Impact of Natural Binary Patterns on Cognition and Perception in the Digital Age: A Comparative Study of Digital and Analogue Native Populations

Dr. Oluwatoyin Mary Yerokun
Department of Computer Science
Faculty of Science, Ekiti State University
Ado Ekiti, Nigeria
yerokunoluwatoyin@gmail.com

Prof. Dipo Theophilus Akomolafe
Department of Computer Science
School of Science Olusegun Agagu University of Science and Technology
Okitipupa, Nigeria
dipoakomolafe@gmail.com
DOI: 10.56201/ijcsmt.v11.no2.2025.pg85.96

Abstract

This study investigates the effects of natural binary patterns (NBPs) on cognition and perception in digital and analogue populations. The researchers compared cognitive processing attention and emotional regulation in one hundred participants fifty (50) digital natives (DN) and fifty (50) analogue natives (AN) using behavioral experiments. Results show that there are significant differences in attentional abilities, memory performance and emotional processing between DNs and ANs when exposed to NBPs. DNs exhibited reduced attentional abilities and increased cognitive load while ANs demonstrated better memory performance and emotional regulation. Our findings suggest that NBPs have a profound impact on cognition and perception, influenced by technological exposure. This research informs strategies for mitigating technological overload and promoting cognitive wellbeing in the digital age. It enhances the understanding of the interplay between technology, cognition and perception.

Introduction

Binary refers to any system, state or condition that can be expressed with only two possible values. Mathematically speaking, binary is a number system that has only two digits – zero (0) or one (1) – and is known as base two (Awati, 2024). Any situation in which its description or reports can be either one way or the other, mostly opposing, is binary by nature. In computing, binary digit (BIT) is the smallest unit of information stored in the computer system that represents a logical state which can have only two states - on or off and are commonly represented as 1s and 0s (Bentley, 2022).

The pattern of electronic circuits is logically two and this is the building block of all computer systems. Yerokun (2005) explained that the computer is built on a binary numbering system because of the logical nature of transistors and switches used in building computers. Electronic circuits use only two states. The quantity of circuitry necessary to distinguish between *n* different voltage levels is roughly proportional to *n-1*, therefore, having three discernible states would require twice as much circuitry per signal. It will require three times as much for having four discernible states, etc., in the words of Avati (2024), tripling the amount of circuitry while merely doubling the amount of information would represent a loss in efficiency.

The binary nature of computers is neither a scientific innovation nor coincidence, it was born out of natural patterns. Ben-Jabeur & Boashash (2015) stated that in nature, there are patterns seen everywhere, on plants, rocks, in the air, deep in the waters, physically and invisible. The patterns strewn all over the natural world have been carefully observed to be in two states. Despite the ternary numbering system that human beings are accustomed to in most languages of the world, all arithmetic systems are built to conform to the language of nature which is a two-state expression.

Definition of Problem

Technology has profoundly impacted binary patterns in daily activities, amplifying and transforming their presence in various ways. Firstly, because computing relies on binary codes (0s and 1s) thereby reinforcing binary thinking, social media has resulted in binary categorizations for all interactions. Words such as like/dislike, friend/unfriend, etc. shape online activities.

Secondly, immersive experiences brought about by binary distinctions like virtual/real have kept many digital natives in the clouded world with stuff like 3D modelling, augmented reality, escape rooms, etc. This in turn have caused a blur in many distinctive lines thereby standing the chance of affecting the generational decisions and choices.

Thirdly, binary classifications are mostly employed in all data analytics. Researchers are more comfortable with using markers/responses such as true/false, yes/no, agreed/disagreed, etc. in eliciting responses and these responses underly data-driven decision-making algorithms tending human existence towards AI-driven decisions.

This means that to a very large extent, binary patterns are responsible for life's decisions in this technological age. It is therefore important to ensure that decisions are made in sharp cognition and broad perception for the sake of posterity. Exploring the soundness of thoughts and depths of knowledge are important factors that must be certified in the acceptance of decision makers and the decisions made.

Aim and Objectives of the Study

The aim of this research is to explore the impact of binary natural patterns (BNP) on the cognition and perception of people with respect to their exposures to technological advancements. To achieve the most scientific results, this broad aim was divided into the following specific objectives:

1. Investigate the relationship between technological exposure and NBP processing in cognition and perception.
2. Investigate cognitive processing, attention and emotional regulation
3. Compare cognitive and perceptual performance between technologically exposed and non-exposed populations.
4. Examine the potential benefits of NBPs in reducing technological overload and promoting cognitive well-being.

