

The Origins and Implications of Ambidexterity

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Abstract:- Ambidexterity denotes the proficient utilization of both hands and is akin to mixed handedness, which involves the use of different hands for different tasks. The etiology of ambidexterity is still being elucidated, with the precise cause remaining elusive. It is posited that many ambidextrous individuals are predominantly left-handed and have acquired dexterity in their right hand. Certain genetic variations may also factor into ambidexterity. Research suggests a potential association between ambidexterity and conditions such as ADHD, schizophrenia, and PTSD; however, further investigations are imperative to comprehensively grasp the origins and implications of ambidexterity. This paper aims to review the same and provide empirical evidence of the same.

I. INTRODUCTION

As a child, I demonstrated ambidextrous tendencies, proficiently utilizing both hands with equivalent dexterity. However, in adulthood, I have predominantly favored my left hand for activities such as writing and eating, while reserving my right hand for tasks like cooking and playing cricket. Despite conscious efforts to alter this pattern, it appears to be deeply ingrained in my subconscious, manifesting as an instinctive behavior.

Genuine ambidexterity is rare where individuals demonstrate high proficiency in using both hands. Such individuals are categorized as "ambidextral," a term denoting equal adeptness with both the right and left hand. Conversely, some individuals exhibit less dexterity in both hands but utilize their right hand for specific tasks and their left hand for others. An entirely distinct classification, "ambisinistral," pertains to individuals lacking a dominant hand and employing both hands, neither exhibiting notable strength.

Only a tiny percentage of the population can use both hands with equal dexterity. Genuine ambidextrous individuals constitute approximately 1 percent of the population. Around 1 in 100 people have no dominant hand and exhibit equal proficiency in using both hands; however, many left-handed individuals can utilize their non-dominant hand almost as effectively as their dominant hand.

Ambidexterity is not just a physical trait but a reflection of the brain's structure. It suggests that a person's brain hemispheres are fairly symmetrical, a characteristic left-handed individuals share. In contrast, right-handed people

typically exhibit left-brain dominance, further highlighting the unique nature of ambidexterity.

II. THE CONCEPT OF HANDEDNESS

Laterality, as defined in the field of biological psychology, pertains to the specialized development of functioning in each hemisphere of the brain or in the corresponding side of the body that each hemisphere controls. The most conspicuous manifestation of laterality is handedness, denoting the propensity to employ either the right or left hand for various activities. Individuals are typically categorized as right-handed, left-handed, or ambidextrous (capable of using both hands). There exists significant inter-individual divergence in the spectrum of activities for which a particular hand is preferred, as well as in the extent of dexterity discrepancy between the two hands. It is a rarity for individuals to exclusively favor either the right or left hand.

The attribute of handedness in human beings pertains to the unequal distribution of fine motor skills between the left and right hands. An individual exhibiting more excellent dexterity with the right hand is termed right-handed, whereas one demonstrating more proficiency with the left hand is considered left-handed. A minority of individuals display equal skill with both hands and are classified as ambidextrous. Those who exhibit awkwardness with both hands are described as ambilevous or ambisinister. Instances of ambisinistrous motor skills or diminished dexterity may stem from debilitating physical conditions. Handedness is generally categorized into four main types.

- Right-handedness is most common and, as the name suggests, pertains to people who use their right hands when performing a task.
- Left-handedness is about 8 to 15% of people are lefthanded and predominantly use their left hand while performing a task. [1]
- Mixed-handedness, also known as cross-dominance, is doing different tasks better with different hands. For example, mixed-handed persons might play badminton with their right hand but draw with their left hand.
- Ambidexterity is Rarely found, ambidexterity is a skill that can be acquired through learning, although it remains exceptionally rare. Individuals who are truly ambidextrous can perform tasks with equal proficiency using either hand. However, those who acquire this skill

typically still exhibit a tendency to favor their originally dominant hand.

