WHY STUDY BABIES:

- It can be useful in understanding intelligence and building AI.

- We are interested in understanding humans as a species.

  Questions that arise:
  - Are any of our concepts innate?

  - How do we cognitively develop into fully-fledged adults? (Learning)

- To develop a genuine intelligent machinery, it's rather looking at the overlap of AI and developmental psychology.

- You can about babies as the computer that can go from not being able to do very much and have limited cognitive capacity then to go to full-fledged adults.

- We can look at adult developmental trajectories when looking at babies for developing AI.

- AI is good at brute computing and categorizing things but are good at genuine understanding.

- We are trying to explain how we develop into adults.

- Certain cognitive capacities that are really basic are going to be innate in the way that certain things come installed on a computer.

  Occlusion:
  - Seeing objects being whole behind obstructions.

  - Seen objects as being coherent assuming that objects continue to exist even though we are not looking at them.

  - These are things people in developmental psychology have stipulated innate.

  EX of things that are not innate:
  - Matlab is something not everyone needs on their computer, so it does not come installed on your computer.

  - There are also human cognitive capacities that may not be innate and you might have to choose to learn something such as playing the piano.

- This all comes back to saying which of our concepts are innate and which of them are learned.

- Considering how we get from knowing so little, babies can't do much and know very little to knowing so much as they develop into adults.

- Want to know how we utilize things and the 8 concepts and capacities to be able to learn more complicated things to show what that developmental trajectory looks like to get to adult intelligence.

- Studying babies and development can tell us how adult intelligence is acquired and the kinds of concepts that facilitate that.

HOW DO WE KNOW ABOUT THE WORLD:

- How do we know about the world?

John Locke:

- **Quote**: "Let us then suppose the mind to be… white paper, void of any characters, without any ideas; how come it to be furnished? To this, I answer in one word: from **experience.**"

- Locke comes with this idea of the blank slate because we don't know anyone and we're just white paper with no concepts and we learn through experience.

- The mind does not have innate inbuilt concepts.

- The blank state view is also known as **Empiricism.**

Empiricism:

- All knowledge is derived from experience.
- We don't have in-built capacities or concepts.

Rene Descartes:

- **Quote:** "We come to know (stuff about the world_ by the power of our own **native intelligence**, without any sensory experience."

- He is taking the opposite side of Locke's argument.

- He is saying you learn about the world through your intelligence and don't need sensory experience.

Nativism:

- (Some) knowledge is innate.

- Everything is innate and learned by intelligence and doesn't need sensory experience.

- It says that there are some innate concepts, but not that all concepts are innate.

- The idea is that there is innate knowledge

- **Innate does not mean it's present from birth.**

- Something can be innate but not present.

- **EX:** Secondary sex perspectives are not present until people hit puberty.

- Both views are trying to bring out the extent to which we have machinery going into the world.

- Do we have neat concepts that facilitate adult concepts about objects, people, and actions, or is everything acquired through experience?

- This is a question that can tell us important things about the kind of machines we are, which is an important question in Cog Sci and is important to AI.

- The Empiricism and the Nativims debate is asking if we're coming in with any machinery and what can that tell us about our adult cognitive capacities.

WHAT CAN A BABY DO?:

Infants can't do much:

- Before 5 months, no reaching.

- Before 7 months, no locomotion.

- Before 10-12 months, no pointing and talking,

- However, they **DO** observe and start learning and observing the world from birth

- They **look and orient to objects and sounds.**

- The way they look and orient to sounds and objects can give a pretty profound insight into the way in which they understand and conceptualize the world.

What do babies look at?:

- Originally people thought babies could not see.

Experiment to prove babies can see (Fantz 1958):

These results from the experiment show what babies preferred to look at:

- black/white stripes > gray
- Moving > stationary arrays
- Sphere > disc
- They were able to ascertain given this very consistent preferential looking.
- It was concluded that babies can see from birth to a certain extent and that you could track the categories they were seen.
- It helped people track the development of visual acuity throughout development.
- Acuity starts off low when babies are very young and it gets better in about 406 months.
- Then it reaches adult level by about 2 years.
- Babies do have diminished vision, but can still see something and can track that by their looking behaviors and patterns.

Experiment to show babies prefer at looking at other things (Quinn, 1990):

- Designed as an example of how babies orient towards novel stimuli.
- They prefer looking at something that's new.
- In this study, babies were shown 6 pairs of cats.
- They then showed them pictures of a dog and a new cat.
- The babies were more interested in the dog because it's a new animal they have not seen before.
- They wanted to orient to the novel stimulus.
- This is something that was consistent in the infant studies because babies like to look at new objects.
- You can observe where babies are making conceptual category distinctions.
- They were categorizing cats and dogs differently.
- Depending on what category babies are looking at more, it shows they are making a category distinction.