Review of Related Literature

Botanists, researchers and biological garden curators have produced thousands of volumes of articles to show the existence of natural binary patterns as seen everywhere. In the work of Yerokun (2024), nature was proved to abound with natural patterns in foods as represented in arrangement of leaves, presentation of roots and flower arrangements. Olorode (2016) showed that African indigenous knowledge, built on natural binary principles was the foundation for all digital systems.

Akomolafe & Yerokun (2022) proved that the development of digital systems indeed emerged through indigenous knowledge, confirming that nature is understood and interpreted through natural binary patterns and systems. Ghulaxe (2024) studied the impact of natural languages on the teaching and learning of technology-based courses at all levels of education. It was discovered that students would do better when their natural settings are the basic entry behavior upon which other courses are projected from and that E-courses to be made available in all regional languages to promote digital nativism through natural language. In the work of Dhawale, Rekha & Maggirwar (2024), some plants renowned for their vibrant blooms were praised to grace gardens and landscapes as bedding plants for natural healing and soothes, across numerous countries. They confirmed the intertwining of humans' health and medical restoration on some of these woody herbaceous perennials, adding splashes of rich colors and textures to garden beds and landscape designs in clear symbiosis of fungi and plants, further pushing that natural patterns are the bedrock of a healthy educational system.

The Intersection of Binary Patterns in Culture

Human culture is intertwined with the natural landscape, and it is measurable on pointers such as language, mythology and philosophy (Yerokun, 2024). Art, music and foods are included in the list.

1. Language: Binary oppositions are fundamental to human language and cognition. In Literature, authors use opposition to understand relationships and consequences of categories. Differences between groups and classes, such as gender, are best explored using oppositions. Examples are male/female, true/false, good/evil, high/low, etc.
2. Mythology: Many mythologies use binary dichotomies as applicable in languages. Examples are light/dark and chaos/order.
3. Philosophy: Binary concepts such as mind/body, reason/emotion, life/death, have shaped Western philosophy.
4. Art: Binary patterns appear in art, from symmetrical compositions to binary color schemes.
5. Music: Binary rhythms and harmonies underline many musical traditions.

Digital Natives: A person is termed a digital native if the individual was born after 1980 and has grown up with the internet, smartphones, and digital technologies.

Analogue Natives: An individual born before 1980, who has experienced a significant portion of their lives without widespread digital technology.

Research Questions

The following research questions were formulated to guide the research:

1. How does exposure to technological advancements influence the cognitive and perceptual processing of natural binary patterns (NBPs)?

2. Do individuals with extensive technological exposure exhibit differences in attention, memory, decision-making, and emotional processing when exposed to NBPs compared to those with limited exposure?
3. Can NBPs be used to mitigate potential negative effects of excessive technological exposure on cognition and perception?

Information and Natural Preprocessing

Nature has intriguingly inspired the binary numbering system in diverse ways. A summary of these inspirations guided the focal points of interviewing and discussions for gathering data. They are:

1. Binary Trees: Tree structures in nature inspired the development of binary trees in computer science.
2. Branching Networks: Rivers, trees and human nerves/cells all exhibit binary-like splitting patterns.
3. Symmetry: Butterfly wings, flower petals, seeds; and leaves' arrangements inspire mathematical connections like the Fibonacci sequence, Pascal's triangle and Geometric patterns.
4. DNA Base Pairing: Adenine (A) pairs with Thymine (T), Cytosine (C) pairs with Guanine (G), resembling binary's 0/1 pairing.
5. Neural Networks: Brain's neural connections can be represented as binary (on/off) signals and neural activities are communicated through binary-like electrical impulses (on/off).
6. Animal Communication: Some animals use binary signals (e.g., birds' songs) to convey information.
7. Fractal Geometry: Mandelbrot set is a perfect example of natural fractals that exhibit self-similarity, binary recursion and scaling progression properties.
8. Computational Models of Nature: In cellular automata, binary-based models simulate natural phenomena (e.g., Conway's Game of Life); genetic algorithms are used to simulate binary-based artificial life; and in Chaos Theory, binary representations help study complex natural systems.
9. Innovative applications and future of computing are targeted on Bio-inspired Computing (Nature-inspired binary algorithms to solve complex problems), Natural Computing (Binary models to simulate natural processes for optimization and prediction) and especially Eco-Informatics (Binary data analysis to aid environmental monitoring and conservation).

