIONS

Each day began with several presentations by the Content Faculty in an auditorium setting.

AFTERNOON PRESENTATIONS

The afternoons offered additional presentations and interactive group activities for the four Cohort Groups, which consisted of 20 to 25 participants. The group sessions began with interactive dialogue between the Content Faculty and Symposium participants. Members of the FrameWorks Faculty reviewed key components of early childhood development from the morning presentations. This was followed by interactive large-group discussions called Cohort Workshops.

GUEST PANEL REPRESENTATIVES

The Honourable Alison Redford, *Minister of Justice and Attorney General, Government of Alberta (Edmonton, AB)*

Dr. Glen Baker, *Professor and Director, Neurochemical Research Unit, Psychiatry, University of Alberta (Edmonton, AB)*

Maria David-Evans, *Deputy Minister, Aboriginal Relations, Government of Alberta (Edmonton, AB)*

Sandra Duxbury, *Senior Policy Manager, Government of Alberta (Edmonton, AB)*

Dr. Richard Hawkes, *Senior Associate and Dean (Research), Faculty of Medicine, University of Calgary (Calgary, AB)*

Linda Hohol, *Board Member, Alberta Health Services (Calgary)*

Ken Hughes, *Board Chair, Alberta Health Services (Edmonton, AB)*

Jeff Kovitz, *Board Chair, The Banff Centre (Banff, AB)*

Kurt Sandstrom, *Assistant Deputy Minister, Safe Communities and Strategic Policy, Government of Alberta (Edmonton, AB)*

Annette Trimbee, *Deputy Minister, Advanced Education and Technology, Government of Alberta (Edmonton, AB)*

The afternoons also included experiential learning activities in which the participants explored communication issues, systems thinking, and change management in relation to the scientific knowledge presentations and assigned readings.

EVENING LEARNING TEAM EVENTS

Each participant was also assigned to a small group called a Learning Team comprised of six to eight people. Participants were asked to identify areas of interest or issues they would like to work on during the week. They were then placed into teams with like-minded individuals to have focused dialogue about their topic of interest. These topics were called Focus Challenges.

The Learning Teams met daily to explore the scientific content and to discuss how it related to their focus area. The purpose of these group interactions was to support the participants' engagement by allowing them to question, explore, and learn about the Symposium content, and create a plan for ongoing group interaction during the year.

FRIDAY MORNING PRESENTATIONS BY THE LEARNING TEAMS

Each Learning Team also prepared a brief Fieldnotes Presentation for the final day of the Symposium. Each team addressed how it planned to communicate and advocate effectively in the future (see examples in Appendix 3). Demonstrating a lively mix of wit and wisdom, these presentations were given to a large audience consisting of all of the participants and faculty. Also present were special guests – high-level academic, policy and government leaders in Alberta. The final event conveyed the great sense of energy and enthusiasm that had been building up over the course of the week.

PERSONAL PLANS

Each individual participant developed his/her own Personal Strategic Plan to guide continued learning and action following the Symposium (see samples in Appendix 3).

Symposium Host Environment

During the week, the participants stayed at the on-site hotel at The Banff Centre, located in beautiful Banff National Park. All of the meetings were held at various venues on-site at The Banff Centre.

The Banff Centre is a public, board-governed, specialized arts and culture institution. Founded in 1933, The Banff Centre provides non-parchment programs in the arts and creativity, and in leadership development, mountain culture, and the environment.

PART 2

Foundational Science

This part of the report highlights major ideas from the 12 Content Faculty presentations on the scientific foundations of early brain and biological development. The complete slide decks and video recordings of these presentations are available for the participants at the Symposium's web portal. The participants were also provided with the current set of the Working Papers series of research summaries produced jointly by the National Scientific Council on the Developing Child and the Harvard Center on the Developing Child. Each presentation uses one or more of these reports as a primary reference. In addition, the References section of the Appendix in this report includes almost 200 peer-review journal articles and reports identified by the Content Faculty to support their presentations. Many of the members of the Content Faculty are also members of the National Scientific Council on the Developing Child and have contributed to writing the Working Papers.

Core Concepts of Early Brain and Biological Development

Central themes on early brain and biological development featured in the Working Papers reports include:

- Child development is a foundation for community and economic development; healthy children build a prosperous and sustainable society.
- Brains are built over time, starting before birth and continuing through infancy, childhood, adolescence, and young adulthood.

FOUNDATIONAL SCIENCE BY DAY OF THE SYMPOSIUM

A different theme in early brain and biological development was explored each day of the Symposium:

- *Monday covered the basics of brain development and child development;*
- *Tuesday introduced the social and biological environment;*
- *Wednesday addressed child and adolescent mental health;*
- *Thursday examined the later-life implications of all these factors, including the continuation of the effects of toxic stress on brain architecture and its negative impact on health from one generation to the next.*

An anchoring principle was that early experiences establish the foundation for all the development, learning, and health that follow later in life. The necessity to buffer children's exposures to and incorporation of toxic stressors – in the form of disruptive, long-term, unprotected, and overwhelming experiences – was viewed as a critical implication of the science for program and policy development.

- Brain architecture and developing abilities are built from the bottom up; simple brain circuits must be successfully created in order to provide a strong scaffold for the more advanced circuits and skills that develop later on.
- The interactive influences of genes and experience shape the architecture of the developing brain; an active ingredient is the "serve and return" nature of children's engagement in relationships with parents and others.
- Toxic stress in early childhood is associated with persistent effects on the nervous and stress hormone systems, leading to lifelong problems in learning, behaviour, and health.
- Creating the right conditions in the early years for childhood development is more effective and far less costly than addressing problems later on.

NO.	NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD WORKING PAPERS	YEAR
1	Young Children Develop in an Environment of Relationships	2004
2	Children's Emotional Development is Built into the Architecture of their Brains	2004
3	Excessive Stress Disrupts the Architecture of the Developing Brain	2005
4	Early Exposure to Toxic Substances Damages Brain Architecture	2006
5	The Timing and Quality of Early Experiences Combine to Shape Brain Architecture	2007
6	Mental Health Problems in Early Childhood Can Impair Learning and Behavior of Life	2008
7	Workforce Development, Welfare Reform, and Development of Young Children	2008
8	Maternal Depression Can Undermine the Development of Young Children	2009
9	Persistent Fear and Anxiety Can Affect Young Children's Learning and Development	2010
10	Early Experiences Can Alter Gene Expression and Affect Long-Term Development	2010

EIGHT (FAILED) ASSUMPTIONS:
What We Thought We Knew About Early Child Development

By Dr. W. Thomas Boyce

ABSTRACT: Major advances have been made in the scientific understanding of early brain and biological development. Eight key assumptions in this area of study have recently been challenged by new evidence from neurobiology research.

As an introduction to the Symposium, eight key – but now outdated – assumptions about the nature of early child development were examined. These myths and their associated disconfirming facts are summarized in the figure below.

Eight Failed Myths and the True Science

FAILED MYTH	TRUE SCIENCE
1. Destiny is in our genes	Partially true. Most traits and diseases are derived not just from nature (Genes); not just from nurture (Environment); and not even from nature plus nurture; but rather from their interaction (Gene x Environment). One such interactive effect is called an epigenetic process, in which environmentally derived changes in the packaging of DNA change the expression (or decoding) of a gene.
2. Knowing, growing, and sowing relationships develop separately	False. Human development has four main areas: Emotional + Physical + Social + Cognitive. These areas interact with each other and get more complicated over time.
3. Children from low-income households are at risk	Partially true. Even though socioeconomic status (SES) conditions are the strongest predictors of developmental outcomes, SES functions in a graded relation across the full spectrum from low to high income. Thus, children from homes of low income, moderate income, and even higher income, can all be at risk.
4. Stress is bad for children	Partially true. Toxic stress poses major threats to development, especially among context-sensitive children. But some kinds of stress can be good for children. For example, tolerably stressful challenges can promote positive development and coping skills.
5. We know how to help disadvantaged children, but it's just too expensive	Partially false. Known early interventions for at-risk children produce significant but mostly modest, positive effects; yet, even small effects across large populations of children can generate important developmental and economic benefits for all of society.
6. Babies are inert	False. Research shows babies have increasing capacities for seeing and recognizing human faces, for imitating the behaviour of other humans, and for interacting with their social environments in a variety of complex and mutually rewarding ways.
7. It's all over by age five	Partially false. Major events in brain development begin early, but they also continue into adolescence and early adulthood. For example, the prefrontal cortex (which controls planning, higher-order decision making, and emotion regulation) matures later in the teen and early adult years.
8. Children are naturally fair and kind	False. Like adults, children also form unequal societies, in which those at the bottom have less access to resources, are more often bullied, and have higher rates of physical and mental health problems.

"The first myth states that 'destiny is in our genes.' But genetic determinism is really beginning to be undermined by a series of elegant and exciting new studies. This research reveals that most human traits and most diseases come not just from genetics and not just from environmental experience, but from a convergence of the two – a mixing of the two into what are called gene-environment interactions. It is this differential expression of the genetic code that turns out to be what really does guide our fate, our ability, and our potential as human beings." **Dr. W. Thomas Boyce**

EMBRYONIC AND NEURAL DEVELOPMENT:
Setting the Stage for the Lifespan

By Dr. Charles Nelson

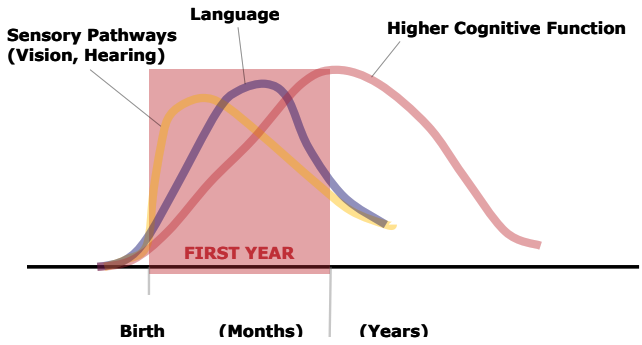
ABSTRACT: Prenatal experiences and early brain development are two critical periods for the health of a child. Exposure to cumulative adversity during these periods may cause enduring neurobiological changes responsible for a range of deficits in different domains.

Embryonic Development – Human development from conception to birth consists of a complex series of events that turn a single cell into a moving, sensing, thinking, and feeling individual. Prenatal development begins with conception and ends at birth. There are different stages of prenatal development and each stage brings its own unique characteristics and vulnerabilities. For example, all of the organs in the body are formed from roughly the second week after conception until the eighth week. This is a sensitive period when the heart, the liver, the brain and other organs form. Towards the last part of pregnancy, the fetus is growing and becoming more elaborate.

Neural Development – The formation of the brain begins within weeks of the formation of the embryo. Prenatal brain development occurs later in gestation. It begins with the formation of the neural tube (approximately one week after conception) and ends with the formation of synapses and myelin. During the third trimester, the brain looks like - but doesn't function like - the adult brain. The stages of brain development in this phase include: neurulation, cell proliferation, cell differentiation, cell migration, cell myelination, and pruning of cells.

Environmental Influences On Early Brain Development – Many aspects of brain development during the prenatal period depend on genetics. But there are also many external and environmental factors that can have a deleterious effect on brain and biological development during these critical early stages of development. For example, the potential for damage to the infant from prenatal exposure to the mother's use of alcohol or nicotine and maternal stress have been well documented. Brain development after birth is influenced substantially by the experience of the infant with the environment. These periods bring certain risks if the baby is exposed to something in the environment (e.g., alcohol, drugs, or measles). Depending on when exposure occurs, it can negatively impact how the brain and other organs form or grow.

Brain Development Continues Long After Childhood – Although the main architecture of the brain is complete by the third trimester of pregnancy, brain development continues through the first two to three years of life. During this period of later development, changes occur in key regions of the brain (e.g., prefrontal cortex) and in key ways (e.g., myelination). Thus, it is critical to understand what impacts brain development at certain periods of development if development is going to proceed normally. The sensory systems for both vision and hearing form largely during the first year of life. Language capacities also develop later in the first year. But the higher cognitive functions in the brain continue to develop over many years of childhood and continue to form into the later years of adolescence (see diagram).



"We know from lots of studies that, if you invest in early development, in the long run that child will be much more likely to be a contributing member of society. That means investing in those first three to five years of life. If we get kids off to a healthy start, the long-term gains will eventually benefit everyone in society." **Dr. Charles Nelson**

BRAIN PLASTICITY AND BEHAVIOURAL DEVELOPMENT

By Dr. Bryan Kolb

ABSTRACT: Brain structure and function are altered by experience. This is called brain plasticity. This experience includes a wide range of factors during and after pregnancy. Brain and behavioural development are also modulated by how genes are expressed or triggered to act through the influence of interaction with the environment.

Neural Plasticity – How the brain is changed by the lived experience is referred to as brain plasticity. Brain architecture is built from the earliest points of time in the development of a child. Neocortical (early brain) development involves a complex dance of genetic and environmental events that interact to adapt the brain to fit a particular environmental context. Behaviours emerge in development as the brain structures and functions underlying specific capacities mature over time. This development represents more than a simple unfolding of a genetic blueprint. It is actually a complex combination of genes interacting with the environment. For example, more complex cognitive functions rely on late-maturing structures and thus many behavioural capacities do not emerge until later in adolescence.

Epigentics – Epigenetics is the process by which gene expression is modified without changing the underlying genetic sequence itself. Human experience actually stimulates structural changes to the areas surrounding our genes. This can result in genes switching on or off.

Factors Influencing Plasticity – A wide range of prenatal and postnatal factors influence brain plasticity in development. Some well-researched factors include: the effects of sensory and motor stimulation; psychoactive drugs taken by the mother or child (both illicit drugs and prescription medications); stress; gonadal hormones; social experiences; and nutrition and diet. The effects of these factors are cumulative and can gain momentum – for good or bad – as one gets older and goes through life. Thus, early experiences contribute to an evolving developmental trajectory for each child that can influence brain functioning long afterwards.

Research Example: Touch – One interesting research example is the surprisingly potent effect of tactile stimulation on preventing addiction in animals. Some studies have used the intervention of stroking the skin with a soft brush on an infant rodent or the mother when she is pregnant (see diagram). The result is the likelihood of addiction later in adulthood can be reduced, just by having two weeks of tactile stimulation experienced as an infant and then no more touch treatment until adulthood. Thus, something about being touched positively at critical early periods has a therapeutic and lasting effect. Many hospitals now use touch therapy for newborn babies to encourage better health. Even being exposed to warm lighting has the same positive effects as touch and tactile stimulation.