➤ *How your Brain Determines which Hand you Prefer.*

It is a persistent belief that individuals can be categorized as either "right-brained" or "left-brained." However, the truth is that we are "whole-brained," utilizing both hemispheres when engaging in activities such as speaking, problem-solving, or playing musical instruments. Nonetheless, it is important to note that the brain's two hemispheres possess specialized functions, and the actual interplay between the two halves of the brain is a subject that is intriguing from a scientific perspective and may surpass common misconceptions.

In the 1800s Paul Broca and Carl Wernicke discovered that different hemispheres of the brain handled different

functions such as speech, language and even motor functions. But it was only in 2009 that scientists researched around 25,000 families and found certain genes were responsible for ambidextrousness in people.

The human brain is anatomically divided into distinct left and right hemispheres by the corpus callosum, a prominent bundle of nerve fibers. Common knowledge suggests that the left hemisphere is primarily responsible for language processing, analytical thinking, and learning, while the right hemisphere is associated with visual processing and emotional perception. However, it is important to clarify that the oversimplified notion of individuals being exclusively "left-brained" or "right-brained" based on their logical or creative tendencies is inaccurate and lacks scientific support.

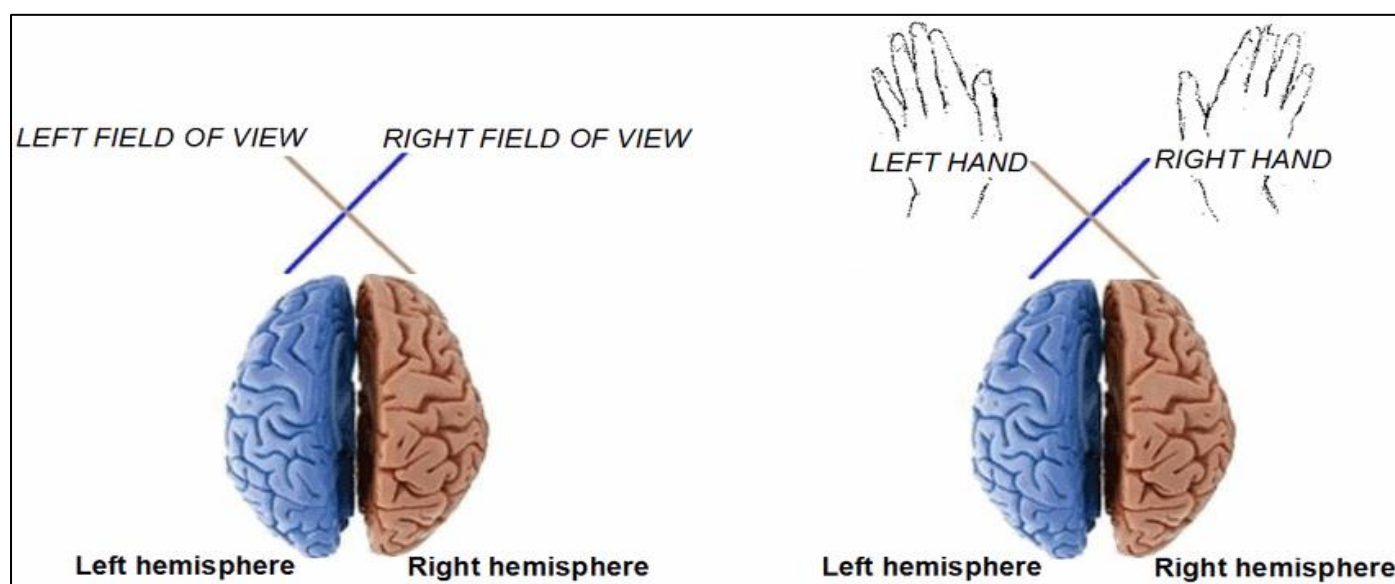


Fig 1 Pic Credit – Research Gate

Studies on human hand preference indicate a consensus among researchers that the inclination towards a particular hand (right or left) is predominantly influenced by biological and likely genetic factors. Two prominent genetic theories propose that the prevalence of individuals with language and speech control located in the left hemisphere of the brain is a result of evolutionary natural selection. This dominance also extends to the right hand, which is primarily responsible for the fine motor movements necessary for written language production. Over millennia, this evolutionary process has led to a genetic predisposition among humans with a preference for the right hand, encompassing approximately 85 percent of the population. Furthermore, these theories aim to elucidate the enduring existence of the left-handed minority, constituting about 15 percent of the global population.