Philosophical Connections

1. Duality: Nature's dualities are perfectly reflected in human choices. In the presentation of options or alternatives to choose from in every situation, mostly two categories are used. Options like left/right, light/dark, order/chaos, good/bad, high/ low, positive/negative, etc. are perfect mirrors of binary's 0/1 dichotomy.

2. Holism: Binary systems can represent holistic natural systems, emphasizing interconnectedness. The gray areas of life or choices are always the overlapping of black and white, nothing else. All natural colors mix up to form either white or black.
3. Emergence: Complex natural phenomena emerge from simple binary interactions. The basic building blocks of the most complex systems are the simple binary. In Object oriented analysis and design (OOADM), every problem can be decomposed into manageable binary sized chunks for easier management and processing.
4. Information Theory: Binary patterns in nature suggest that information is fundamental to the universe.
5. Reflection of Human Thought: Cognitive biases are mirrored by human binary thinking from oversimplification of options into only true/false, yes/no.

Methodology

Behavioral experiments such as attentional tasks and memory games, were conducted with permission and spontaneously on the respondents at different levels of interaction to generate original responses. The respondents were monitored for emotional reflexes through their shift in attention and delay time between questions and responses.

Data Collection

Respondents in this survey were selected by stratified sampling. The target population of one hundred (100) respondents was divided into four (4) distinct subgroups of twenty-five (25) each to ensure adequate representative sampling. They are comprised of friends, relatives, colleagues and willing strangers spread across all ages (16 to 85 years) within the southern Nigeria. Over a period of ten months. the researchers met the target strata as they commuted on official, academic and social engagements around nine (9) states, namely: Lagos, Ondo, Ekiti, Oyo, Osun, Edo, Delta, Anambra, Kogi and FCT (Abuja). Participants were people with varying levels of technological knowledge and covered both digital and analogue nativities with urban and rural exposures, frequent and infrequent tech users. Structured interviews were conducted with the selected individuals using sets of questions predetermined from the discussion questions. Some colleagues were interviewed in-depth with a semi structured instrument to allow flexible, detailed probing and deeper exploration of the subject area. Two (2) batches of the strata were interviewed in groups – students (DNs) and senior citizens (ANs) for the specific purpose of observing their attention span and relational understanding as societal microcosm.

Interview/Discussion Questions

The research questions were further mapped into six (6) sub-themes and each expressed in two interview/discussion questions, making a total of twelve questions. They covered binary cognition, natural computing, bio-inspired ethics, digital representations and algorithms, universal language

and tailed into the meeting points between technology and nature. Table 1 is a presentation of the responses.

Table 1: Presentation of all responses

			Digital Natives					Analogue Natives			
			Urban		Rural			Urban		Rural	
S/No.	**Questions**		**Yes**	**No**	**Yes**	**No**		**Yes**	**No**	**Yes**	**No**
1	Binary Cognition:	A									
	Do you recognize binary patterns in nature?	A1	22	3	19	5		23	2	21	4
	Do binary patterns influence your decisions and choices?	A2	16	9	21	4		23	2	18	6
2	Natural Computing:	B									
	Can binary models of natural systems help you understand computational technologies better?	B1	25	0	20	5		24	0	18	5
	Do you accept that computing systems are natural than scientific innovations?	B2	18	7	23	2		24	1	25	0
3	Bio-Inspired Ethics:	C									
	How do binary patterns in nature inform your understanding of morality and ethics?	C1	15	8	23	2		21	3	25	0
	How do binary patterns reconcile complexity and simplicity in natural systems?	C2	15	8	23	2		21	3	25	0
4	Digital Reps & Algorithms	D									

	Can digital representations enhance or diminish empathy?	D1	13	12	15	10		17	8	23	2
	How do algorithms influence our perception of truth?	D2	13	12	15	10		18	7	23	2
5	Universal Language:	E									
	Do you agree that binary patterns suggest a universal language?	E1	19	6	23	2		25	0	25	0
	Do you agree that nature has hidden codes underlying all natural phenomena?	E2	5	20	15	10		25	0	25	0
6	Technology meets Nature:	F									
	Can binary thinking influence your understanding of complex technologies?	F1	22	3	21	4		24	1	25	0
	How has technology influenced binary patterns in culture?	F2	15	4	13	12		6	19	2	23

Discussion of Findings

The location and residence of all respondents did not have significant impact on their binary cognition because 85% of respondents confirmed identifying binary patterns in nature. When presented with a list of high occurrences of NBPs. traditional beliefs scored the highest identification point while vegetation was named by 43%. It is worth mentioning however, that only 55 repondents knew that electric current (on/off) is based on NBP, 36% though electric current is analogue while the remaining 9% were not sure. Table 2 shows the complete identification points listed in the survey instrument and identification responses.