"The brain hypothesis is the idea that 'you are your brain.' The average person, when really pushed, does not believe it. They believe that if you just tried harder, you could do better. Well, in some cases that is true, but in other cases it is not true. But it is more complicated than that because it is all about your brain. It is not about your heart. It is about what is going on in your brain." **Dr. Bryan Kolb**

THE GOOD, THE BAD, AND THE DAMAGING:
Chronic Stress and the Concept of Allostatic Load

By Dr. Matthew Hill

ABSTRACT: Stress adaptation processes play a major role in early brain and biological development. Key areas include the three major types of stress, how stress affects the brain and body, and the role of stress in early development.

Stress And Allostasis – When under stress, the body requires additional biochemical energy to prepare for a fight-or- flight response. This dynamic process of stress response is called allostasis, which refers to adaptation through change. The body creates a set point that triggers in response to threat. Through allostasis, the autonomic nervous system, the hypothalamic–pituitary–adrenal axis, and the cardiovascular, metabolic, and immune systems all interact to protect the body. Certain hormones drive the effects of stress and also modulate the ability of the brain to process information.

Different Kinds Of Stress – There are different grades of stress: positive stress, tolerable stress, and toxic stress. Positive stress is an appropriate response to a challenging situation, but is entirely manageable. Positive stress could arise when studying for a test or giving a speech. Tolerable stress occurs when events seriously challenge our biological response. The effects can be diminished through supportive social relationships. Exposure to mild stressors is believed to produce a long-term positive inoculating effect. Individuals may become more resilient to stress later in life through the development of active coping skills.

Toxic Stress – Toxic stress is different from the other two types of stress. Aspects of toxic stress are often uncontrollable and unpredictable, and the emotional response is more intense. For children, being brought up by a mother who is seriously depressed, being maltreated as a child, or living in a chaotic and unpredictable home situation are toxic stress experiences that can fundamentally change the trajectory of a child's life. Examples of toxic stress for adults include poverty, loss of a job, loss of social status, or being in an abusive relationship.

Effects Of Toxic Stress – Toxic stress affects the body and the brain. When we are under stress, our body launches hormonal responses such as increases in adrenaline and cortisol. These hormones increase available levels of glucose in the body to provide energy for responding to a threat. In the short term, these changes allow us to persevere. The problem in modern society is that these stress hormones can remain elevated over long periods of time. The result creates "wear and tear" on the brain and biologic systems involved. This is called an allostatic load and it is associated with developing health problems such as hypertension or insulin resistance and, later, Type II diabetes.

Chronic Stress Hurts The Brain – There are also negative effects on the brain itself from chronic stress. When stress becomes pervasive and persistent over a long period of time, some parts of the brain experience shrinkage in the size of neurons and brain cells, and premature aging. The shrinkage compromises the functionality of these brain structures. In addition, there are also negative behavioural consequences of chronic stress, such as impulsivity, poor decision-making, memory deficits, and habit formation - which can make one prone to addictions.

Stress And Development – Early toxic stress can create a vicious cycle that renders children more sensitive to stressful life experiences in the future. In some kinds of early life stresses such as familial instability, abuse or neglect, it even affects how the physical brain architecture is formed. By the time the child is an adult, his/her set point for triggering stress responses has been altered to be more similar to a person who has experienced chronic or traumatic stress. This means that children who have experienced toxic stress from adverse life events have already been damaged by the experience because it has changed their brain and the way it responds to stress in general.

"It is important to first understand the basic mechanisms in the brain and body that are driving some of the health risks to children. Knowing more about these areas sets the stage for developing appropriate clinical interventions."
Dr. Matthew Hill

RISK, RESILIENCE, AND GENE-ENVIRONMENT INTERPLAY IN PRIMATES

By Dr. Stephen Suomi

ABSTRACT: The study of rhesus monkeys offers insights into human development concerning early social interaction, genetic factors, and risks for positive and negative outcomes later in life. Dr. Suomi and his research team watch how monkeys grow and study differences in personality and the biological substrates that underlie these differences.

Caregiver Attachment – The study of rhesus monkeys can inform our understanding of human development due to the large overlap of genetics and socialization functions between the primate and human species. Like humans, rhesus monkeys exhibit a wide range of individual differences in their reactions to environmental stress and challenge. The monkey infants form strong emotional attachments to their biological mothers that are functionally the same as the social bonds that human infants often develop with their caregivers. Having positive and trusting relationships between an infant and caregiver – called secure attachment – somehow confers resiliency to the young. This effect is especially helpful to those babies who carry certain kinds of genetic factors that may otherwise increase their risk for negative developmental outcomes. Conversely, adverse early social experiences and lack of good parenting can have lasting negative effects, resulting in an insecure attachment personality type.

Maternal Buffering – Research shows the amount and quality of nurturing a child experiences is associated with responsiveness later in adulthood to stress, anxiety, and susceptibility to depression. Thus, having a nurturing caregiver relationship is an important protective factor that fosters better health and appears to overcome some genetic risk for poor outcomes. This protective effect is called maternal buffering.

Gene x Environment Interaction – Studies of both humans and monkeys provide compelling evidence for the role of gene-environment (G x E) interactions throughout development. A better understanding of these interactions may explain why individuals differ in their responsiveness to stress and also their capacity for resilience.

G x E Research Example 1 – An example of the G x E concept is found in primate research examining a specific part of the serotonin transporter gene (5-HTT) to determine whether there is either a short or long allele as part of the pair of alleles on the gene. Short allele status is associated with deficits in neurobehavioral functioning, low serotonin metabolism, extreme responsiveness to social stressors, aggression during youth, and alcohol use in early adulthood. However, these negative outcomes were found only in monkeys reared with other peers of the same age but not in the monkeys raised by their birth mothers.

G x E Research Example 2 – Similar findings have also been obtained in studies of humans. The classic Dunedin Study followed young adults who had experienced maltreatment as children. The results found that short allele status of the serotonin transporter gene was associated with increased depressive symptoms in young adulthood. However, this was found only among those who had experienced neglect or abuse earlier as a child or were currently experiencing high stress as a young adult but not among those who did not experience these adverse events or concurrent stress.

"Early experiences influence virtually all aspects of a monkey's behaviour and biology. Not only do they influence how its behaviour develops and how it learns to regulate its emotions, but it also influences development at the level of stress hormones, metabolism, various neurotransmitters, the structure and function of the brain, and gene expression. That is, early experiences can change the way genes work." **Dr. Stephen Suomi**

EARLY GENETIC AND ENVIRONMENTAL FACTORS IMPACTING THE REWARD AND MOTIVATION SYSTEMS

By Dr. Pat Levitt

ABSTRACT: Genetic and environmental factors combine to influence the formation and function of the reward and motivational systems in early childhood.

Reward Systems – The cognitive, social-emotional, and reward systems of the brain are interconnected. Scientific studies clearly show that how we respond to novelty and challenge in the outside world is very sensitive to early experiences and to genetic risk. There are sensitive periods during early development and maturation when the architecture and chemistry of the reward systems in the brain can be changed and damaged.

Multiple Risk Factors – Many specific factors can alter the development of brain systems that control reward and motivation. Specific prenatal and postnatal adverse experiences (such as drugs, stress, and abuse) establish a vulnerability to these complex reward systems. Cognitive, social-emotional, and reward systems are interconnected and thus the timing of differences in the assembly of these aspects of brain architecture over the course of development imposes unique opportunities for positively or negatively impacting the functional outcomes that rely on these parts of the brain.

Stress Effects – Early vulnerability is created through the effect of stress on the basic brain chemicals (e.g., dopamine and serotonin) that participate in the process of building brain architecture. Genes and environmental factors interact during early development to tune the way brain chemicals work. If they are tuned poorly from early adverse experiences, changes to the neurotransmitters will have long-term impacts on how the brain functions. Thus, patterns of experience – both good and bad – during early development impact brain architecture and neurochemistry. This early impact has long-lasting consequences. Building healthy brains depends on a combination of factors in the genes and the environment.

Early Social Interaction – Positive interaction between the child and caregiver is required for healthy development. This interaction is now recognized as being very important for healthy development of the brain and reward systems. Moment-to-moment exchanges of behaviours between a child and parent or other people have been called a serve and return model. This metaphor of a game of tennis refers to a process similar to hitting the ball back and forth between two players. It is through this interactive process that many aspects of brain development occur. This means that children are not little sponges that passively absorb the world around them. Children learn by actively participating and interacting with their environments. Reward and motivational systems start early and are built gradually over time through social interactions.

"There are certain parts of the brain architecture that seem to be particularly important in controlling our ability to interact with our outside world and to create 'homeostatic balance.' This is our feeling of being in control. These are the areas of the brain that include our reward circuitry, which involves the amygdala, the hippocampus, and the prefrontal cortex. The prefrontal cortex is a part of the human brain that has evolved in a very dramatic way and is getting much larger, so that we now try to have control over our emotions and over our desire to do rewarding things. These are also the parts of the brain that are particularly sensitive to adverse early experiences like toxic stress, abuse, neglect, and poor caregiving." **Dr. Pat Levitt**

RISK AND WELLNESS:
Individual and Contextual Influences on Development

By Dr. Jacob Burack

ABSTRACT: Development is a complex process. Individuals constantly influence and are influenced by the many aspects of the social environments in which they live. Other people play a vital role in creating a positive context for child development and can serve as protective factors against stressors. There are also biological differences in how children respond to stress and take advantage of social supports.

Normal Development – The brain and biological systems develop early in all species. During this period, most aspects of development follow an orderly path, as general functioning evolves in a consistent way and follows universal sequences. Simple skills develop first and more complex skills develop later, such that each step builds upon the prior steps.

Social Development – The social world of children gets more complex over time. There are four major age-related stages of social development: infancy, childhood, adolescence, and adulthood. Infants are focused entirely on themselves, their families, and their home environments. As children begin attending school, they live in a social stage that includes school, teachers, other children, peers, a special other person, neighbours, and concepts of religion and spiritually. Adolescents have an even more complex social environment, with the addition of community, authority figures, and a sense of personal identity. In adulthood, the social environment becomes even more complicated. Being an adult also involves training and higher education, work, career, co-workers, community activities, a romantic partner/spouse, extended family, becoming a parent, and so on.

Social Framework For Wellness – Based on the recognition of increasingly complicated and interconnected social environments, scientists have a developmental framework for understanding individual competence and well-being over different age periods and across major life domains. Children are expected to meet the societal expectations for achieving success in school, getting along with other people, knowing how to act appropriately, and maintaining their emotional well-being. However, what represents competence and well-being is in the eye of the beholder. There are different cultural perspectives on what constitutes successful early development.

Resiliency And Differences In Sensitivity To Stress – As Dr. Nelson and his colleges demonstrated in studies of children adopted from Romanian orphanages, some children are resilient and can overcome dire circumstances. In contrast, poor outcomes have also been observed in children in low-risk situations who would not otherwise be expected to experience problems. These different developmental outcomes are thought to be related, in part, to variations in individual biological sensitivity to contextual risk factors. A new theory proposed by Dr. Boyce and his colleagues suggests that stress reactivity is related to an individual's biological sensitivity to context and life events. Those children with heightened biological sensitivity to context are both more vulnerable to toxic stress in negative contexts and more sensitive to positive environmental influences when they are in good contexts. Thus the high biological sensitivity of a child may be maladaptive in the context of adversity but adaptive in the context of a nurturing and supportive environment.

Research Example: Suicide Risk In Aboriginal Youth – A stereotype reported in the media is that First Nations youth in Canada have very high rates of adolescent suicide. But when researchers investigated this in the late 1990s, they found that few communities actually had very high rates of youth suicide. In most of the bands, there were not high rates of youth suicide. The communities that promoted their own Aboriginal culture and heritage had the lowest youth suicide rates. Thus, certain efforts at the community level were protective of the children.

"Development is complex. We are trying to examine the complexity of these kinds of cultural contextual factors and also look at the individual child and how he or she is able to function within the social setting." **Dr. Jacob Burack**

AN OVERVIEW OF CHILD MALTREATMENT:
Implications for Child Development and Approaches to Prevention

By Dr. Harriet MacMillan

ABSTRACT: Child maltreatment is a major public health problem. There are five types of child maltreatment, including neglect and witnessing violence among adults in the home. Child abuse and neglect can cause death, serious injury, and long-term emotional and physical health consequences for children. Its effects can extend across the lifespan. Abuse can be prevented and both the victims and perpetrators can benefit from clinical treatment.

Child Maltreatment – Child maltreatment is an exposure to negative interpersonal experiences – a severe form of toxic stress – but it is not a clinical disorder. There are five major kinds of child maltreatment: physical abuse; sexual abuse; emotional/psychological abuse; neglect; and intimate partner violence (domestic violence by adults that is witnessed by children). One of the key messages from research is that neglect and exposure to intimate partner violence are just as potentially harmful to children as physical, sexual, or emotional abuse.

Prevalence – Except for sexual abuse, each kind of child maltreatment is increasing in prevalence in Canadian society. Official national data from 2003 of substantiated cases filed with local authorities shows that about 2 per every 100 children in Canada are maltreated. Self-report data has the prevalence rates more than 10 times higher, in the 20-30% range.

Consequences – Research has linked exposure to all five types of child maltreatment to impairment in child development as well as to health problems later in adolescence and adulthood as a result of the toxic stress experienced. Some background factors (such as family context and parental mental health or addiction problems) also have a role in the impact of abuse on children. Not all children are affected in the same ways by maltreatment.

Treatment – Treatment for child maltreatment should not occur when the child is still in an environment of ongoing abuse and/or neglect. Thus, in some cases the child must be removed from an abusive home in order to be treated effectively. The use of foster care homes as a form of intervention can benefit youth, compared with children who return home to live with their biological families who abused them. For those children who have severe reactions to abuse and develop posttraumatic stress disorder symptoms, cognitive behavioural therapy is an effective treatment. In addition to the affected child, the parents and other close family members should also receive treatment and support.

Prevention – Our first goal is to prevent maltreatment from ever occurring in the first place. This is accomplished by efforts at universal prevention (e.g., education and raising awareness about the issue to the general population) in addition to targeted prevention, which focuses on known risks and people susceptible to abuse. Once abuse has happened, the next goals are to try to prevent it from happening again, to prevent the damage from maltreatment from becoming worse over time, and to improve long-term outcomes for the victim and the family.