The genetic proposal to explain hand preference states that there are two alleles, or two manifestations of a gene at the same genetic location, that are associated with handedness. One of these alleles is a D gene (for dextral, meaning ζ right ζ) and the other allele is a C gene (for ζ chance ζ). The D gene is more frequent in the population and

is more likely to occur as part of the genetic heritage of an individual. It is the D gene that promotes right-hand preference in the majority of humans. The C gene is less likely to occur within the gene pool, but when it is present, the hand preference of the individual with the C gene is determined randomly. Individuals with the C gene will have a 50 percent chance of being right-handed and a 50 percent chance of being left-handed.

The theories concerning the causation of hand preference are of significant interest due to their ability to explain how external cultural and societal influences can affect the hand preference of individuals with the C gene, a group that includes most left-handers and some right-handers. Researchers have observed the impact of these external pressures on hand preference.

Furthermore, these theories provide an explanation for the occurrence of right-handed children in families with left-handed parents and left-handed children in families with right-handed parents. When the familial genetic pool contains C genes, chance influences, including familial training and

other environmental interventions favoring the use of one hand over the other, can shape hand preference. The proposed genetic locus responsible for hand preference contains an allele from each parent, resulting in three possible genetic combinations: DD individuals who are strongly right-handed, DC individuals who are mostly right-handed, and CC individuals who can be either right-handed or left-handed. These genetic combinations account for the predominant right-handedness observed in the human population, with a persistent minority of left-handers.

In view of historical evidence, the prevalence of right-hand preference has been demonstrated throughout the course of human history (Price, 2021). Neuroscientific research has revealed that the motor centers of the brain appear to govern the contralateral sides of the body (i.e., the left hemisphere controls the right side of the body and vice versa). As experimentation and stroke studies have advanced, the correlation between brain function and handedness has come into sharper focus (Corballis, 2017).

Throughout the mid to late 1800s, several scientific reports suggested that the processing and understanding of language predominantly occur in the left hemisphere of the brain for most individuals (Corballis, 2014; Javed et al., 2020). In the 1950s, Roger Sperry commenced his study on "Split-Brain" patients, individuals with severe epilepsy requiring corpus callosum lesioning. These patients possessed functional hemispheres but lacked the means to share signals between them. Surprisingly, they functioned relatively normally. Gazzaniga, a renowned researcher at Sperry's lab, observed deficits in these patients when asked about images in their left visual field. The patients were consistently unable to name objects seen in their left visual field but had no difficulty naming objects in their right visual field (Gazzaniga & Sperry, 1965; Lienhard, 2017).

The explanation lies in the division of labor between the brain hemispheres. Visual information from the left visual field is processed by the right hemisphere, which lacks direct access to the brain's language centers situated in the left hemisphere. This explanation suggests a connection between handedness and the brain's language centers. In most individuals, the left hemisphere contains these language centers, favoring the right hand for writing due to strong connectivity. This preference reinforces the right hand's dominance. Conversely, left-handed individuals are thought to have language centers in the right hemisphere, potentially influencing their left-handed preference. However, complexity exists, with many left-handed individuals showing normal left side lateralization for speech (Scientific American, 2004; NPR, 2017).

III. CREATIVE VISIONARIES & AMBIDEXTERITY

Nearly six decades following the demise of Albert Einstein, neurosurgeons delving into the study of his brain made a noteworthy revelation. They found that the hemispheres of Einstein's brain displayed exceptional connectivity. This exceptional connectivity between the right

hemisphere, associated with creativity, and the left hemisphere, associated with logic, may have conferred a significant cognitive advantage upon the renowned Father of Relativity. While the evidence supporting Einstein's ambidexterity remains inconclusive, the study validated his non-right-handedness.