- It gives us a lot of insight into how they're categorically dividing the world.

Experiment to show pictures relate to what babies here (Izard, 2008):

- Babies were able to represent analog magnitude across different sensory modalities.

- They preferred representation in the new modality that matched the analog magnitude of the stimulus they are presented with.

- In the study, the researchers played combinations of syllables.

- It would either be a bunch of short syllables or long syllables and were played for a minute.

- They would then show the babies 2 different arrays and they would look at which of the visual arrays they preferred
  .
- Some of the arrays continued 4 - 12 dots.

- The babies would look at the longer array that corresponded to the number of times they heard a syllable, which corresponds to the auditory stimulus.

- Babies are able to represent the analog magnitude of the short syllables and the array with the 12 dots as being similar.

- They prefer the objects that correspond with the syllables and likewise with the longer syllables.

- Babies prefer coherence across different modalities and they don't have to learn that vision and audition correspond in these ways, which is something that is more inbuilt.

- What babies are looking at can tell us the way in which they're grouping difference and similarities of things.

- **The way babies orient and observe things can tell us what they know and how they represent the world.**

- This seems like good evidence of **nativism** if babies are able to map the analog represents of the syllables to the corresponding array with that amount of dots.
- Babies have some inbuilt capacity to compare and represent magnitudes across different modalities.

- In this case, babies were using the visual and auditory modalities.

OTHER METHODS TO SEE WHAT BABIES CAN DO:

Web-based Testing (Scott & Schultz):

- Allows experimenters to get a lot of data and use software to allow the computer to track what the baby is looking at exactly.

- People are able to run experiments with lots of data and use the computer to show what experimental stimuli babies are using to look at.

- It's a useful tool, so you don't have to bring so many babies into a lab.

Neuroimaging techniques like fNIRS (Powell & Saxe):

- It is kind of like **fMRI.**

- It's a human dynamic measure, but you get it by putting a cap on a baby, and is safe.

- The probes don't get hot and the LED light is safe for their eyes.

- It's robust to motion and environmental noise.

- It's non-invasive.

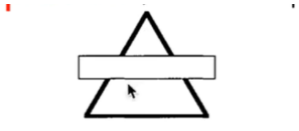
- They don't have to wear any gel on their head like other neuroimaging techniques.

- The readings from this technique are very high resolution.

- It also gets good penetration into the cortex, so it gives you an idea regards to the cortex on the outside of the baby's brain where things are happening.

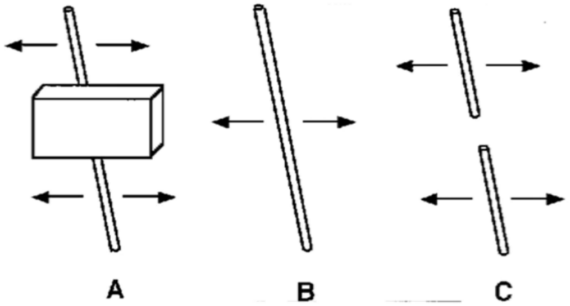
- It also gets the picture that isn't as fine-grained as **MRI** but is able to overcome some of the limitations you see from **fMRI** and **EEG** testing on babies.

Amodal Completion (Kellman & Spelke 1983):



- The babies don’t have a strong expectation or preference for the shapes they were looking at.

Occlusion (Kellman & Spelke 1983):



Which will they look longer at?

- The babies were looking at C the most because it interested them due to being 2 sticks.

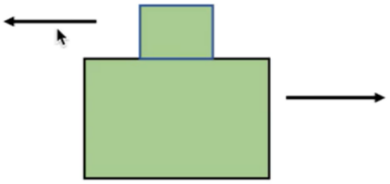
- The motion is calling the baby’s attention to the sticks.

- Movement is called to attention to alignment.

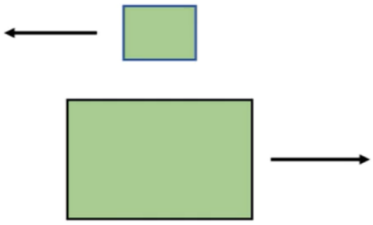
Coherence (Hosten, Spelke, Kestebaum):

- Motion makes babies think that occluded objects are whole even behind in the includer.

- They also studied motion with regard to coherence.