Research Example: The Nurse Family Partnership – In this U.S.-based program, specially trained nurses repeatedly visit the home to promote basic health-related behaviours, maternal life-course development, and parental care of children. This program is effective in preventing child maltreatment. Parent-child interaction therapy (PCIT) is used to prevent the recurrence of child physical abuse, but it is not effective for preventing child neglect. The PCIT program is based on research showing that parents who empathize and connect emotionally with their infants and who can properly respond to their babies' communicative signals are less likely to abuse or neglect their children. Presently in Canada, none of the child maltreatment support programs have been scientifically evaluated for their effectiveness.

"There is such an urgency to help children who have been exposed to child maltreatment, as well as to prevent it, but programs are put into place without knowing if they do more harm than good. It is a huge public health problem. I hope we can bring the same emphasis on science and having evidence-based programs that we do for other public health problems." **Dr. Harriet MacMillan**

THE AFTERMATH OF ADVERSE CHILDHOOD EXPERIENCES:
Posttraumatic Stress Disorder and Beyond

By Dr. Ruth Lanius

ABSTRACT: Adverse childhood experiences can lead to complex psychological and physical adaptations. Posttraumatic stress disorder (PTSD) related to childhood trauma is associated with significant deficits in emotion regulation, interpersonal functioning, and an impaired sense of self. Certain regions of the brain important for regulating emotions and social interactions also appear to be altered due to early maltreatment.

Early Stress And Mental Health – Complex psychological and physical adaptations tend to follow adverse childhood experiences. Research shows that adverse childhood experiences significantly increase the risk of developing mental-health problems, including posttraumatic stress disorder (PTSD), depression, substance abuse and other addictions. For example, PTSD related to childhood trauma is associated with altered brain functioning, including deficits in emotion regulation, interpersonal functioning, and an impaired sense of self. These findings suggest that exposure to extremely stressful situations as a child may leave an emotional scar that compromises the ability to be resilient to other stressors later in life.

Child Maltreatment And Emotion Regulation – New research has examined the functional brain architecture of emotion processes and interpersonal problems. The results show that people with PTSD related to early life trauma – such as child maltreatment – have problems regulating their emotions. Thus, the person displays an emotional response that is poorly regulated and does not fall within the normal range of emotive response. Under-modulation refers to symptoms such as reliving flashbacks, vivid memories, and fear or anger states associated with past adverse events. Over-modulation is also common for those who have PTSD. It includes symptoms of dissociation (such as out-of-body experiences), emotional numbing symptoms (being detached from one's emotions), and the inability to feel pain.

Emotion Regulation And Parenting – Abuse-related problems with emotion processing and interpersonal communication skills have also been associated with poorer parenting skills once the victim of child maltreatment has grown up and has children. Thus, it is important to provide targeted treatment to parents in order to prevent the intergenerational transmission of trauma.

Child Maltreatment And Sense Of Self – One of the most tragic outcomes of early childhood maltreatment is the effect it has on sense of self. Many people who have experienced maltreatment (toxic stress) as a child have an impaired expression of their self-identity. They may feel that they have two selves or that they do not know who they really are. This effect may come from attempts to disassociate from memories of terrifying abuse or very unpleasant past experiences. This effect is troubling, as a core sense of self-identity is needed for healthy development and positive mental health.

Treatment – Clinical help is available to support those with traumatic experiences. A stage-oriented treatment involving emotion regulation, interpersonal effectiveness skills, and prolonged exposure is often effective. This approach uses cognitive behavioural therapy and skills training in emotional and interpersonal regulation. This kind of treatment has been shown to reduce the impairments of PTSD related to childhood abuse.

"People with posttraumatic stress disorder related to early life trauma have significant symptoms of emotional dysregulation – both under-modulation and over-modulation – and they also have significant deficits in social emotion processing. This may disable them from engaging in normal social emotion processing." **Dr. Ruth Lanius**

DEPRESSION:
Brain, Body and Beyond

By Dr. Glenda MacQueen

ABSTRACT: Depression is a chronic and serious mental illness that results from a combination of factors, including genetic vulnerability, adverse early life experiences, and stressful events. Depression appears to change brain architecture and function. It is linked to risk for having other mental and physical health problems. The whole family, not just the depressed person, experiences depression.

Depression Defined – Depression is a psychiatric disorder that can be manifested through a variety of emotional, physical, and other associated symptoms. A defining characteristic is a period of at least two weeks during which the person feels depressed in mood or a loss of interest or pleasure in most activities. Some also emphasize body aches and pains rather than feelings of sadness. There are usually increased feelings of anxiety, memory deficits, and impaired decision-making. The variety of its symptoms suggests many areas of the brain and neural networks may be involved in depression.

Depression Prevalence – According to the most recent national study of Canadians, the annual prevalence of major depressive disorder (MDD) affects between 4 and 5% of the population. However, the lifetime rate is much higher, with almost 20% of the population experiencing at least one major depressive episode, including twice as many women as men (24% vs. 14%, respectively). Depression also affects children. In Canada, 9% of female and 5% of male youth, aged 12 to 19, have experienced a major depressive episode in the past year.

Depression And Stress – Depression provides an example of the consequences of allostatic load. Stressful life events can precipitate depression. In depression, stress hormones are involved in the psychopathology, reflecting emotional arousal and psychic disorganization. There are also changes in the body as a result of long-term imbalances in hormonal and other regulatory systems related to stress. Depression is a disorder that can affect the functioning of the whole body, including the cardiovascular, metabolic, and immune systems, as well as the structure and function of the brain itself.

Depression Changes The Brain – The amygdala and the hippocampus are two areas of the brain closely involved in mood regulation and depression. The amygdala is involved in emotional learning and memory. The hippocampus is involved in contextual learning and memory. Data from structural and functional brain imaging research studies shows that the hippocampus, prefrontal cortex, and amygdala may undergo changes in size and function with depressive episodes.

Depression And Physical Health – Depression may be more than just a psychiatric disease, as there is evidence of widespread systemic consequences and other health problems. For example, the neuroendocrine dysregulation and elevated activity in the sympathetic nervous system that occur in depression are linked to heart disease, obesity, diabetes, hypertension, and other serious physical health problems. Depression is a comorbid factor for dozens of chronic medical conditions, substance abuse, and other addictions.

Child Maltreatment And Depression – Studies suggest inadequate or abusive parenting early in life can sensitize the neurocircuitry of the parts of the brain involved in the regulation of stress and emotion. This can make one more prone to depression. Research on maltreated children has found an increased risk for internalizing problems, having depressive symptoms in childhood, and having major depression disorder in adulthood.

Depression Is A Family Affair – Research indicates that when mothers experience depression during and/or after pregnancy there is a range of negative effects possible for their children. These effects include a failure to thrive, insecure attachment, behavioural disturbances, decreased cognitive abilities, emotional regulation problems, depression, and problems in school. Given the chronic and cyclic nature of depression, it is also experienced indirectly by the family members of the person with depression. Such interfamilial impact is exacerbated when many people with depression do not receive adequate diagnosis and treatment. However, once obtained, clinical treatment is usually quite effective.

"A whole host of studies now suggest that when people have recurrent depression, the size of the hippocampus is small. That may be one of the simplest pieces of evidence suggesting that when people have depression, there really are changes to brain structure." **Dr. Glenda MacQueen**

HOW STRESS IMPACTS PARENTAL CARE AND THE INTERGENERATIONAL TRANSMISSION OF PARENTING ABILITIES

By Dr. Linda Mayes

ABSTRACT: Being a parent is more difficult for those who have suffered early adversity or chronic stress. These experiences can reduce the capacity to care for others, including the tolerance of distress, reactivity to stress, decision-making skills, and emotional attentiveness. These effects are related to the ways early stress affects the basic stress-reward systems and brain functioning later as adults.

Stress And Parenting – Recent studies demonstrate that key parental capacities - such as emotional attentiveness, distress tolerance, decision-making, and sensitivity to infant needs and cues - are adversely impacted by both acute and chronic stress. Early childhood adversity may also result in lowered stress tolerance and heightened stress reactivity in adulthood.

Several psychiatric disorders and substance abuse problems also show a similar symptom profile of increased stress sensitivity. For parents in these circumstances, caring for an infant can be experienced as more stressful than it is rewarding. This high stress can lead the adult to turn away from his/her parenting role or to show impaired understanding of the infant's needs. With chronic parental dysfunction, the poorer stress regulation that follows in the infant or child further increases the stress for the parent. This added stress can then make an addicted parent more prone to drink alcohol or use drugs (or use whatever is his/her addictive agent) as an attempt to reduce his/her stress level. This process offers a window into understanding how neglect and other forms of child abuse can begin.

Risk Of Intergenerational Transfer Of Poor Parenting – Dysfunctional parenting has the consequence of creating similarly dysfunctional stress regulatory capacities in the infant and child. These problems may persist into adulthood and perpetuate intergenerational transmission of parenting difficulties. For this reason, early intervention and prevention programs that typically focus on services for at-risk infants and young children should be augmented to include a focus on services for the parents. Parents need help to become better at understanding their own responses to their parenting role as well as how to better understand the needs of their infants.

Research Example: Mindful Parenting Skills Training – One effective intervention is called Minding the Baby.

In this program, the focus is on how parents make the transition from being adults without children to being parents. Traditionally, for infant or early childhood interventions, the focus is on educating parents on what the baby needs; for example: "Your baby needs a schedule" or "Your baby needs to be held a certain way." However, until one really knows what that person brings to his/her role as a parent, that kind of tactical knowledge is not that easily used. In contrast, the goal of the intervention is to explore how parents think about their caregiver role and how to view this process more from the perspective of their baby.

"A great deal is known about how toxic stress in early childhood affects a child's learning abilities, emotional development, and other important capacities, but we think less often about how toxic stress endures into adulthood and then affects those very abilities that parents need to then care for their children. So in essence, children exposed to early adversity when they become adults – if there is not some intervention in between – may pass on those very same effects of the early adversities to their children by the effects of early stress." **Dr. Linda Mayes**

ADULT MENTAL AND PHYSICAL HEALTH AND DEVELOPMENTAL "PROGRAMMING"

By Dr. Pat Levitt

ABSTRACT: Early stressors, even before birth, can influence the physical and mental outcomes of adults. Studies on the developmental biology of stress and allostasis help to explain some of the underlying reasons for the higher risks of physical and mental health disorders found among those with troubled childhoods.

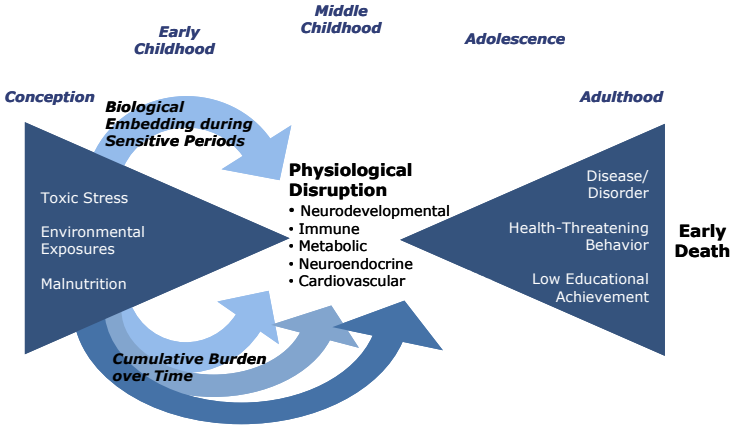
Childhood Stress And Disease Later In Life – Exposure to more intense stressors, especially those that are uncontrollable or pervasive, can harm the proper development of early brain architecture. This can set the stage for changes in emotionality and stress responsiveness that can promote poor coping skills and increase vulnerability to mental and physical illnesses. The scientific evidence demonstrates that early adverse experiences can become biologically embedded in the development of multiple organ systems. This results in long-term negative impacts on many aspects of health, including metabolic regulation and cardiovascular health, which can lead to heart attacks and diabetes. It also impacts the development of basic cognitive, language, and social skills.

Cumulative Allostatic Load – Why do these body systems seem so vulnerable to early adverse experiences? The answer may lie in the power of very early adverse experiences and their negative impact of placing an extreme allostatic load on a developing system. Even though the system can function normally for a while, ultimately the stress cannot be tolerated, and the weakened biological system fails. This increases the chance for illness and disease.

Conceptual Model – The diagram below depicts a new biodevelopmental framework for considering the role of early childhood risk factors in lifelong health. Toxic stress, environmental exposure to physical toxins, and malnutrition all pose serious early risks for children. These risks can accumulate over time, as a child gets older, and can become embedded in the brain and body systems of the developing child. This set of adverse conditions creates the opportunity for various kinds of physiological disruptions that later manifest in a variety of health problems in adolescence and adulthood and can even result in premature death.

Health Outcomes – Early childhood adversity can influence a wide range of health and prosocial outcomes over the lifespan. More specifically, early stress can influence risk for a variety of mental and physical health problems, including depression and anxiety, substance abuse, sex and food addictions, autoimmune diseases, diabetes, cancers, cardiovascular diseases, and others.

Preventing Disease In Childhood – The interconnectivity of the brain and biological systems is evidenced by the fact that the emotional regulatory systems and peripheral organ systems are both involved in developing chronic diseases. Taken together, these scientific advances support the role of positive early experiences in strengthening brain architecture and foster a growing understanding of how significant adversity damages brain circuits and undermines lifelong learning, behaviour, and both physical and mental health. Thus, it is important to intervene very early with families and children who are at risk in order to prevent the development of toxic stress-induced illness and disease later in life.



"Why do early adverse experiences get under our skin and can create either positive or negative situations that may bear out over the lifetime of an individual? We actually have a lot of information now about early development experiences – like toxic stress – that can create risks later on for developing cardiovascular disease, autoimmune disorders, cancers, as well as mental illnesses." **Dr. Pat Levitt**

PART 3

Communicating Science

This part of the report reviews communications strategies for the transfer of the foundational scientific knowledge to applied domains.