One of the renowned ambidextrous individuals is the esteemed Italian painter, sculptor, and architect of the Renaissance era, Michelangelo Buonarroti. His contemporaries and subsequent biographers have provided accounts of his proficiency in using both hands for artistic activities. Legend has it that Michelangelo practiced writing and painting with his left hand when his right hand was impaired, in order to develop ambidexterity. This enabled him to continue his work even when his dominant hand was incapacitated. According to certain anecdotes, he was capable of writing equally well with both hands in both forward and reverse directions.

Another luminary known for his ambidextrous abilities was Leonardo da Vinci. This eminent artist and art scientist demonstrated the capacity to write proficiently with both hands. In ordinary correspondence, da Vinci utilized his right hand; however, he composed his secret musings in mirrored script using his left hand, rendering the text difficult for others to discern. It is plausible that da Vinci may have employed visualization exercises in his practices.

➤ *Are there any Risks to being Ambidextrous?*

The existing body of research on ambidexterity is notably deficient, with a dearth of studies explicitly investigating the correlation between ambidextrousness and health hazards. However, scholars have scrutinized the potential perils associated with mixed handedness, which entails the utilization of different hands for specific tasks. Furthermore, there exists literature on the subject of left-handedness and its associated risks, findings which may be relevant to ambidextrous individuals, particularly those who exhibit a dominant left-handedness. Here's what research says

- *Attention Deficit Hyperactivity Disorder (ADHD)-*

Cerebral laterality, the concept that different brain hemispheres specialize in distinct functions, also known as the lateralization of brain function, has been identified as a crucial factor linked to neurodevelopmental disorders. A 2010 research study found that mixed-handedness, a condition associated with atypical cerebral laterality, has been correlated with ADHD among children and adolescents. Similarly, a 2015 study highlighted the association between non-right handedness, which encompasses ambidextrous individuals and those initially left-handed, and ADHD symptoms. These findings underscore the potential relevance of cerebral laterality in understanding and addressing ADHD within clinical and educational contexts.

- *Learning Difficulties –*

The typical lateralization of the brain, which is the specialization of different brain functions in the left and right hemispheres, can be associated with ambidexterity and

mixed-handedness and may lead to learning difficulties in children. A study conducted in 2015 suggested that these difficulties may manifest in challenges related to verbal fluency, writing pace, and information retrieval. The study also found that children with an inconsistent hand preference may have lower coordination compared to those who are predominantly right- or left-handed, potentially affecting their learning performance in school. A recent study published in the journal *Pediatrics*, led by Dr. Alina Rodriguez from the Department of Epidemiology and Public Health at Imperial College London, has contributed to the existing body of research on the correlation between handedness and brain function. The study suggests a potential interconnection among mixed-handedness, neurotransmitter dysfunction in the right hemisphere, and symptoms of attention-deficit/hyperactivity disorder (ADHD).

The research involved an analysis of data from 7,871 Finnish children born in 1986, who were evaluated at ages seven or eight and later at age 16. At age 8, the children were classified as left-handed, right-handed, or mixed-handed based on parental reports. The findings showed that 1.1% of the children (87) were ambidextrous, similar to the general population. Language skills and behavioral issues were assessed through questionnaires completed by parents and teachers at age 8, and the participants themselves, along with their parents and teachers, provided responses at age 16. ADHD symptoms at age 16 were evaluated using a scale from the Diagnostic and Statistical Manual of Mental Disorders-IV. At age 8, ambidextrous children were found to be twice as likely to encounter difficulties in language skills and academic performance compared to their right-handed counterparts. As teenagers, mixed-handed individuals were twice as likely to manifest symptoms of ADHD. Notably, ambidextrous children exhibited more severe ADHD symptoms compared to right-handed individuals with ADHD. Furthermore, language difficulties were more prevalent among mixed-handed adolescents compared to their left-handed or right-handed peers.

The researchers emphasize that these findings do not imply a definitive association between ambidexterity and learning disabilities or ADHD in all cases. However, the study suggests that mixed-handed individuals may face a higher risk of encountering these challenges. The research sheds light on the potential link between handedness and brain hemispheric dominance, particularly the left hemisphere's dominance among right-handed individuals, and calls for further investigation in this area. Understanding the mechanisms linking handedness with learning and language skills could potentially lead to improved detection and intervention strategies for conditions such as ADHD.

