

## **“Asymmetry, Lateralization, and Alternating Rhythms of the Human Body”**

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### Part 3: How did Humans Become Asymmetric?

In the book Right Hand Left Hand: The Origins of Asymmetry in Brains, Bodies, Atoms, and Cultures Chris McManus does a fascinating job of theorizing the answer to how humans came to be asymmetric.

When considering how humans came to be asymmetric, we will start with where the matter that constitutes our bodies came from: our universe. Is our universe asymmetric or symmetric? Conservation of parity refers to symmetry being preserved in the universe. McManus questions if parity (symmetry) has been maintained within the universe and whether it is symmetrical or asymmetrical. He lays out 2 different theories regarding whether the universe is a weak left hander (weak interaction theory) or ultimately balanced between left and right (circular polarized light theory). If we take a look at neutron stars (enormous bodies of matter) they exhibit an electromagnetic polarization where half of the star exhibits polarized light moving clockwise (right) and the other half moving counter-clockwise (left). This also means that the amino acids on one half will be right handed and the other half will be left handed. When neutrons explode, they blast fragments of matter out into space. These fragments may then form separate galaxies and planets. Depending on which section (L or R) of the star exploded will determine whether its resultant forming galaxy will be predominately left or right handed. This explains why most of the galaxies scientists have found are weakly left handed. It also leaves open the possibility that these left handed galaxies may indeed be balanced out by other right handed ones elsewhere in the universe.

McManus lays out the theory that meteors carrying L amino acids crashed onto earth and that is what life evolved from. Essentially all of the amino acids on our planet are left handed. Left handed amino acids are chemically more stable than right handed ones and thus are better able to support life. Therefore, life is more likely to form in a left oriented galaxy. It is also interesting to note that regarding sub-atomic particles, most electrons are left handed and all neutrinos are left handed. The reference to the direction of handedness infers the direction the molecules rotate light (clockwise or counterclockwise). Molecules that are mirror images of each other are said to be chiral or referred to as stereoisomers or enantiomers. They cannot be made identical when rotated 3 dimensionally in space. Just as the case with our hands and feet.

The genetic code and its entire translation machinery are based only on L amino acids. If we imagine amino acids as legos, they must all be the same shape to be able to interlock with one another. This is just like how you can only shake hands with either two right or two left hands. Ultimately, this affects how molecules and thus hormones bind to one another.

Racemisation is the tendency for one chiral form to spontaneously shift into the other form and become less pure in consistency. When this happens, there will be more of a mixture of both L and D vs. purity of one type. This is typically not desirable and can reflect protein fatigue. The less homochirality there is, the more chemical instability exists. Pasteurization can facilitate the creation of more D protein/amino acids.

Some interesting points about L vs. D amino acids

- Stereoisomers will have different properties. One example is scent. We will detect a left handed molecule differently from a right handed one.
- Drugs produced synthetically tend to be a 50-50 mix of left and right handed molecules. It is more difficult to synthetically produce a pure substance of either left or right polarity although the pharmaceutical industry has made advances with this. When substances are naturally produced their molecules will be purely of either left or right. Wine is an example of this.
- Drug companies have exploited stereoisomers in an attempt to extend drug patents by carrying out a chiral switch when a patent is about to expire. As you can imagine, this has resulted in some undesirable consequences.