Knowledge Translation

In order to develop social policies and programs that incorporate scientific knowledge about early brain and biological development, that science must be communicated effectively to policymakers and the public. This requires an intentional approach to framing this science. As cognitive science research has shown, the public does not take in new information as blank slates ready to see the truth. Instead, people tend to use interpretive frameworks and mental models that are culturally constructed. Quite often, the way in which scientists, advocates, and the news media communicate information about early brain and biological development reinforces these cultural models.

Fortunately, the accuracy of the communication about early brain and biological development can be improved dramatically by using the findings from research that explores how the public conceptualizes and organizes information about this area. This research offers practical recommendations on how to change the public conversation and create more effective communication about early child development in Alberta.

The FrameWorks Research Approach

The FrameWorks Institute conducts research into the dominant public attitudes and understandings of early childhood development and the communications approaches that hold the best promise for overcoming barriers to understanding created by the dominant attitudes and understandings held by the public. The AFWI has sponsored several provincial projects that have allowed FrameWorks to extend its research program from the United States into Alberta.

The FrameWorks Institute has also collaborated with the National Scientific Council on the Developing Child and the Harvard Center on the Developing Child to implement framing recommendations into the series of Working Papers that were noted in Part 2. These Working Papers offer a model of effective framing in action. In addition, the FrameWorks Institute maintains a comprehensive website with numerous research reports and interactive teaching tools to help science communicators.

Unique Research Methodology

Strategic Frame Analysis,™ developed by the FrameWorks Institute, is an approach to communications research and practice that integrates essential constructs from the cognitive and social sciences to describe and explain how communications in general, and media in particular, influence public support for social programs and policies. FrameWorks' research on early child development resulted in the development of a "core story" narrative that explains why development matters, what develops, how it develops, and what can go wrong.

See Appendix 4 for more information on the specific research methods used by the FrameWorks Institute.

Step 1 – *Charting the Landscape of Early Child Development*

The FrameWorks Institute has conducted extensive research in the United States with the Harvard Center on the Developing Child on how to strategically communicate information about child development. Despite cultural similarities between the United States and Alberta, the cultural patterns of understanding that individuals within these groups share and employ in processing information vary in subtle but important ways. Such differences shape the effect of messages and are therefore highly relevant to the practice of communications. Armed with the knowledge of how Albertans reason about child development and how these patterns of reasoning differ from those employed by Americans, messages about early child development can be framed to have optimal and intended effects in the Albertan context.

Step 2 – *Exposing the Gaps and Traps in Early Child Development*

Next, FrameWorks compares how Albertans think about child development to the key messages and themes of the science on this issue, and identifies the specific places where gaps exist between these two understandings, and where existing cultural models are likely to create traps in the public's thinking.

More than the Family Bubble

One cultural model of early child development is that it occurs primarily inside the "family bubble." This refers to the broadly held assumption that everything related to child development exists in the domain of private family life. This view contrasts sharply with scientific evidence that includes multiple positive and negative social influences on early development that happen in addition to what goes on within the family.

Put Individuals in Their Community and Social Contexts

A second problematic assumption is the degree to which people use only individualistic thinking, and cannot see how what surrounds us also shapes us as we develop. This view suggests that individual behaviours, morals, and character are the exclusive drivers of child development. By extension, it is up to the child as an individual and autonomous being to figure out how to become a healthy adult – a process that might be described as "self-makingness." This is a process understood to be unique to each child and not under the purview of others outside of the child's family to intervene. The problem is that by over-emphasizing the role of the individual, policy makers cannot discern how public policies or more community-oriented actions would support healthy development.

The consequences of these two cultural models are serious. Incorrect assumptions can exclude good policy ideas from consideration. For example, a family-focused mindset excludes the important roles of key social environments (e.g., school, community, work) and interpersonal relationships (e.g., teachers, friends, neighbours) that occur outside of the family. And it is just these kinds of social influences that are critical components of healthy development for every child and which offer important locations for program and policy innovation.

Development is Mysterious

For the public, the process in which the brain is involved in development is murky and not well understood. Put another way, there is "a brain" somewhere in the black box of development, but what happens to this brain remains shrouded in mystery. This contrasts with the scientific understanding that development is influenced by many interactive factors in predictable ways with predictable outcomes.

Development is a Dynamic – not a Passive – Process

When people think about the process of development, they tend to assume that children are little sponges that are filled by, and passively absorb, things immediately around them. This contrasts with the scientific understanding that development doesn't happen automatically or passively. Rather, the child interacts with his or her environment and that interaction, in turn, changes the very mechanics of the developing brain. Basic skills and competencies are taught, practised, and learned in the early years of life, as the development of brain architecture supports them. Brains are built through repeated interactive social experiences in the early years.

Toxic Stress Sabotages Healthy Brain Architecture

The public holds an implicit understanding that stress, even when severe, is a compulsory and even beneficial aspect of development. Scientists understand that excessive stress has a cumulative, negative, lifelong effect on developing brains. The communications challenge is to distinguish between positive stress – the kind that the public readily acknowledges – and the more serious toxic stress that varies in duration, severity and cumulative effect.

Improving the Social and Physical Environment to Support Child Mental Health

As people struggle to understand the complex processes that support or erode child mental health, they tend to toggle between two contrasting views. First, they think that children can't have mental-health problems because children are emotionally and psychologically underdeveloped. Second, they view children as little adults in how they function emotionally and psychologically, so that mental-health problems and treatments are basically the same for children and adults. Both of these views contrast markedly with the scientific understanding of child mental health as being determined by multiple causal factors that change over time, including gene-environment interactions, social relationships, and life experiences.

Step 3 – *Re-drawing the Map of Early Child Development*

The third stage is to identify the communications strategies that close these gaps and activate more productive ways to think and process information about early brain and child development.

Re-framing of Scientific Concepts

A frame is the way a story is told that structures meaning. It includes multiple elements such as values, metaphors, context, data, and tone to support that meaning.

Components of effective re-framing should:

- Redirect attention away from incorrect default cultural models;
- Link the values behind the issues to societal and individual goals;
- Use simplifying models or metaphors to explain the key concepts;
- Connect these key concepts from the science explicitly to potential policy and program implications;
- Note the consequences of continued inaction.

Re-framing Child Development with Key Values Endorsed by Society

A value is a general claim about desirable social and personal conditions. Values are the ideals that provide the organizing principles on the basis of which people reach decisions. Communication about child development can be more effective when the scientific facts are presented in ways that link to values.

Prior FrameWorks research, which was conducted in the United States, identified "future prosperity" as a value that can help communicate the importance of early development in a more effective way. The premise for a connection between early child development and this value would be that the future prosperity of any society depends on its ability to foster the health and well-being of the next generation. Most people accept this idea. Thus, when a society invests wisely in its children and families, that next generation will yield a lifetime of productivity and responsible citizenship. Additional research is now underway by FrameWorks to identify values that more accurately reflect the societal goals of Albertans.

Simplifying Models for Core Concepts of Early Child Development

A simplifying model uses a concrete metaphor to bridge the gap between expert and public thinking. Bridging the Knowledge Gap Between Experts and the Public with a Simplifying Model. The six simplifying models that follow have all been developed, tested, and found effective in improving public understanding of early child development and children's mental health in the U.S. Additional research in Alberta will further refine these models for use in the province.

FrameWorks Summary – Six Key Scientific Concepts as Core Stories

CORE STORY #1 – BRAIN ARCHITECTURE

The basic architecture of the brain is constructed through an ongoing process that begins before birth, peaks in childhood and adolescence, and continues into all phases of adulthood. The metaphor here is building a house and needing a strong foundation to have a well-functioning structure.

CORE STORY #2 – SKILLS BEGET SKILLS

Brains are built from the bottom up, with simple neural circuits needed before more advanced circuits and skills can develop. The visual metaphor that matches this concept is that of a set of scaffolding, with the simple lower levels needed before more complex higher levels can be added.

CORE STORY #3 – SERVE AND RETURN

The interactive influences of genes and experience literally shape the architecture of the developing brain. It is like a game of tennis or volleyball, where the active ingredient is the "serve and return" or the back and forth repeated interactive nature of how children relate to caregivers and other people.

CORE STORY #4 – CAN'T DO ONE WITHOUT THE OTHER

The cognitive, emotional, and social capacities of a developing child are inextricably intertwined. Brain development, basic learning, behaviour, and physical and mental health are inter-related in childhood and over the life course. Like a fabric that has many interconnected woven fibres, these different experiential domains of child development influence each other.

CORE STORY #5 – TOXIC STRESS

Toxic stress in the early years of life damages the developing brain and leads to problems in learning, behaviour, and increased risk for physical and mental illness.

CORE STORY #6 – PAY NOW OR PAY LATER

Brain plasticity and the ability to change behaviour both decrease over time as a child gets older. Thus, funding programs and services that offer a healthy environment and positive experiences in infancy and the early years of childhood is far less costly than trying to address problems later. The return on investment for early-intervention programs is well established in research studies.

PART 4

Implications of the Science

This part of the report highlights the key policy and program implications of the scientific knowledge.

Three Key Implications

Early childhood is a time of great opportunity for positive growth and a period of considerable risk as well. What is done – or not done – during this early part of life can have profound implications for the individual and also for society. The recent scientific discoveries in this area offer exciting new directions that were not appreciated even as recently as a decade ago. The knowledge gained from this research presents decision-makers, policy leaders, program developers, clinicians, educators, and stakeholders with valuable insights into the influences of early brain and biologic developmental processes and family dynamics. Although the application of this knowledge has myriad routes, three areas merit a high priority as we go forward.

IMPLICATION #1 – START EARLY

Intervention in the very early years of a child's life makes a meaningful and lasting difference. Early intervention is also cost-effective. If we wait to intervene until children are in school or even adults, we miss out on the most promising opportunities to create better outcomes and to spend investment dollars wisely. Providing intervention and support to children and families during the early years of life is a rallying cry everyone can endorse.

IMPLICATION #2 – PREVENT OR REDUCE TOXIC STRESS

Toxic stress experiences sabotage healthy child development and should be prevented. There is a need to explore which policies and programs can best prevent toxic stress conditions from taking hold in communities and to reduce the damaging effects of toxic stress for at-risk pregnant mothers, young children, and their families. This could involve creating contexts that enable positive parent-child attachments and responsive caregiving. Also needed are ways to avoid child maltreatment, family violence, and mental health and addiction problems in parents.

IMPLICATION #3 – EMPOWER THE FAMILY AND THE COMMUNITY

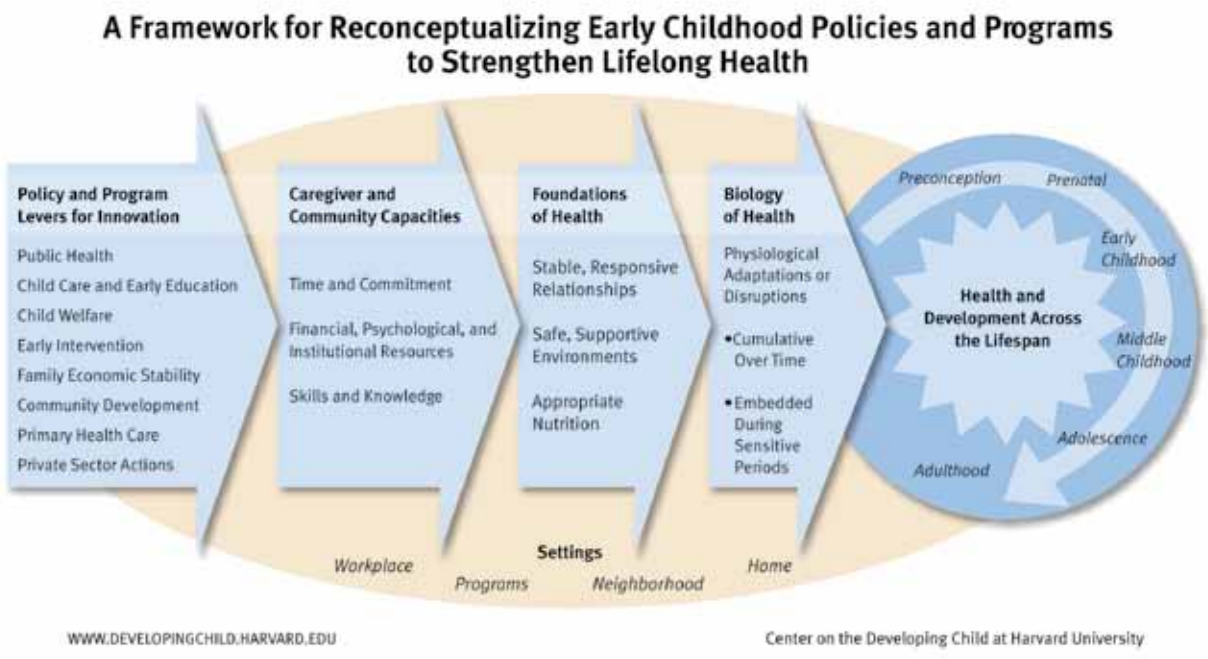
Effective strategies to encourage child health and wellness must also include the family of the child and what influences its ability to provide for the child. To provide more or better early daycare services is not enough if the children using the services are burdened by anxieties, fears, and chronic stress resulting from adverse experiences at home, that in turn result from economic dislocation or other social stressors. Similarly, offering science-based information on child-development processes and related advice for better parenting is not sufficient if the mothers and fathers receiving this advice are having difficulty coping with their own stressful life events that undermine their ability to function in society. Although such problems are

multi-determined and difficult to resolve, policy and program decision-makers must acknowledge that larger societal issues that affect the family also affect the child. Thus, parents and other family members need assistance too – not just the developing child. Both the workplace and local communities can offer more support to families.

As the diagram below shows, people in a variety of areas are needed to act as levers for innovation in early childhood policy and program development. Different decision-making, policy, and program-delivery sectors in Alberta were well represented among the participants of the Symposium. As these professionals continue to interact in the future as members of the Learning Teams, the implications for action will no doubt be frequently discussed and debated.

Possibilities for New Policies and Programs

Many considerations are involved in identifying the best methods for supporting early-life success, reducing toxic-stress factors, and supporting parents and families. There are also other worthwhile areas to consider for change. The purpose of the Symposium was not to dictate particular policies or programs that should be enacted. Those choices are more appropriate for the participants themselves. With knowledge from the research experts and know-how from FrameWorks, the participants are now better equipped to continue their quest to improve the lives of children and families in the province.



