Prenatal determinants of perceptual development

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The Developmental Psychobiology Lab

- My lab investigates how the individual sensory systems relate to one another and how their functions are integrated during early development.
- Studies than manipulate the amount, type, or timing of prenatal sensory experience are difficult to undertake with mammals.

bobwhite quail embryo (day 22)

usefulness of precocial avian embryos to study prenatal influences on perceptual development

- allows investigation of the various neural, physiological, and behavioral effects of modified sensory experience during the prenatal period, including:
  - **unusually early visual experience**
  - **augmented auditory experience**
  - **modified tactile and vestibular experience**

  (all common characteristics of preterm birth in humans)

bobwhite quail (*Colinus virginianus*)

- **are highly precocial** (all sensory systems functional at hatching; capable of locomotion; can be tested in the hours following hatching)
- **develop *in ovo* rather than *in utero*** (allows ready access to the embryo during prenatal development without invasive surgery or expensive technology)
- **allow precise control of developmental age** (we initiate the process of development by providing the fertilized cell the necessary temperature and humidity to initiate cell division and proliferation)

bobwhite quail

- **allow precise control of embryos' and chicks' experiential history** (we can easily add, remove, or transpose normally occurring sensory stimulation to explore effects of different amounts, types, or timing of experience)
- **allow for direct manipulations of arousal during the prenatal period of development** (we can experimentally modify embryonic arousal levels by drugs or sensory stimulation to explore links across levels of analysis)

invariant sequence of sensory system onset in birds and mammals

visual

auditory ➔

chemical ➔

vestibular ➔

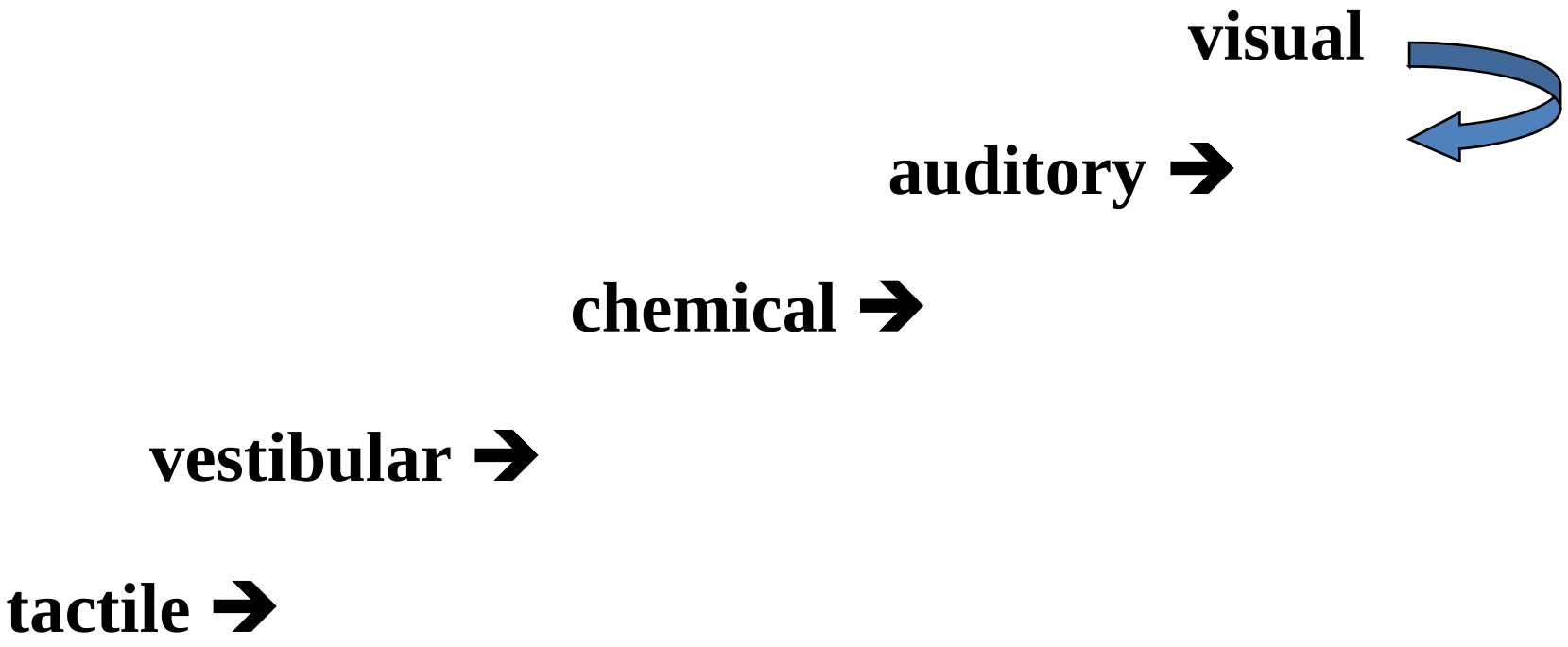
tactile ➔

Developmental Time

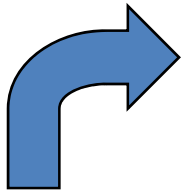
implications of the invariant pattern of sensory system development

- as a result of the differences in the timing of onset of function across the sensory modalities, each individual sensory system has a ***different experiential history*** by the time of birth or hatching
- the limited functioning of the various sensory systems at some stages of prenatal development provides a reliable ***order and structure*** to prenatal and early postnatal sensory experience
- these limitations and those provided by the prenatal milieu can ***regulate the quantity and complexity*** of sensory experience and competition, thereby reducing the attentional demands placed on the developing embryo or fetus

modifying the invariant sequence of sensory system function



modifying the background of sensory system onset



visual

auditory

chemical

vestibular

tactile

What do we know?

- Given our time constraints, I won't go to data slides – but the take home message is that we have shown that altering the *timing* and *amount* of stimulation to the various sensory systems during prenatal development alters patterns of neural activation, regulation of physiological arousal, and perceptual learning and memory during subsequent postnatal development

Developmentally Appropriate Care

- Our comparative-based work and that of our colleagues has had an impact on managing the sensory environment of preterm infants in the NICU. Hospitals in over 35 states now employ methods to reduce overall light and sound levels and increase tactile and vestibular stimulation to more closely approximate the typical timing and levels of stimulation that the prematurely born infant would normally encounter in the uterine environment

advances in high-risk preterm care

Current Themes and Directions

- identify and explore the significance of *intersensory linkages* during prenatal development to perceptual and cognitive development
- determine the role of prenatal sensory experience in contingency detection and contingency learning
- further delineate the role of *intersensory redundancy* in guiding and constraining perceptual learning and development in animals and humans