Table 2: Identification of NBPs in the immediate environment – Binary cognition

S/No.	Can you name two (2) natural binary patterns?	Response
1.	Presentation options (either/or)	42
2.	Distinctive order - black/white (no gray)	28

3.	Plants/leaves/seed arrangements - in pairs	43
4.	Electric current - on/off	55
5.	Traditional beliefs - true/false	79
6.	Description and expressions - words and opposites	36
7.	Others	05

With respect to knowledge and truth, forty-six (46) analogue natives agreed that the knowledge and application of binary patterns as seen in algorithmic flows influence their perception of truth, thereby influencing their decisions and choices; while only thirty-eight (38) digital natives, especially rural dwellers are bio-inspired ethically. It is important to know that these categories of respondents prove that there is a preformed dichotomy in the classes of their options at every chance to choose. Even when there were multiple options, they naturally saw only binary options, except they were pressed further for elaborate responses.

Figures 1 and 2 illustrate the general perception of digital and analogue natives both at separate urban and rural locations respectively. Analogue natives seem to have higher sensitivity to NBPs and align their thoughts with them as reflected in their choices being highly influenced by NBPs.

Regarding universal language, both natives agreed that when attention is given to NBPs, there is some kind of universal language that models and gives better understanding of computational technologies (92%). ANs agreed that NBPs have huge influence on their understanding of complex technologies (86%) and DNs after being shown more NBPs agreed that all natural phenomena have hidden codes which inspire scientific innovations(98%). This further showed that there are significant differences in attentional abilities, memory performance and emotional processing between DNs and ANs. Eighty-seven percent (87%) of DNs interviewed had not hitherto taken note of the interconnectedness between NBPs and technology until their attention was drawn to expression and landscapes expressly denoting NBPs.

Figure 1: Digital and analogue urban natives' sensitivity to NBP.

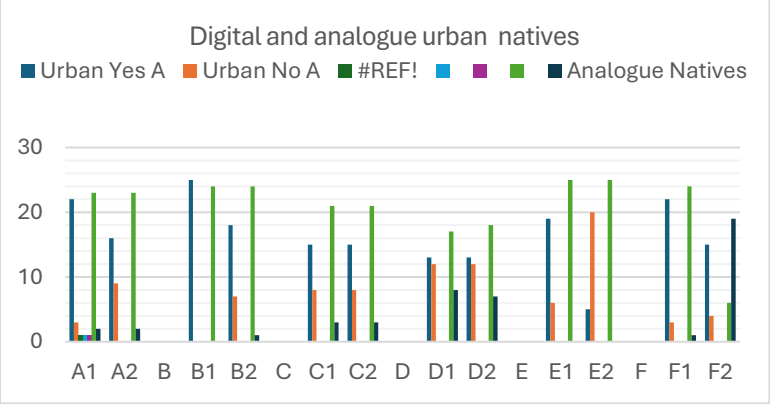
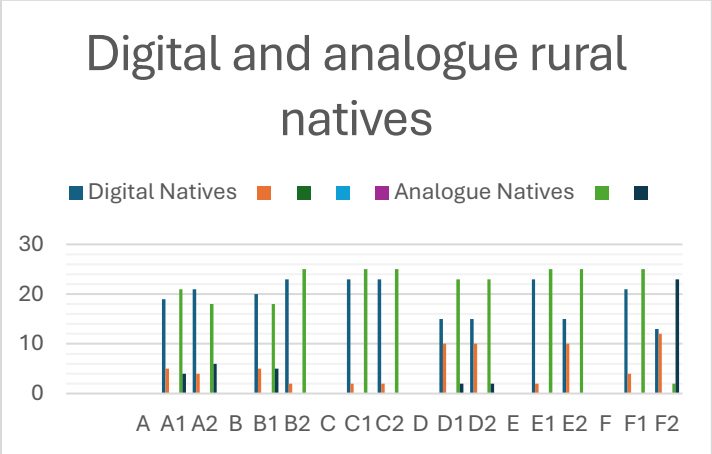