Faculty Comments on the Implications of the Scientific Knowledge

Content Faculty members commented on how the science in their area of expertise could be applied to policy and program service issues. The following are selected quotes from these interviews.

Dr. Boyce – "A responsibility of our societies is to begin to have a change of heart – a national raising of consciousness – about the salience and the critical importance of children to the well-being of larger society."

Dr. Kolb – "There is a tendency for people to think the problem is simple. If we can just give a little more kindergarten, then the kids will all be getting PhDs. But it is not quite that simple. We need to look at it as a family process. There are all kinds of adverse events going on in the home. Stress, for example, or maybe there is an addiction by one of the parents or a loss of a job. The point is that it all combines together to produce this environmental mixture that is going to have quite an effect on brain development."

Dr. Suomi – "One message from the monkey research is that early parenting is very important for good healthy development of children. The more you can do to support parents, it will go along way to ensuring the future of their children."

Dr. Burack – "As policy makers, we have to take into account cultural complexity. For example, many or most school systems in Canada are failing the First Nations' youth. So we are trying to understand how to integrate the First Nations' culture into the schools and how to get the teachers to become more sensitized to the cultural background of these children."

Dr. MacMillan – "It is important that all people working with children have expertise in the area of child maltreatment and how it relates to child development. With the research we have on programs that successfully prevent child maltreatment, we can bring key components of these evidence-based programs to Alberta and to Canada generally. We also need more research to evaluate the programs we already have and to help us develop new ones."

Dr. Lanius – "One area of concern is the intergenerational transmission of trauma. If a caregiver is affected by being on an emotional roller coaster, how does that affect his or her ability to parent effectively? We need to look at how to better support these at-risk parents in terms of policy, treatment, and future research."

Dr. MacQueen – "One of the things that can help us make a difference in people who have challenges from adverse early experiences is to think about prevention. For example, if we can help a mom who already has a depression to have a better long-term outcome, then maybe we can also decrease the risk of her children having adverse outcomes over time."

Dr. Mayes – "Usually when we are trying to deal with children who have been under tremendous adversity, what we do is to appropriately intervene immediately and get those children to safer places. But that leaves behind, if you will, another victim. And that is their parents. By intervening with the parents as well as with the children, we can potentially impact the next child they will have or help the other children in the family. While it sounds like that requires another whole level of funding and child protective services, it actually doesn't. Rather, it requires more training to think about toxic stress and early childhood adversity as a family issue instead of just as a specific child issue."

Dr. Levitt – "I think Albertans are beginning to get very focused in this area and are recognizing that the health and welfare of our children translates into the health and welfare of our community for a long time."

PART 5

Early Development and Addiction

This part of the report provides a brief overview of addiction, explores how early brain development is linked to addiction later in life, and previews the 2010 Recovery from Addiction Symposium. Also presented are comments from the Content Faculty on addiction.

Overview of Addiction

Addiction is a chronic, relapsing brain disease. People struggling with addiction use substances or engage in behaviours in ways that they cannot control, even when it results in negative outcomes. Addiction has many forms, with two primary types: (1) Substance-related addictions, which include the abuse of tobacco, alcohol, and street or prescription drugs; and (2) Behavioural-oriented addictions, which include problematic use of gambling, food, sex, the Internet, and work.

Despite the magnitude of the problem, addiction remains profoundly under-diagnosed and under-treated. The reason for this is twofold: there is a lack of awareness about the complexity and chronic nature of the disease and its treatment; and those with addictions must contend with social stigma and prejudice. Unlike other chronic diseases, such as heart disease, diabetes or hypertension, addiction has not been formally recognized by our health care system as a chronic, relapsing disease; thus it is treated with only brief episodes of care. This leads to a revolving-door phenomenon in which addicted clients are admitted to care, released, and then later admitted to similar programs and services. This approach wastes time and money. It also ultimately fails society and the person trying to overcome his/her addiction. Given the high personal and societal costs involved, a new, more effective approach to support recovery from addiction is needed.

Contemporary neuroscience-based clinical research indicates that addiction treatment is more effective when addiction is understood as a developmental and cyclical process. Although the form of the addictive substance or behavior may differ, the underlying causal mechanisms and neurochemical components are similar. Further evidence for a common underlying process is found in the high rates of cross-addiction (e.g., people having multiple addictions at the same time) and of comorbidity between addictions, mental health disorders, and other stress-related diseases.

When addiction is properly recognized as a brain disease with an underlying neurobiological process, its treatment should occur within a chronic disease-management model. Such an approach includes the use of qualified providers, trauma-informed services, involvement of family members, aftercare programs, long-term follow up, and consistent monitoring to prevent relapse.

Early Brain Development and the Link to Addiction

Becoming addicted is a gradual process and involves many different and interdependent causal factors. The research clearly shows that most adults with addictions first developed these problems during adolescence or young adulthood. This finding makes sense from a developmental perspective, since teenagers have greater access to and may seek out opportunities to experiment with alcohol, drugs, and other potentially addictive experiences as they gain more independence from their parents. From a biological perspective, adolescence is a time in which the part of the brain responsible for decision-making and executive control is undergoing considerable change and is not yet fully mature. Exposure to experiences that can alter brain architecture in these same areas may increase the likelihood of developing an addiction.

Adverse experiences that occur earlier in childhood, even as far back as the pre- and postnatal periods, can also alter brain architecture in ways that may prime an individual to become vulnerable to addiction. Scientists now know that the quality of the infant-caregiver interaction and the exposure to adverse events have direct effects on the brain systems responsible for regulating emotions and coping with stress, and that these effects occur through an epigenetic mechanism. In other words, children who are exposed to adverse experiences including neglect may grow up to be adults who have difficulty coping with stress, anxiety, and mood. This can lead individuals to attempt self-medication to reduce stress, lower anxiety, or improve mood.

Neuroscientific research supports key conclusions that link early brain and biological development with important aspects of addiction:

- Addiction is a chronic brain disease, not a failure of will;
- Early experiences can have long-lasting effects on brain architecture, including the areas responsible for mood regulation and stress responses;
- Stress and anxiety are proximate causes of self-medicating behaviours and addiction relapse;
- People who experience adverse childhood experiences are more likely to develop addictions in adulthood.

This research has far-reaching implications on how to approach addiction prevention, intervention, and treatment, and yet the evidence is not currently being incorporated into most addiction-related policies and practices. The 2010 Recovery from Addiction Symposium is designed to help Albertans develop new ways to approach health promotion and disease prevention in the realm of addiction, and make a positive difference in the lives of Alberta's children and families.

Content Faculty Comments on Brain Development and Addiction

The following are selected quotes from some of the interviews with the Content Faculty on how the science presented at the EBBD Symposium is linked to addiction.

Dr. Nelson – "If development is compromised before birth, it increases the likelihood the child is going into an environment that may not be ideal to facilitate development. It is as though the child then takes a second 'hit.' It is one thing to be exposed to alcohol or drugs prenatally, but then to go to a home where there is alcohol and more drugs and a chaotic family life is a recipe for disaster."

Dr. Kolb – "We know prescription drugs taken by the mother can influence how the brain develops in the infant, because these chemicals cross the placental barrier and can influence the brain directly. We also know that prescription drugs taken by juveniles (like Ritalin) can also influence the brain, but it can also have long-lasting unintended effects. Nothing is benign – every experience builds on other ones."

Dr. Lanius – "I think these risks for addictions are related to emotion dysregulation. We often see significant emotional dysregulation in children. They often have no control over their emotions – going up and down and up and down. These problems are often related to substance abuse. People feel so out of control that they turn to substances in an attempt to help regulate that intense emotional roller coaster. It can also relate to eating disorders; for example, when you are really feeling out of control there is increased risk for starving oneself, binging and purging, or over-eating, in an attempt to self-regulate one's emotions. Or we see self-destructive behaviours – such as self-cutting, self-burning, or picking at the skin – when people feel really dysregulated and out of control emotionally."

Dr. Mayes – "One may have a choice about a particular addictive agent, but there is a process that cuts across all addictions. And the reason that is important is that an addiction process is one of the outcomes of early toxic stress. Often we turn to habitually rewarding things as a way of dealing with stress. Early toxic stress conveys a kind of dysregulation of our stress reactions, so that even minor things in life become more stressful. And then we turn to even more rewarding things to try to take care of the stress. A related issue is: how does an addicted adult who becomes a parent then experience their infant? Often their infant becomes a stressor as well. For example, their baby's cry may be stressful, or not knowing what their baby needs or feels may be stressful. These kinds of stressful experiences can then make the parent turn back to drugs or alcohol or whatever they have found that habitually works to reduce feelings of stress. So, from this perspective, addiction is a problem developed from early stress and adversity."

Dr. Levitt – "There are parts of the brain that are particularly sensitive to adverse experiences like toxic stress, abuse, neglect, poor caregiving, and all sorts of things that can influence the brain to not develop properly. So what happens later when these parts of the brain are not developed properly? Later on we try to seek out – maybe even over seek out – those kinds of things in the environment that can make us feel better – like drugs, alcohol, or other addictive substances and behaviours. This use then creates an even worse problem and makes things more stressful. This diminishes our ability to cope with the environment. The continued stress from the addiction then weakens the other body systems. Hence, our risk is increased for developing other diseases, like cardiovascular, cancer, and autoimmune disorders."

PART 6

RESOURCES:

Opening the door

A goal of the Symposium was to create greater access to scientific research and related knowledge-transfer materials. This part of the report identifies additional resources available to support promoting child and family health. The resources listed on this page were selected by the Content Faculty as being the most useful for non-researchers interested in making a positive difference in early brain and biological development domains.

Resources at the EBBD Symposium Website

The website for the Symposium has a variety of useful documents and other resources that can be accessed by the participants. The web portal can be found at http://ebbd.banffcentre.ca/. A partial list of the resources includes:

- PDF versions of the 10 Working Papers by the National Scientific Council on the Developing Child and the Harvard University Center on the Developing Child (see page 17). Also included is the most recent report on the foundations of lifelong health.
- PDF and PowerPoint versions of the full slide decks for all 12 of the Content Faculty presentations.
- Video recordings of the Content Faculty delivering their presentations.
- Video recordings of four presentations by the FrameWorks Faculty at the event.
- FrameWorks Institute Materials – Strategic Frame Analysis E-Workshop; E-Webinars on Framing, Science Stories, Gene-environment Interaction, and Child Mental Health; and links to other resources.

- Learning Team Compass Reports presented by the 13 groups on the last day of the week.
- Online Community Forums – News, community, chat, photos, and more for the Symposium participants.
- Learning Teams – A part of the site dedicated to each of the 13 small groups of participants.
- Participant Roster – Access to mini-profiles of all participants and faculty, e-mails, blogs, and other e-tools.

Other Resources for Participants and the Public

- The current set of summary research reports from the National Scientific Council on the Developing Child and the Harvard University Center on the Developing Child.
- Knowledge-transfer reports of scientific research written for professional audiences (see Appendix 5).

Closing Comments

As we have learned, early brain and biological development is an important and dynamic process offering many opportunities for vitality and for vulnerability. The Symposium has initiated an exciting path of discovery and hope for adopting new and more effective strategies to create a better society in Alberta through creating a better start for our children.

The Symposium brought together a distinguished panel of experts in the scientific study of early brain and biological development with key stakeholders from Alberta. These researchers and clinicians shared their knowledge and insights with a diverse and caring group of more than a hundred professionals from many sectors involved with child health. This initial learning will be further enhanced through the later use of the many educational resources generated from the conference materials and identified in this summary report.

While knowledge is the fuel, it is people coming together who function as the flame to ignite change. Many opportunities for collaboration and friendship were created among the participants during their time together this spring in Banff. This is perhaps the most significant outcome from the Symposium, as this event was just the first step in a much larger, three-year initiative.

Evaluation Highlights

According to results from the post-event evaluation survey, the event was a success for participants:

- 96% agreed that because of attending the Symposium they had more confidence discussing the science of early brain and biological development with others in their workplace or work environment.
- 100% agreed that because of attending the Symposium they felt better equipped to champion issues related to early brain and biological development with others in their workplace or work environment.

Participant Comments

Question: "What were your personal highlights at the Symposium?"

"It was valuable to have such a multidisciplinary group of people come together and discuss common issues from different perspectives and functional roles."

"The quality of the presentations was superb."

"The exposure to the metaphors of the FrameWorks Institute was a great opportunity."

"It is important that we provide services and interventions that are based on the most up-to-date science, so we can support creating change and improving the lives of children and families."

Content Faculty Comments

"I think it is wonderful to bring together people from different fields like this at the Symposium."

Dr. Mayes

"It has been a great chance for education and bringing together a number of different areas that don't usually come together."

Dr. Lanius

"Because we all share the same risk factors, we can all benefit from the same scientific literature that, in turn, can impact policy. I think that is what this is all about – how to have an exchange between the science experts and the policy makers."

Dr. Nelson

Appendix I

SYMPOSIUM PEOPLE: *Development & Management*

The People Who Developed the Symposium

In addition to the sponsors, the Symposium involved a great number of people in its development, planning, and delivery. Major groups involved these activities were the Senior Leadership Team, the Participation Committee, the Design Committee, and the Resource Committee.