Common motion – connected
Opposite motion – not connected
No motion – ambiguous



Regardless of motion, perceived to be unconnected

- The blocks were moving together and at the same speed to the left or right.
- Experiments would reach for the top block and the babies would look in a way that shows how surprised they are.
- For the left image, babies would be surprised that the top block moved because they thought the big block would move with it.
- For the right image, babies were not surprised when the top block was moved because they were not connected.
- If the blocks were not connected they were thinking the blocks were not the same object.
- It tells us that motion is skewing them ob object coherence.
- However, babies are sensitive to objects touching each other.

OBJECT PERMANENCE:

- Objects continue to exist when you aren't looking at them.
- Objects won't just disappear.
- In an experiment, babies are surprised when objects disappear and they see that an object is doing something that is considered physically impossible.

PROSOCIAL BEHAVIOR:

- **Theory of Mind:** How do we develop an understanding of minds and people's thoughts and relationships.
- In an experiment, babies were shown a character bullying another person and then another character helping another person.

- The babies were asked which one do you want and the majority chose the character who helped people.

- **Babies seem to have an attraction to helpful social individuals.**

- This shows how babies are evaluated as individuals in the world.

- The babies were also shown a neutral character who didn't bully or help a person and the majority of them chose the neutral character over the bully.

- Babies are able to track neutrality and they prefer helpers.

- A good candidate for innate knowledge and capacity is pro-social behavior and attraction to helpful pro-social individuals.

IN-GROUP PREFERENCES:

- Infants seem to have in-group preferences in an innate way.

- There are preferences babies have for members of their own group.

- Babies prefer their own race **(Barhaim et al. 2006)** and their own language preference **(Mehler et al. 1998; Moon et al 1993).**

- Babies are in-built with something that allows making in-group and out-group distinctions.

- The innate thing is how people prefer in-group and out-group.

  Example McKee (2006):
  - 6 months old infants were shown faces ofo 2 women who are bilingual speakers in both English and Spanish.

  - Most babies look towards the women who spoke English because that is their native language.

CORE KNOWLEDGE:

Babies (Perhaps innately):
- Represent included objects as **cohesive wholes** (when cues like motion cues are present).

- Have a sense of **object permanence.**

- **Ingroup** bias.

- Prefer **proscoial actors.**

STAHL AND FEIGENSON (2015):

- How does **learning** fit in with these innate “core knowledge” capacities?

- Are core knowledge and learning **in tension?**

- When and what do we learn how to do these fit into these core capalbilites.

- In the studies, researchers would see what expectations were violated when showing something to infants.

- Babies have an understanding of object continuity and object permanence.

- Infants will look longer or be surprised in their facial reactions and causes changes in brain electrical activity.

- Infants look longer when an object passes through a wall, which violates object solidity.

- Infants will look longer when an object is hidden in one location and is revealed to be in an entirely different location, which violates object permanence.

- **Hypothesis:** Violations of core knowledge **signal special opportunity for learning.**

- Infants are using these violations of expectation to learn about it and explore their world.

- The structure of expectation, violation of expectation, and learning underwrite a lot of how we learn and explore our world especially very early on in development.

  Knowledge Consistent Experiment:
  - Babies would see a truck be stopped by a wall when going down a ramp.

  - Their expectation of solidity is that objects can’t be passed by walls.

  Knowledge Violation Experiment:
  - Babies would see the truck somehow passed through the wall, which violated their knowledge consistently.

  - Babies will look longer at the violation experiment and are trying to figure out what happened and are surprised.

  - Babies are learning from the knowledge violation condition because they look longer at things that violate their knowledge.

- They learn more about the knowledge violation condition.

- Their **hypothesis** is that violation of knowledge invites you to learn things.

Squeaking Experiment:

- Gave babies the opportunity to learn something about an object they had seen before that was consistent or violated their knowledge.

- The babies were given a ball and a truck that was able to squeak.

- It gave the babies an opportunity to learn to associate that object with a particular sound.

- The target was then shown to a distracter object.

- In these experiments, they either used a ball or a truck first, so the distracter object is the one they used second.

- This established a baseline to see how much the babies preferred looking at the ball over the truck, but the squeaking sound was not playing.

- The babies had learned to associate the ball with the squeak.

- They would then show the target next to the distractor and play with the noise and the babies were able to associate the target object with the noise rather than the distracter object.

- The researchers had a **hypothesis** where knowledge violations were invitations for learning.

- If they saw an object behave in a way that was knowledge consistent they did not have a preference for the target object over the distractor object.

- They were only learning and preferring to look at the target object where it violated their expectation in some profound way.

- Do preverbal infants activity **test hypotheses** about events, especially events involving **violations of core knowledge?**

- Infants are able to explore targets differently **depending** on the type of **expectation violation.**

CONCLUSION:

- When infants see an object defy their expectations, they learn about that object better.
- They will explore that object more.
- They will also test relevant hypotheses for the object's behavior.