- *Schizophrenia* –

There is ongoing speculation regarding the potential correlation between ambidextrous or mixed-handed individuals and an elevated susceptibility to developing schizophrenia. A study conducted in 2021 revealed that ambidexterity is linked to genetic variations in the *VRK2* gene, which has been implicated in the onset of schizophrenia and major depressive disorder, as indicated by a study from

2018. Furthermore, a study from 2013 uncovered an association between left-handedness and schizophrenia, a correlation that may extend to ambidextrous individuals who predominantly favor their left hand.

- *Post Traumatic Stress Disorder (PTSD)*-

A study conducted in 2007 revealed that combat veterans who engage in dual-handed activities are more susceptible to developing post-traumatic stress disorder (PTSD). PTSD is a mental health condition that arises after exposure to a terrifying or overwhelming event. The study suggested that atypical cerebral lateralization may be linked to PTSD, as it is believed to heighten an individual's responsiveness to threats, potentially elevating the risk of developing PTSD. As previously mentioned, the abnormal cerebral lateralization is associated with the use of both hands, offering a possible explanation for the correlation between PTSD and ambidexterity or mixed-handedness, although further research is necessary to provide conclusive evidence.

- *Synesthesia* –

The phenomenon of synesthesia involves a neurological condition wherein sensory stimuli, such as sound, are perceived through a different sense, such as sight, resulting in experiences such as seeing colors in response to hearing sounds. Although there is currently no direct correlation established between ambidexterity and synesthesia, there is some speculation that individuals who are left-handed may have a higher propensity for synesthesia. Consequently, it is plausible that an ambidextrous individual who predominantly favors their left hand may be more predisposed to this condition.

IV. CONCLUSION

Years of neuropsychological testing and brain imaging have dispelled the notion of "Right brain for art and creativity and left brain for analytics." Both brain hemispheres activate for most activities and thoughts. Nonetheless, lateralization remains significant, with the left hemisphere more associated with language and the right with visuospatial ability (Gotts et al., 2013). This understanding is crucial in countering limiting beliefs about humanities versus sciences. As Sal Khan aptly articulates, humans possess natural curiosity, and the integration of science and math into art and literature, and creativity and art into science and math should be recognized and encouraged.

- *Conflict of Interest-*

The research has not been sponsored or influenced by anybody/any organization - not fully neutral. There is no conflict of interest with anybody/any organization

- *Authors' Biography* –

The Author is an undergraduate Psychology student at the University of British Columbia, Canada. Being himself ambidextrous and having worked with children with learning disabilities and ADHD, his curiosity led him to research the topic and also if there is a correlation between learning disabilities and handedness.

REFERENCES

- [1]. <https://www.bionity.com/en/encyclopedia/Handedness>
- [2]. <https://www.rd.com/list/facts-ambidextrous-people/>
- [3]. <https://www.zmescience.com/>
- [4]. <https://www.mentalfloss.com/article/30667/11-facts-about-ambidextrous>
- [5]. <https://www.scientificamerican.com/>
- [6]. <https://www.scientificamerican.com/article/ambidexterity-and-adhd/>
- [7]. Rosen, V. (2018). One Brain. Two Minds? Many Questions. *Journal of Undergraduate Neuroscience Education* : JUNE : A Publication of FUN, Faculty for Undergraduate Neuroscience, 16(2), R48–R50. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6057762/>
- [8]. Price, M. (2021). The left brain knows what the right hand is doing. Retrieved April 17, 2021, from <https://www.apa.org> website: <https://www.apa.org/monitor/2009/01/brain>
- [9]. Corballis, M. C. (2017). The Evolution of Lateralized Brain Circuits. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.01021>
- [10]. <https://www.magneticmemorymethod.com/ambidextrousness/>
- [11]. [The-ambidextrous-brain-demystifying-the-left-vs-right-brain-debate](#)