A. Senior Leadership Team

A small group of key individuals representing the scientific and policy areas of early child development and family health directed the development of the Symposium's overall structure and format. The Senior Leadership Team included:

- Dr. Glenda MacQueen, Professor, Department of Psychiatry, University of Calgary (Calgary, AB)
- Gillian Najarian, Deputy Director, Harvard Center on the Developing Child (Cambridge, MA)
- Dr. Charles Nelson, Professor of Pediatrics and Neuroscience, Harvard Medical School (Boston, MA)
- John Sproule, Senior Policy Director, Institute of Health Economics (Edmonton, AB)
- Paula Tyler, Executive Director, Alberta Family Wellness Initiative (Calgary, AB)
- Kate Pedlow, Symposium Lead, Norlien Foundation (Calgary, AB)

B. Participation Committee

Another part of the development of the Symposium involved the processes and selection procedures needed to identify and invite the people who became the participants of the Symposium – "The 100 Albertans" - and by extension, the people committed to continuing their participation in the larger three-year strategy. The Participation Committee included:

- Dr. Thierry Lacaze, Director, Women and Children's Health Research Institute (Edmonton, AB)
- Nancy Reynolds, President and CEO, The Alberta Centre for Child, Family and Community Research (Edmonton, AB)
- John Sproule, Senior Policy Director, Institute of Health Economics (Edmonton, AB)

C. Design Committee

The design of the specific aspects of the Symposium format and events was led by members of the Design Committee:

- Dr. Roger Palmer, Professor, Faculty of Business, University of Alberta (Edmonton, AB)
- Dr. Brent Scott, Director, Alberta Children's Hospital Research Institute for Child and Maternal Health (Calgary, AB)
- John Sproule, Senior Policy Director, Institute of Health Economics (Edmonton, AB)

D. Resource Committee

Another group of individuals from a variety of organizations assisted in developing and procuring a wide range of resources needed for the Symposium. The Resource Committee included:

- Susan Nall Bales, Founder and President, FrameWorks Institute (Washington, DC)
- Dr. Margaret Clarke, Fraser Mustard Chair in Childhood Development, Professor, Faculty of Medicine (Pediatrics and Psychiatry), University of Calgary (Calgary, AB)
- Ron Dyck, Assistant Deputy Minister, Research Division, Alberta Advanced Education and Technology, Government of Alberta (Edmonton, AB)
- Karen Ferguson, Assistant Deputy Minister, Community Strategies and Support Division, Alberta Ministry of Children and Youth Services (Edmonton, AB)
- Dr. Roger Palmer, Professor, Faculty of Business, University of Alberta (Edmonton, AB)
- Nancy Reynolds, President and CEO, Alberta Centre for Child, Family and Community Research (Edmonton, AB)
- Dr. Brent Scott, Director, Alberta Children's Hospital Research Institute for Child and Maternal Health (Calgary, AB)
- Dr. Lorraine Stewart, Executive Director, Program Delivery, Alberta Ministry of Education (Edmonton, AB)

The People Who Managed the Symposium

The Norlien Foundation Staff

- Nancy Mannix, Chair and Patron (Calgary, AB)
- Dr. David Elton, President (Calgary, AB)
- Paula Tyler, Executive Director (Calgary, AB)
- Kate Pedlow, General Counsel and Program Officer and Symposium Lead (Calgary, AB)
- Dr. Nicole Sherren, Scientific Director and Program Officer (Calgary, AB)
- Kim Ah-Sue, Program Officer (Calgary, AB)
- Marisa Etmanski, Director of Edmonton Office (Edmonton, AB)
- Ralph Strother, Senior Program Officer (Calgary, AB)
- Heidi Dunstan, Executive Assistant and Special Projects (Calgary, AB)
- Maggie Stuchbury, Executive Assistant (Calgary, AB)
- Emma Heck, Administrative Support (Calgary, AB)

Appendix 2

SYMPOSIUM PEOPLE: *Participants by Learning Teams*

Each participant was assigned to a small group called a Learning Team, which was comprised of six to eight people.

AREA 1: Research Priorities

FOCUS AREA: Exploring the priority needs for research in Alberta that builds upon the content presented in the Symposium and how a research agenda could be developed that supports the needs of the policy and practice arenas.

TEAM 1 – Research Priorities

Sherry Fawcett, PhD, MSc, Psychiatry Resident, University of Alberta

Troy Harker, PhD, MSc, Fellow in Neuropsychology, Stollery Childrens Hospital

Anita Kozyrskyj, PhD, MSc, Associate Professor and Research Chair, Pediatrics, University of Alberta

Deborah Kurrasch, PhD, Assistant Professor, Medical Genetics, University of Calgary

Frank MacMaster, PhD, Assistant Professor, Psychiatry and Pediatrics, University of Calgary

Kara Murias, MD, MSc, Resident Physician, Pediatric Neurology, University of Calgary

Suzanne Tough, PhD, MSc, Professor, Pediatrics and Community Health Sciences, University of Calgary

Brenda Woo, BSc, BASc, Senior Environmental Health Specialist, Health Canada

TEAM 2 – Research Priorities

Karen Benzies, PhD, Associate Professor, Nursing, University of Calgary

Matthew Brown, PhD, Postdoctoral Fellow, Psychiatry, University of Alberta

Lucia Capano, MD, Resident Physician, Pediatric Neurology, University of Calgary

Xinjie Cui, PhD, Director, Child and Youth Data Lab, Alberta Centre for Child, Family and Community Research

Deborah Dewey, PhD, Professor, Pediatrics and Community Health Sciences, University of Calgary

Markhus Lahtinen, PhD, Health Care Quality Analyst, Health Quality Council of Alberta

Eric Mash, PhD, Professor, Clinical Psychology, University of Calgary

Dianna Millard, PhD, Director, School of Research and Improvement in Alberta Education

Fiona Schulte, PhD, Postdoctoral Research Fellow, Pediatric Oncology, Alberta Children's Hospital

AREA 2: Coordination of Education, Justice, Health, and Human Services

FOCUS AREA: Building and leveraging a common science base related to the learnings of the Symposium to guide collaborative problem-solving and innovation across the domains of education, justice, health, and human services generally in order to improve coordination among systems and deliver more effective services for children and their families in Alberta.

TEAM 3 – Coordination of Education, Justice,Health, and Human Services

Lori Anderson, MA, Vice President, Calgary Zone, Alberta Health Services, Government of Alberta

Judith Barlow, MA, Executive Director, Young Offender Branch, Correctional Services, Alberta Solicitor General and Public Security, Government of Alberta

Gail Campbell, MEd, Director, Early Learning, Alberta Education, Government of Alberta

Richelle Mychasiuk, MA, PhD Candidate, Canadian Centre of Behavioural Neuroscience, University of Lethbridge

David Ray, BA, BSW, Manager, Aboriginal Initiatives, Alberta Aboriginal Relations

Susan Westenberger, BS, Sergeant, Community and Youth Services, Calgary Police Service

TEAM 4 – Coordination of Education, Justice, Health, and Human Services

Dawne Clark, PhD, MA, Associate Professor, Child and Youth Studies, Mount Royal University

Ilene Fleming, Director, Success By 6

Cathy Pryce, RN, Vice President, Addiction and Mental Health, Alberta Health Services

Chris Sprysak, CA, LLB, LLM, Assistant Professor, Law School, University of Alberta

Lorraine Stewart, PhD, Executive Director, Alberta Education, Government of Alberta

Sherri Wilson, BSc, HEd, Senior Manager, Alberta Health and Wellness

TEAM 5 – Coordination of Education, Justice, Health and Human Services

The Honourable Ted Carruthers, Judge, The Provincial Court of Alberta

Ruth Collins-Nakai, MD, MBA, Director, Council for Early Development

Fern Miller, BA, Senior Manager, Alberta Health and Wellness

Tim Moorhouse, MA, Director, Ministry of Children and Youth Services, Government of Alberta

Marni Pearce, PhD, Director, Cross-Ministry Education, Alberta Education, Government of Alberta

Pippa Rowcliffe, MA, Director of Communications, Human Early Learning Partnership, University of British Columbia

Sandra Woitas, MEd, Director, Edmonton Public Schools Foundation

AREA 3: Collaboration Between Academia and Policy & Practice Areas

FOCUS AREA: Encouraging more effective collaboration related to the learnings of the Symposium between academia and the policy and practice arenas to benefit children and their families in Alberta.

TEAM 6 – Collaboration Between Academia and Policy & Practice Areas

Lynette Beauchamp, BSW, RSW, Mental Health Coordinator, Primary Care Network, Alberta Health Services

Jane Hewes, PhD, MA, Chair, Early Learning and Child Care, Grant McEwen University

Saifa Koonar, MBA, President and Chief Executive Officer, Alberta Children's Hospital

Kellie Leitch, O. Ont., MD, MBA, FRCS(C), Associate Professor, Surgery, University of Toronto

Pattie Pryma, RN, MN, MEd, Associate Professor, Nursing, Mount Royal University

Marnie Robb, PhD, MEd, Senior Policy Advisor, Aboriginal Relations, Government of Alberta

Sherry Thompson, PhD, President, Sherry Thompson Consulting

TEAM 7 – Collaboration Between Academia and Policy & Practice Areas

Suzanne Curtin, PhD, Associate Professor, Psychology and Linguistics, University of Calgary

Ron Dyck, PhD, Assistant Deputy Minister, Research, Alberta Ministry of Advanced Education and Technology and Associate Clinical Professor, Medicine and Dentistry, University of Alberta

Carol Ewashen, PhD, Associate Professor, Nursing, University of Calgary

Susan Graham, PhD, Professor and Canada Research Chair in Language and Cognitive Development, and Director, Program in Clinical Psychology, University of Calgary

Brent Scott, MD, Director, Alberta Children's Hospital Research Institute for Child and Maternal Health and Professor and Head, Department of Pediatrics, University of Calgary

Marianne Stewart, MHSA, Vice President and Chief Operating Officer, Primary Care Division, Capital Health

AREA 4: Child Mental Health Policy and Practice

FOCUS AREA: Exploring ways that the learnings of the Symposium could be used to advance policy and practice in children's mental health.

TEAM 8 – Child Mental Health Policy and Practice

Lola Baydala, MD, Associate Professor, Pediatrics, University of Alberta

Pierre Berube, MEd, Certified Psychologist, Executive Director, Psychologists' Association of Alberta

Germaine Dechant, RN, MHSA, ICD.D, Chief Executive Officer, CASA Child, Adolescent and Family Mental Health

Daniel Grigat, MA, Project Coordinator, Knowledge Transfer Initiatives, Alberta Innovates – Health Solutions

Carole Anne Hapchyn, MD, FRCP(C), Clinical Professor, Psychiatry and Pediatrics, University of Alberta; Program Psychiatrist, Infant and Preschool Team, CASA Child, Adolescent and Family Mental Health; and Medical Director, Autism Follow-up Clinic, Glenrose Rehabilitation Hospital

Margaret King, MN, Assistant Deputy Minister, Community and Population Health, Alberta Health and Wellness

Nancy Reynolds, DOT, BScOT, President and Chief Executive Officer, Alberta Centre for Child, Family and Community Research

Evelyn Wotherspoon, MSW, RSW, Social Worker, Collaborative Mental Health Care Program, Alberta Health Services

Ursula Zanussi, MD, Child and Adolescent Psychiatry Resident, Faculty of Medicine, University of Calgary

TEAM 9 – Child Mental Health Policy and Practice

Ada Chan, RN, MBA, School of Business, University of Alberta

Diane Conley, BN, RN, Executive Director, Access and Early Intervention, Addiction and Mental Health, Alberta Health Services

Jaret Farris, BComm, BScOT, Director, Community and Outreach Services, CASA Child, Adolescent and Family Mental Health

Gerry Giesbrecht, PhD, RPsych, Postdoctoral Fellow, Behavioural Health Research Unit, Department of Paediatrics, University of Calgary/ Alberta Children's Hospital

Rosa Gonzalez, BSW, RSW, Mental Health Coordinator, Edmonton Oliver Primary Care Network, Alberta Health Services

Wade Junek, MD, FRCP(C), President, Canadian Academy of Child and Adolescent Psychiatry and Clinical and Consulting Psychiatrist, Day Treatment Services, Mental Health and Addictions Program, IWK Health Centre

June McCrone-Jenkins, BEd, Aboriginal Programs and Policy Advisor, Aboriginal Community Initiatives, Ministry of Aboriginal Relations, Government of Alberta

Fay Orr, BA, BAA, Mental Health Patient Advocate, Alberta Mental Health Patient Advocate Office

Louise Simard, BA, LLB, Senior Counsel, MacPherson Leslie & Tyerman and Member of the Medical Council of Canada.

AREA 5: Child and Family Primary Care Practice

FOCUS AREA: The impacts of the learnings of the Symposium on primary care for children and their families in Alberta and how this content could be used to enhance practice.

TEAM 10 - Child and Family Primary Care Practice

Lisa Cook, PhD, Information Specialist, Chinook Primary Care Network, Alberta Health Services

Janet Fizzell, BSW, Chief Executive Officer, Central Region for Alberta Child and Family Services Authority, Government of Alberta

Sandra Mintz, MBA, Executive Director, Chinook Primary Care Network, Alberta Health Services

Mark Moland, MA, Knowledge Management Consultant, Quality Practice and Partnerships, Alberta Health Services

Beverley Stich, MD, FRPC(C), Clinical Psychiatry Consultant, Edmonton Oliver Primary Care Network and Associate Clinical Professor, Psychiatry, University of Alberta

Bonnie Lynn Wright, PhD, RN, MScN, CCHN(C), Evaluation Coordinator, Chinook Primary Care Network

AREA 6: Early Childhood Intervention and Development Services

FOCUS AREA: Exploring the ways that the learnings of the Symposium could be used to advance policy and practice in intervention and development services for early childhood.

TEAM 11 – Early Childhood Intervention and Development Services

Holly Clark, BA, LLB, Vice President, Administration, HRJ Consulting

Daniel Goldowitz, PhD, CMMT, CFRI, Scientific Director, Neurodevelopment Network (NeuroDevNet); and Professor, Medical Genetics, Centre for Molecular Medicine and Therapeutics, University of British Columbia

Karen Ferguson, Assistant Deputy Minister, Community Strategies and Support Division, Ministry of Child and Youth Services, Government of Alberta

Monte Krueger, MA, Director, Policy Research and Analysis, Alberta Education and Technology

Nazeem Muhajarine, PhD, MSc, Professor & Chair, Community Health and Epidemiology, University of Saskatchewan

Deborah Parker-Loewen, PhD, Registered Doctoral Psychologist, Private Practice and member of the Child and Youth Advisory Committee, Mental Health Commission of Canada

Kesa Shikaze, BSc, Project Manager, Community and Population Health Division, Alberta Health and Wellness

TEAM 12 – Early Childhood Intervention and Development Services

Casey Boodt, MEd, Interim Director, UpStart, United Way of Calgary and Area

Laura Ghali, PhD, Director, Research and Community Partnerships for the Fraser Mustard Chair in Childhood Development, and Adjunct Professor, Pediatrics, University of Calgary

Patrick Harris, Executive Director, Kids Health Foundation

Deborah Hopkins, BS, Senior Manager, Early Childhood Development Initiatives, Alberta Children and Youth Services

Lillian Parenteau, Chief Executive Officer, Region 10 Métis Settlements Child and Youth Services Authority, Alberta Health Services

Shelly Philley, RN, MSA, Director, Reproductive Health, Healthy Child and Youth Development, Alberta Health Service

Noella Piquette-Tomei, PhD, Registered Psychologist and Associate Professor, Education, University of Lethbridge

Sandi Roberts, MEd, ECD, SafeCom Leader Education, Safe Communities and Strategic Policy, Justice and Attorney General, Government of Alberta

Wadieh Yacoub, MD, Medical Officer of Health & Director of Health Protection, First Nations and Inuit Health for the Alberta Region, Health Canada and Clinical Assistant Professor, Public Health and Community Health Sciences, University of Alberta and University of Calgary

AREA 7: Training and Development for Clinicians and Professionals

FOCUS AREA: Exploring ways that the learnings of the Symposium could be incorporated into professional training and clinical preparation.