- Demorphins and deltorphins are opioid peptides with a D amino acid that replaces the equivalent L amino acid and creates a kink in the chain making the peptide completely inactive. They are opioid peptides because they act on the brain in the same way as natural opiates such as morphine and heroine but are a thousand times more potent. They are powerful painkillers yet non-addictive and without the sedation and gastrointestinal side effects.
- Regarding our digestive enzymes, they are looking for left handed proteins to break down. If the body is presented with right handed proteins (that have resulted from racemization via pasteurization) they will not get properly digested.
- Alzheimer's is an accumulation of amyloid protein in the brain which contains D series amino acids. The L version gets removed but the D version doesn't.
- The enzyme in kidneys called D amino acid oxidase neutralizes D amino acids. D amino acids can be found in the blood or bowel from bacteria. It is possible that our intestinal bacteria may be producing D amino acids food.
- In the human body, D serine is made by serine racemise and has enzymes that break it down. It is found in the brain and doesn't seem to come from spontaneous racemisation. Large quantities are detected in the hippocampus and cortex and seem to modulate the NMDA neurotransmitter system which is involved in memory and learning.
- A bacteria's cell membrane is composed of exotic L amino acids and D amino acids as a defense mechanism.
- Mold produces chemicals that prevents D amino acids from forming and hence functions as a natural anti-biotic (penicillin).
- Amphibian skin is the only place where proteins containing D amino acids have been found structurally in vertebrates although there are animals that use D amino acids functionally (brain in humans).
- Some venoms use a D amino acid via an enzyme that converts it from the L version. This is an "example of evolution exploiting existing resources rather than developing an entirely new technology."
- All sugars are right handed.

It is the asymmetrical nature of the building blocks of our body, left amino acids, which allow our human asymmetrical form to be possible. During embryological development, asymmetrical cilia that are constructed by left handed amino acids direct the flow of signaling molecules to the left via their clockwise rotating propellers. These signaling molecules which are now more concentrated on the left side of the embryo direct asymmetrical gene expression for proper formation of the left and right sides of the body. This is how the heart has come to be on the left side of the body as well as all the other asymmetrical traits of the human being. In situations where the cilia are not rotating properly, misshapen, or absent organ arrangement patterns can develop in a complete reversal (situs inversus) or randomly (some organs are on the opposite side of normal but not all).

Are there situations where asymmetry is not desirable in a human being? Part 4 of "Asymmetry, Lateralization, and Alternating Rhythms of the Human Body" will discuss this question.

#### References

"Body Asymmetries: Incidence, Etiology and Clinical Implications". Zeenat Fatima Zaidi. Australian Journal of Basic and Applied Sciences, 5(9): 2157-2191, 2011. ISSN 1991-8178.

"Lateralized rhythms of the central and autonomic nervous systems." Int J Psychophysiol. Shannahoff-Khalsa D.1991 Dec;11(3):225-51.

"Survival with an Asymmetrical Brain: Advantages and Disadvantages of Cerebral Lateralization." Vallortigara G, Rogers LJ. Behav Brain Sci. 2005 Aug;28(4):575-89; discussion 589-633.

"The importance of being asymmetric: the physiology of digesta propulsion on Earth and in space." Arun CP. Ann N Y Acad Sci.2004 Nov;1027:74-84.

“Development of the asymmetric human”. Lewis Wolpert (2005). *European Review*, 13, pp 97-103.  
doi:10.1017/S1062798705000682.

“Hemispheric asymmetry for visual information processing.” Joseph B. Hellige. *Acta Neurobiol. Exp.* 1996, 56: 485-497.  
[http://en.wikipedia.org/wiki/Suprachiasmatic\\_nucleus](http://en.wikipedia.org/wiki/Suprachiasmatic_nucleus)

“Development of functional asymmetries in young infants: A sensory-motor approach”

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<http://www.diva-portal.org/smash/get/diva2:144424/FULLTEXT01.pdf>

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1998 John Wiley & Sons, Inc.

“Gait analysis in patients with idiopathic scoliosis.” Inès A. Kramers-de Quervain, Roland Müller, A. Stacoff, Dieter Grob, Edgar Stüssi. *Eur Spine J* (2004) 13 : 449–456.

“The effect of heat-processed foods and metabolized vitamin D milk on the dentofacial structures of experimental animals”. Francis M. Pottenger, Jr., M.D., F.A.C.P., Monrovia, California.

“Autism and gastrointestinal symptoms”. K Horvath, JA Perman - *Current gastroenterology reports*, 2002 – Springer

“Pathways underlying the gut-to-brain connection in autism spectrum disorders as future targets for disease management.” de Theije, Caroline GM, et al. *European journal of pharmacology* 668 (2011): S70-S80.

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