Human Development

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0.1 Learned in this study

- Emergence of understanding/learning by observing many instances of a symbol to extract it
- An AGI must be able to efficiently separate constant from variable in the examples it is given
- In order to reduce the problem of dimensionality, it must be able to focus its scope/attention

0.2 Things to explore

- Parallel between a program's evolution an a human evolution
- Vision and speech development
- Cell divisions in the brain (how is the brain formed?)
- What if the human genome is a particular cellular automata that generate more "chaos" than other variants, which would explain why we only have ~23000 genes[1] [2]?

1 Progression/Evolution of the agent - environment interactions

1.1 Zygote

Life begins with the fertilization of of a human egg by sperm. The zygote then goes through mitosis, rapidly increasing the number of cells while remaining the same size as the original zygote. After various phases, the zygote has turned into an embryo. After a couple of weeks (~8 weeks[3]) the embryo is instead called a fetus.

1.2 Embryo/Fetus

At some point during that process, the embryo/fetus begins to process information. The exact moment this process begins is most likely very interesting and similar in fashion to abiogenesis. One could certainly argue that at every point in time information is processed so it never actually starts/stops. However, if we consider the brain as the main unit of information processing, we can consider that by the time the corpus callosum has appeared[4], the brain may have started processing information.

Information processing is most likely a process that gradually increases.

In the beginning it might appear similar to a single light flickering in the dark, toggling from the on state to the off state. As more and more units develop, the flickering keeps occurring but in bigger and bigger volumes. As a single unit, the embryo/fetus is dependent on its mother to provide it with energy. This probably also means that from that moment forward, the brain would attempt to use the least energy it needs to spend.

Milestones Opening its eyes

[1] Evolution - What Darwin Never Knew - NOVA PBS Documentary - https://www.youtube.com/watch?v=AYBRbCLI4zU
[2] https://en.wikipedia.org/wiki/Human_genome
[3] https://en.wikipedia.org/wiki/Embryo
[4] https://en.wikipedia.org/wiki/Human_brain_development_timeline

1.3 Baby

1.3.1 Language acquisition

Research shows that the unborn child is capable of hearing by about the fourth month of gestation, but the auditory apparatus is not fully formed until about the sixth month. At birth, hearing is the most developed of the senses, so it is of prime importance to the baby in exploring its world. [5]

The human fetus has some basic hearing capacity from the age of about 18 weeks. This ability matures and develops over the next few weeks, with low-frequency sounds outside the mother's body being heard better than those of high frequency. From birth up to four months, the baby starts to respond to loud or sudden sounds, beginning to localize them by turning the head. From three to six months, the baby begins to recognize and also make sounds. Between six and 12 months, he or she begins to babble, recognizes basic words like "mommy," and starts to recognize voices. The baby begins to form words from the age of about one year. Each child reaches these milestones in hearing and speech development at different times, but very slow development may indicate some problem with the hearing apparatus. [6]

In the first few months (1 to 4 months) following its birth, a baby's language is primarily focused around making voewel-like noises (cooes) and/or babbles[7]. It will also attempt to vocalize.

> Infants first begin vocalizing by crying, followed by cooing and then vocal play. These first forms of sound production are the easiest for children to use.
>
> When reaching an age of 6 months, infants are finally able to control the opening and closing of the vocal tract, and upon obtaining this ability, infants begin to distinguish between the different sounds of vowels and consonants. This period is known as the beginning of the canonical stage. During the canonical stage, the babbling involves reduplicated sounds containing alternations of vowels and consonants (e.g.; baba or bobo).
>
> By the time an infant reaches 8–9 months, they display productions of more advanced sounds known as variegated babbling. Variegated babbling differs greatly from reduplicated babbling. This stage includes more complex combinations of consonant and vowel syllables (e.g.; babadoobe).
>
> By 9–10 months of age, infant babbling begins to resemble the native language of a child. The final stage is known as conversational babbling, or the "jargon stage" (usually occurring by about ten months of age). The jargon stage is defined as "pre-linguistic vocalizations in which infants use adult-like stress and intonation". The general structure of the syllables that they are producing is very closely related to the sounds of their native language and this form of babbling significantly predicts the form of early words.
>
> Infants continue to use intonation patterns and timing that matches the characteristics of their language. Most babbling consists of a small number of sounds, which suggests the child is preparing the basic sounds necessary to speak the language to which he is exposed.[8]

Milestones

- Crawling
- Eating by ourselves
- Walking
  - Most normal infants start learning to walk towards the end of their first year – at around 11 months[9].
- Speaking

[5] Carter, Rita. The human brain book. Penguin, 2014.
[6] Carter, Rita. The human brain book. Penguin, 2014.
[7] https://en.wikipedia.org/wiki/Child_development_stages
[8] https://en.wikipedia.org/wiki/Babbling
[9] Bermúdez, José Luis. Cognitive Science: An Introduction to the Science of the Mind. Cambridge: Cambridge University Press, 2010.

> In their first few days, human infants learn to distinguish people by their odors; then, over the next few weeks, they learn to recognize individuals by sound of voice; only after several months do they start to reliably distinguish the sights of faces. Most likely we learn to make each of these distinctions by several different methods, and it is probably no accident that these abilities develop in a sequence that corresponds to their increasing complexity. [10]

2 Understanding concepts/symbols

Understanding comes from the observation of a sequence of inputs. Those inputs are then correlated to one another such that if you

To understand a color, for instance *red*, you need to associate various observations with the symbol inside your head. Red cars, red books, red stop signs, red blocks, etc. After a while the concept emerges from all the different observations. In the same way that a child gets asked by its parent "what color is this?" while pointing at various objects, the child learns both to recognize specific colors as well as understand that colors is an abstract concept that contains many instances.

Thus, a system that wants to rapidly learn must be able to quickly identify what remains constant from what changes.

3 Vision

It's been said *(citation needed)* that when a child is born, he is unable to see (or at least his vision is far from the one he'll later acquire in life). Thus, for a while he has to get used to the signals that come to its eyes. As its brain starts to process the information, it builds up a processing architecture that may remind some of a neural network.

Each and every person has its own signature. However, it is not uncommon for many people to share a similar signature (have their *aura* sensed as a single identity).

4 References

[10] Minsky, Marvin Lee. The Society of Mind (New York: Simon and Schuster, 1986), 312.