TEAM 13 - Training and Development for Clinicians and Professionals

The Honourable Lynn Cook-Stanhope, Judge, The Provincial Court of Alberta

Carol Arnold-Schutta, MA, Senior Manager, Workforce Development, Human Resources, Alberta Children and Youth Services, Government of Alberta

Nancy Brager, MD, FRCP(C), Director, Undergraduate Medical Education in Psychiatry and Associate Professor, Medicine and Psychiatry, University of Calgary

Lisa Burback, MD, Resident in Psychiatry, University of Alberta

Matthew Hicks, PhD, MD, Pediatric Resident and Fellow in Neonatology, University of Calgary

Toni LaChance, MA, ECD, Chair and Instructor, Early Learning and Child Care, Red Deer College

Anita Paras, RN, MN, Workforce Planner and Manager, Alberta Health and Wellness, Government of Alberta

Lindy VanRiper, MD, Psychiatry Resident, Pediatrics, University of Alberta

Jennifer Wells, BSc, BEd, Mediation Lead and Manager, Family Justice Services, Alberta Justice, Government of Alberta

Appendix 3

SYMPOSIUM LEARNING TOOLS

The participants benefited from several carefully prepared learning tools that were used throughout the week.

National Scientific Council on the Developing Child Working Papers

A binder was provided that included all current National Scientific Council on the Developing Child Working Papers.

Presenter Binder

A binder was provided that included daily agendas, the slides from the faculty presentations, biographies of the faculty presenters, summary reports, and other materials about the Symposium.

Guest Directory

The printed directory included photos, bio sketches, and contact information for the approximately 150 people involved with the Symposium as participants, faculty, and support staff.

Navigator Guide

Based on advances in adult learning styles and professional development practices, a 134-page Navigator Guide was created to support engagement and personal interaction with the ideas and experiences of the Symposium. The Guide featured daily agendas, notes pages, and many different exercises and bits of advice for enhanced learning in groups and as individuals. The Guide also had sections to assist Learning Teams in finding and developing a personal strategy after the event.

Learning Team Compass

Members of each of the 13 groups collaboratively completed a set of questions called the Learning Team Compass to guide their future interaction and support of each other. The questions included: Q1. How will you share updates on your goals? Q2. How will you seek feedback from one another? Q3. What type of regular check in process could support your Learning Team best? Q4. How will you benefit from your Learning Team knowledge, experience & networks? Q5. Which Learning Team members are included in your EBBD Personal Strategy? Q6. What do you need from the Learning Team to be successful in your EBBD Personal Strategy and Goals?

See samples below and on the next pages.

Participant Personal Strategic Plans

The individual participants in the Symposium were asked to create Personal Strategic Plans to assist them after the event and to guide their future efforts to apply what was learned from the week. This exercise included answering the following six questions: Q1. My Focus Challenge Area was:___ Q2. My personal or team goals are:___ Q3. Building on the EBBD Symposium and in support of the initiative's three-year strategy, my key milestones for the next year are:___ Q4. Why this matters to me: ___ Q5. What resources, tools and products do you plan to draw upon after the Symposium? Q6. Who will be a resource and how will I engage them in the first year?

See samples on next pages.

Learning Team Compass - Sample 1

Learning Team Compass – Team #6

How will you share updates on your goals?

- We will be keeping in touch through an on-line community using Google Groups.
- We will be trying to get together in person every four months in Red Deer.
- We will share e-mail addresses so that we can support each other in fulfilling our individual commitments.

How will you seek feedback from one another?

- We will be gathering and sharing research articles on best practices in collaboration among academics, policy makers, and practitioners.
- We will share drafts of upcoming PowerPoint presentations or written materials including EBBD materials with our Learning Team group members as needed.

What type of regular check in process could support your Learning Team best?

- We will touch base by e-mail to do a temperature check every second month.
- We will also be keeping in touch through an on-line community using Google Groups.
- We will also be trying to get together in person every four months in Red Deer.
- We will also share e-mail addresses so that we can support each other in fulfilling our individual commitments.

How will you benefit from your Learning Team knowledge, experience & networks?

- We will benefit from the diversity of our experience, education, and networks – which include health care, mental health, research, post secondary teaching and curriculum development, community-building, policy development and cultural competence/ sensitivity/diversity.

Which Learning Team members are included in your EBBD Personal Strategy?

- We have made a commitment to contribute to the group initiative and to support each other in our individual goals, and to build dyadic interactions in specific areas of interest.

What do you need from the Learning Team to be successful in your EBBD Personal Strategy and Goals?

- We have made a commitment to support each other in our individual goals, and to build dyadic interactions in specific areas of interest and to contribute to the group initiative on building effective collaborations, and ad-hoc collaborations and dialogue.

Learning Team Compass - Sample 2

Learning Team Compass – Team #12

How will you share updates on your goals?

- Our group will hold quarterly meetings via video and teleconference. We will have a rotating chair and this person will be responsible for organizing and running the meeting. We will be in regular e-mail contact and use the portals provided by the Norlien Foundation. This will provide us an opportunity to update on the successes and challenges we are facing within our network.

How will you seek feedback from one another?

- See above. We will ensure healthy dialogue and debate of ideas. We will honour all ideas given. We will honour ideas by parking and revisiting them later on.

What type of regular check in process could support your Learning Team best?

- The Norlien should ask for a Quarterly report based on our discussions. In addition, we will invite a representative from Norlien to participate in all of our group meetings.

How will you benefit from your Learning Team knowledge, experience & networks?

- The networking itself is very crucial to gaining knowledge at this Symposium. The Learning Teams increase our capacity to problem solve. Innovation and creativity will be encouraged from the dialogue.

Which Learning Team members are included in your EBBD Personal Strategy?

- Patrick Harris, Casey Boodt, Shelley Philley, Sandi Roberts, Laura Ghali, Deborah Hopkins, Lillian Parenteau, Wadieh Yacoub.

What do you need from the Learning Team to be successful in your EBBD Personal Strategy and Goals?

- For our Learning Team to be successful we must have collaborative support, sharing of information, opportunities to debrief and to celebrate. We also need to ensure that we are mutually respectful and accountable to each other.

Participant Personal Strategic Plans – Sample Responses

Participant A = Policy Maker

Participant B = Program Developer

Participant C = Representative for Professional Body

Q1. My Focus Challenge was:

Participant A: Impacts of the learning from the EBBD Symposium on primary care for children and families and how this content could be used to enhance practice.

Participant B: On primary care for children and their families in Alberta and how this EBBD Symposium content could be used to enhance practice.

Participant C: Exploring ways that the knowledge from the EBBD Symposium could be used to advance policy and practice in children's mental health.

Q2. My personal or team goals are:

Participant A: Healthy children in a prosperous society. Support informed decision-making policy by sharing knowledge gained from this Symposium. Identify where this knowledge can be implemented into policy and practice.

Participant B: Personal goals are to develop/improve both professional and parent training resources on EBBD content – translating effectively science learned in Symposium.

Participant C: To communicate the new learning to my constituency groups and explore ways to include it in objectives for learning and exams.

Q3. Building on the EBBD Symposium and in support of the initiative's three-year strategy, my key milestones for the next year are:

Participant A: * June 2010 – Review our current resources (print and otherwise) that we use for the public and identify if they have any current EBBD content). * September 2010 – Bring our leaders together across the province to discuss next steps and implementation. * January 2011 – Review our health promotion, disease and injury prevention plan for key areas for strategy and action on EBBD; identify the information and resources that might be available for use in the primary care environment.

Participant B: * June 2010 – Integrate learnings into clinical practice parameters; develop communication plan to distribute Symposium information. *December 2010 – Re-develop assessment protocol and implement organization-wide. * April 2011 – Implement interventions to address environmental issues. * May 2011 - Complete preliminary evaluation of the clinical practice changes.

Participant C: * August 2010 – Review materials, learnings, and communications. * December 2010 – Promote draft objectives. Objectives, if changed, will need to be reviewed by many. This process takes time. It will not be done (finalized) in one year, as it needs to go through an approval process.

Q4. Why this matters to me:

Participant A: If we do not incorporate these changes in process & evidence based content into practice then we will be relegated to always be in the business of crisis intervention & perpetuate the associated trauma for children, youth & families.

Participant B: This information is current and essential yet difficult to "frame" for parents and professionals – it is important to do this well and reduce the science/practice/policy gap in something less than 20 years!

Participant C: The topic is of great interest and importance for me because of its societal impact, because it is emerging in the context of a "new frontier" and because I may be able to help influence outcomes through promoting policies that are based on the learnings.

Q5. What resources, tools and products do you plan to draw upon after the Symposium?

Participant A: The Symposium resource binder and online Symposium web portal, Alberta Centre for Child, Family & Community Research, FrameWorks, my Study Circle.

Participant B: FrameWorks toolkit for ECD and other website materials, PowerPoint handouts and references from this Symposium, more study circle time/opportunities to "test out" what we've developed and see if it's effective.

Participant C: See all of the materials presented at the Symposium.

Q6. Who will be a resource and how will I engage them in the first year?

Participant A: *FrameWorks – June Study Circle meeting and forward communication materials to them for feedback. *Organization X – Discuss using Symposium opportunities for specific groups. *Colleagues in other departments – Discuss how we can share information and broaden understanding of early brain development and how we can integrate this in our policies and programs collaboratively. * My Learning Team group members from Symposium – Quarterly meetings.

Participant B: *FrameWorks - Continue working with study circle leaders and participants. *EBBD Faculty – As needed and ongoing. *EBBD Participants – In my learning team interactions and at next Symposium.

Participant C: *Members of my Learning Team – Through email and telephone. *Physicians across Canada – When examining objectives, I will consult with the experts to see if the objectives capture the knowledge or need to be improved.

Appendix 4

PRIMER ON FRAMEWORKS INSTITUTE METHODOLOGY

Also see the Symposium participant web portal for several online resources from FrameWorks Institute: Strategic Frame Analysis E-Workshop, E-Webinars on Framing, Science Stories, Gene-environment Interaction, and Child Mental Health.

The information below is reprinted with permission from the FrameWorks Institute in order to provide the readers of this report with more detail on key elements of the research methodology used by the staff at the Institute in conducting its trademarked Strategic Frame Analysis.™

SOURCE: Research Methods page of FrameWorks Institute's website. http://www.frameworksinstitute.org/methods.html

Strategic Frame Analysis™

Developed by the FrameWorks Institute, Strategic Frame Analysis™ is an approach to communications research and practice that integrates essential constructs from the cognitive and social sciences to describe and explain how communications in general, and media in particular, influence public support for social programs and policies. The innovative research that undergirds Strategic Frame Analysis™ comprises a set of multi-disciplinary, multi-method, iterative processes that emphasize empirical testing of potential frame effects. Below we list the basic methodological components of the approach. Some methods are unique to FrameWorks, others are more common social science methods, but all underscore the power and potential of strategically reframing social issues.

METHODS USED IN STRATEGIC FRAME ANALYSIS

Content Analysis of News Media – FrameWorks conducts media content analyses that review and analyze the framing of various issues in a wide variety of news outlets including: network television, major national and regional newspapers, news radio programs, online news from major outlets such as CNN.com or MSNBC.com, and news magazines such as Time and Newsweek. This research allows FrameWorks to review media coverage of issues, discern important thematic patterns in news reporting (in terms of reporting style, content, allocation of news time, etc.) as well as to identify the leading frames within that coverage.

Cognitive Interviews – FrameWorks routinely invests in a series of one-on-one interviews with citizens to discern how they think about the issues we are studying. This approach combines techniques from cultural anthropology and cognitive linguistics. Essentially we examine the way people think about a topic, the pattern of reasoning, the connections they make to other issues, and the devices they use to resist new information. In-depth interviews conducted from this perspective allow our researchers to identify the cultural models – implicit shared understandings and assumptions – that guide people's thinking about abstract social issues.

Peer Discourse Analysis – Peer discourse analysis captures the effects of frames in social settings by exploring inter-group negotiations around the social issues we are studying. The analysis is organized to validate the findings from the cognitive interviews and the media content analysis, to experiment with promising alternative frames, and to observe the negotiations between members of the public (i.e., peers) when using dominant cultural models and potential reframing elements. The analysis consists of a discourse analysis conducted using data from a set of moderated focus groups of 10 to 12 people who are influential in the target community.

Expert Interviews and Materials Reviews – To better understand how experts and advocates communicate about an issue, as well as to better understand the basic content of the messages they want to advance with the public, we interview them, attend their professional meetings, and analyze an array of publicly available materials they produce. Using the data from these sources, FrameWorks is able to draft a core story that lays out the central problems associated with the issue, the evidence or science base that supports these conclusions, as well as the policy and program solutions that expert knowledge and understandings suggests will help resolve the issue.

Mapping the Gap Conceptual Analysis – In the Map the Gap analysis, FrameWorks' researchers juxtapose public understanding of an issue (identified through the cognitive interviews, peer discourse analysis, and media content analysis) and the understandings of policy experts and advocates on the issue (gathered via the expert interviews and material reviews). In this way, we are able to "map" or situate the ways that experts and advocates explain social issues against the dominant cultural models that the public brings to bear on the same issue. In this analysis, we specifically look for places where there is incongruity between experts' and the public's conceptualization of the issue. These incongruous spaces then become our primary targets for reframing.

Simplifying Model Development – A simplifying model is a reframing tool that concretizes and clarifies technical concepts and processes through a familiar and easily understood metaphor. These metaphors capture the essence of a scientific concept or explain an important mechanism on an issue and have a high capacity for spreading easily through a population. Numerous studies in the cognitive sciences as well as a growing body of FrameWorks research have established that the public's ability to reason about complex, abstract or technical public policy concepts rely heavily on metaphor and analogy. As a result, we actively develop simple and concrete metaphorical frame elements that help people to organize information on issues in new ways, to fill in understanding currently missing from the public's repertoire, and to shift attention away from the default patterns they already use to understand those issues. FrameWorks identifies, empirically tests, and refines simplifying models for complex social problems using a wide range of the discrete methodologies discussed on this page.

National Experimental Surveys – FrameWorks uses experimental surveys to test the efficacy of using some frames over others. To conduct these experiments, we employ web-based surveys and randomly assign a nationally representative sample to one or more treatments and a control group. The treatment groups are exposed to framed messages and are subsequently asked a series of question that assess their support for a variety of related policy questions. By comparing the responses of the treatment groups to the control group condition (people who received no stimulus at all), we can ascertain any effects that emerge as a result of the way in which the issues were framed in the stimuli. Using this method, we can demonstrate the magnitude and extent to which exposure to particular frames affect the public's policy preferences.

Talkback Testing – Talkback Testing is based on established cognitive science techniques and allows FrameWorks to make preliminary evaluations of which simplifying models and other frame elements are most easily understood by the public, allow the public to most productively use new information, have the best chance of seeping into the public discourse and have the least chance of breaking down and morphing unproductively from their original form during transmission. In conversational group settings, subjects are asked to think about a particular simplifying model or frame element, and then asked to communicate with a third party about that issue. By measuring and comparing subjects' acceptance of and facility with different simplifying models and frame elements – as they try to explain and reason about an issue – FrameWorks is able to judge how effectively these elements are likely to be absorbed and used once introduced to the wider public.

Simplifying Models Research Process: Three Phases

PHASE	METHODS	OUTPUTS
Phase 1: Explorative Research: Mapping the Gaps	• Cultural models interviews • Peer discourse sessions • Expert interviews and materials review	• Detailed knowledge of expert and lay understandings
Phase 2: Simplifying Models Design: Metaphor Generation	• Comparative analysis to identify gaps in understanding • Linguistic analysis to generate candidate models	• Location of the cognitive holes • Candidate simplifying models to fill the holes
Phase 3: Empirical Research: Bridge Testing	• On-the-street interviews • Quantitative survey experiment • Persistence Trials	• Data for model refinement • Identification of an effective simplifying model

SOURCE: Kendall-Taylor, N. (2010-March). An Empirical Simplifying Models Research Process: Theory and Method. Washington, DC: FrameWorks Institute. Unpublished White Paper.

Appendix 5

Additional Resources: Knowledge-Transfer Reports

Reports of Scientific Research on EBBD Topics Translated for Professional Audiences

Each of the reports featured below is available online at no cost. See the website link address under each report. Note that this is not an extensive list.

1 **A Science-based Framework for Early Childhood Policy:** Using Evidence to Improve Outcomes In Learning, Behavior, and Health for Vulnerable Children. (2007). Boston, MA: Center on the Developing Child at Harvard University.

Available from: http://developingchild.harvard.edu/library/reports_and_working_papers/policy_framework/

2 **Alberta's Health Research and Innovation Strategy.** (2010). Edmonton, AB: Government of Alberta, Alberta Health and Wellness.

Available from: http://www.advancededucation.gov.ab.ca/media/277640/ahris_report_aug2010_web.pdf

Highlights document Available from: http://www.advancededucation.gov.ab.ca/media/277579/final%20ahris%20highlights%20sheet-high-res%20(no%20cover,%20no%20bleeds).pdf

3 **Benefit-Cost Analysis of Early Childhood Interventions:** Workshop Summary. (2009). National Research Council and Institute of Medicine. Beatty, A.; Committee on Strengthening Benefit-Cost Methodology for the Evaluation of Early Childhood. Washington, DC: The National Academies Press.

Available from: http://www.nap.edu/catalog/12777.html

4 **Child Maltreatment 2008.** (2010). U.S. Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. Rockville, MD: Author.

Available from: http://www.acf.hhs.gov/programs/cb/stats_research/index.htm#can

5 **Depression in Parents, Parenting, and Children:** Opportunities to Improve Identification, Treatment, and Prevention. (2009). National Research Council and Institute of Medicine. M. J. England & L. J. Sims (Eds.). Washington, DC: National Academies Press. (Can read entire book online at no cost).

Available from: http://www.nap.edu/catalog.php?record_id=12565

6 **From Neurons to Neighborhoods:** The Science of Early Childhood Development. (2000). Shonkoff, J. P., & Phillips, D. A. (Eds.). Washington, DC: National Academies Press.

Available from: http://www.nap.edu/catalog.php?record_id=12565

7 **Healthy Development:** A Summit on Young Children's Mental Health. (2009). Partnering with Communication Scientists, Collaborating across Disciplines and Leveraging Impact to Promote Children's Mental Health. Washington, DC: Society for Research in Child Development.

Available from: http://www.apa.org/pi/families/summit-report.pdf

8 **Positive Futures - Optimizing Mental Health for Alberta's Children and Youth:** A Framework for Action (2006-2016). (2006). Alberta Health and Wellness. Edmonton, AB: Author.

Available from: http://www.health.alberta.ca/documents/Mental-Health-Framework-Child-06.pdf

9 **Preventing Child Maltreatment:** A Guide to Taking Action and Generating Evidence. (2006). World Health Organization & International Society for the Prevention of Child Abuse and Neglect. Butchart, A., Harvey, A. P, Mian, M., & Furniss, T. Geneva: WHO.

Available from: http://whqlibdoc.who.int/publications/2006/9241594365_eng.pdf

10 **Preventing Child Maltreatment:** Program Activities Guide. (no date). Centers for Disease Control and Prevention. Atlanta, GA: Author.

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GLOSSARY

Adrenalin – A hormone, secreted when under stress by the medulla of the adrenal gland, that stimulates the heart, increases blood sugar, muscular strength, and endurance, etc.; also called epinephrine.

Alleles – One of two or more forms of the DNA sequence of a particular gene; each gene can have different alleles. Sometimes, different DNA sequences (alleles) can result in different traits, such as colour. Sometimes, different DNA sequences (alleles) will have the same result in the expression of a gene.

Allostasis – The ability to achieve stability through change, a process critical to survival.

Allostatic Load – Through allostasis, the autonomic nervous system, the hypothalamic–pituitary–adrenal (HPA) axis, and the cardiovascular, metabolic, and immune systems protect the body by responding to internal and external stress. Stress promotes adaptation, but prolonged stress leads over time to wear and tear on the body.

Amygdala – A part of the brain that performs primary roles in the formation and storage of memories associated with emotional events. The amygdala is also involved in the modulation of memory consolidation.

Brain Architecture – All of the physical structures and components of the brain and how they are created together as a working functioning system. The basic architecture of the brain is constructed through an ongoing process that begins before birth, peaks in childhood and adolescence, and continues into all phases of adulthood.

Brain Plasticity – Behaviours emerge in development as the brain structures and functions underlying specific capacities mature over time. This development represents more than a simple unfolding of a genetic blueprint. It is actually a complex combination of genes interacting with the environment.

Biological Sensitivity to Stress – Individuals vary in their biological sensitivity to contextual risk factors and life events. Children with heightened biological sensitivity to context are both more vulnerable to toxic stress in negative contexts and more sensitive to positive environmental influences when they are in good contexts.

Can't Do One Without The Other – A concept such that the cognitive, emotional, and social capacities of a developing child are inextricably intertwined. Brain development, basic learning, behaviour, and physical and mental health are inter-related in childhood and over the life course.

Child Maltreatment – There are five major kinds of child maltreatment: physical abuse, sexual abuse, emotional or psychological abuse, neglect and intimate partner or domestic violence by adults witnessed by children.

Core Story – A knowledge translation technique from FrameWorks Institute. A core story defines a topic in a consistent way, prioritizes the scientific knowledge, identifies the key points, and removes the unnecessary detail. A good core story unifies the many messages from the scientific community into a single story line with several basic themes. This simpler model can be used to create a link between scientific findings and policy.

Cortisol – A steroid hormone produced by the adrenal cortex that regulates carbohydrate metabolism and maintains blood pressure. Also called hydrocortisone.

Depression – A complex disorder that can be manifested through a variety of emotional, physical, and other associated symptoms (e.g., anxiety, worry, and pain).

DNA methylation – A type of epigenetic change involving chemical modification of DNA that is stable over rounds of cell division but does not involve changes in the underlying DNA sequence of the organism. Epigenetic change is an important aspect of cellular differentiation, allowing cells to stably maintain different characteristics despite containing the same genetic material.

Dopamine – A monoamine neurotransmitter formed in the brain and essential to the normal functioning of the central nervous system. Dopamine is the main neurotransmitter of the reward system and becomes dysregulated in addiction.

Emotion Dysregulation – Often people with posttraumatic stress disorder (PTSD) related to early life trauma – such as child maltreatment – have problems regulating their emotions. The person displays an emotional response that is poorly regulated and does not fall within the normal range of emotive response. Under-modulation refers to symptoms such as reliving flashbacks, vivid memories, and fear or anger states associated with past adverse events. Over-modulation is also common for those who have PTSD. This includes symptoms of dissociation (such as out-of-body experiences), emotional numbing symptoms (being detached from one's emotions), and the inability to feel pain.

Epigenetics – A gene is basically like any other molecule in the cell and thus it is subject to physical modifications. These modifications alter the structure and chemical properties of the DNA, and thus the expression of the gene. Collectively, these modifications can be considered as an additional layer of information that is contained within the genome. This information is thus epigenetic in nature. The name derives from the Greek epi meaning ''upon'' and genetics.

Family Bubble – According to FrameWorks research, a common yet incorrect idea held by the public that refers to the idea that everything related to child development exists in the domain of private family life. This view contrasts sharply with the scientific evidence that includes multiple positive and negative influences on early development that happen in addition to what goes on within the family.

Gene X Environment Interaction – A model that emphasizes the complex manner in which genes and environment shape physiology and behavior through Gene x Environment interactions. For example, genes that shape maternal stress response could impact the environment by influencing parenting behavior, which, in turn, influences maternal–child interactions. This Gene x Environment effect could subsequently impact child stress response, which, in turn, may influence child behaviour.

Hippocampus – Part of the brain related to the formation and long-term storage of associative and episodic memories. One of several limbic structures that have been implicated in mood disorders. Included in the functions of hippocampal circuitry are control of learning and memory and regulation of the hypothalamic-pituitary-adrenal (HPA) axis, both of which are altered in depression.

Maternal Buffering – Positive effect of having a nurturing caregiver relationship, an important protective factor that fosters better health and appears to overcome some genetic risk for poor outcomes.

Myelin – An electrically insulating biomolecule that helps speed the conduction of electrical impulses in nervous system cells. Myelin is essential for the proper functioning of the nervous system.

Neocortex – A part of the mammalian brain that makes up the outer layers of the cerebral hemispheres. The neocortex is divided into frontal, parietal, occipital, and temporal lobes, which perform different functions. In humans, the frontal lobe contains areas devoted to language, decision-making, and social and emotional processing.

Neurotransmitter – A biochemical substance such as dopamine or serotonin that transmits or inhibits nerve impulses at a synapse.

Neurulation – The formation of the embryonic neural plate and its transformation into the neural tube.

Nucleus Accumbens – A part of the brain thought to play an important role in reward, pleasure, and addiction. It may be involved in the regulation of emotions, perhaps consequent to its role in mediating dopamine release.

Pay Now or Pay Later – The concept that brain plasticity and the ability to change behaviour decrease over time as a child gets older. Thus, funding programs and services that offer a healthy environment and positive experiences in infancy and the early years of childhood is far less costly than trying to fix problems later with more expensive remedies once the child has become an adult. This point emphasizes the cost-effectiveness of early childhood interventions.

Prefrontal Cortex – A part of the forebrain that is divided into the lateral, orbitofrontal, and medial prefrontal areas and is involved in executive functions such as working memory, decision-making, planning, and judgment.

Secure Attachment – When infants form strong, positive, and trusting emotional attachments to their mothers and other caregivers.

Serotonin – An amine neurotransmitter formed in the brain and essential to the normal functioning of the central nervous system. Serotonin is important in the regulation of mood and arousal.

Serve and Return – The serve-and-return model uses the metaphor of a game of tennis to describe the moment-to-moment exchanges of behaviours between a child and parent or other people. The concept recognizes that positive interaction between a child and caregiver is required for healthy development.

Skills Beget Skills – A concept recognizing that brains are built from the bottom up and that simple neural circuits must be properly established before more advanced circuits and skills can develop. Certain foundational elements of brain function are required for other aspects to perform properly.

Social Protective Factors – A positive and supporting person in the life of a child is a major contributor to the overall wellness of the child and can be a significant protective factor. Other people from extended family, school, and other places are also important to positive social development for children and adolescents.

Stress Response – A fight-or-flight response activates the autonomic nervous system, which initiates, within seconds, an integrated, short-onset repertoire of biobehavioral changes associated with accelerations of heart and respiratory rates, sweat production, and other physiological changes.

Synapse – The minute space between a nerve cell and another nerve cell, a muscle cell, etc., through which nerve impulses are transmitted from one to the other.

Thalamus – A part of the brain that relays all information received from the senses (except smell) to the various processing centres in the cerebral cortex. The thalamus regulates the electrical rhythms that parts of the brain use to communicate with each other.

Toxic Stress – Experiences that are severe, uncontrollable, or unpredictable produce an intense physiological response in the brain and body (see Stress Response in this glossary). When these experiences are frequent or long-lasting, this response becomes damaging to biological tissues, including brain matter. For children, being brought up by a mother who is seriously depressed or addicted, being maltreated as a child, or living in a chaotic and unpredictable home situation are toxic-stress experiences. Toxic stress in the early years of life damages the developing brain and can lead to lifelong problems in learning and behaviour, and increased risk for physical and mental illness.

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LEVITT – ADULT MENTAL AND PHYSICAL HEALTH AND DEVELOPMENTAL "PROGRAMMING"

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MACMILLAN – AN OVERVIEW OF CHILD MALTREATMENT: IMPLICATIONS FOR CHILD DEVELOPMENT AND APPROACHES TO PREVENTION

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MACQUEEN – DEPRESSION: BRAIN, BODY AND BEYOND

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MAYES – HOW STRESS IMPACTS PARENTAL CARE AND THE INTERGENERATIONAL TRANSMISSION OF PARENTING ABILITIES

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