Figure 2: Digital and analogue rural natives' expressions on binary cognition and bio-ethic influence



Almost all respondents born after 2015 exhibited reduced attentional abilities with theoretical learnings but had increased cognitive load while ANs demonstrated better memory performance and emotional regulation. Eighty-two percent (82%) of DNs were willing to undertake challenging tasks as long as there were technological devices active for use but lost interest as soon as they were to do serious reflections and reasonings before making decisions.

Ninety-five percent (95%) of DNs possess and rely on an average of two ICT devices to undertake any task at home or school. This causes a heavy overload against cognitive wellbeing of youths in the digital age. It is interesting however, to find that digital representations can enhance or diminish empathy. Sixty-nine (69) respondents from both nativities agreed that binary patterns in nature deeply inform their understanding of morality and ethics.

Conclusion

The existence of NBPs should be a great pointer to reconcile complex and simple systems in our world. Analogue natives understand the natural phenomenon around them and flow with innovations easily while digital natives are pushing towards technological overload which may lead to crashes if not well managed. The older generation need to teach, train and expose the younger generation about cultural navigation and natural systems.

References

Akomolafe, D. & Yerokun, O. M. (2022). Emergence of Digital Systems through Indigenous Knowledge. Asian Journal of Pure and Applied Mathematics 4(3): 139-157, 2022; Article no.AJPAM.922.

Awati, R (2024) WhatIs – Definition Binary. TechTarget. www.computerweekly.com.

Bentley, P. (2022). How do you read binary numbers. Science Focus. www.sciencefocus.com/science/how-to-read-binary

Boashash B. and Ben-Jabeur, T. (2015). Time-Frequency Features for Pattern Recognition Using High-Resolution TFDs: A Tutorial Review. Natural Signal – ScienceDirect. www.sciencedirect.com/topics/computerscience/natural-signal

Ghulaxe, P.P. (2024): THE RUBRICS JOURNAL OF INTERDISCIPLINARY STUDIES International, Indexed and Peer Reviewed e-Journal, Vol.6 Issue 2 Pp 1326 – 1331

Olorode, O. (2016). Overcoming the Challenges of Development through Indigenous Knowledge; a Public Lecture Delivered at the Ondo State University of Science and Technology, Okitipupa, Ondo State, Nigeria. Unpublished.

Pooja, K., Dhawale, 1, Rekha, C. & Maggirwar, A. (2024). Diversity of Arbuscular Mycorrhizal Fungi and their Symbiotic Association with Salvia splendens. The Rubrics Journal Of Interdisciplinary Studies, Vol.6(2), March 2024. e-Journal www.therubrics.in.

Samuel, O.W. and Omisore, M.O. (2013). Hybrid Intelligent System for the Diagnosis of Typhoid Fever. Journal of Computer Engineering & Information Technology, Volume 2(2), 1-9.

Suhas M Pidhekar (2024): Technology Integration in Higher Education: Life Science and Technology Narendra Manwar1 and THE RUBRICS JOURNAL OF INTERDISCIPLINARY STUDIES International, Indexed and Peer Reviewed e-Journal, Vol.6 Issue 2. Pp 1304=1309. www.rubrics.com

Surhatono, D, Aditya, W. Lestari, M. and Yasin, M. (2013). Expert system in detecting coffee plant diseases. International Journal of Electrical Energy, 1(3), 156-162.

Yerokun, O.M, Owolabi, A.A., Iyawa, I.J. & Nwanze, M.N. (2022). Using Expert System for Industrial Utilization of Leguminous Crops. Computer Networks (Elsevier) Volume 216 (24) August 2022, 108798.

Yerokun, O.M. & Onyesolu, M.O. (2021): On the Development of Neuro-Fuzzy Expert System for Detection of Leghemoglobin (NFESDL) in Legumes. Journal of Digital Innovations & Contemp Res. in Science, Engineering & Technology. Vol. 9, No. 1. Pp 129-140 DOI: dx.doi.org/10.22624/AIMS/DIGITAL/V9N1P1

Yerokun, O.M. (2024). Artificial Intelligence in Indigenous Knowledge and Practices: A Comparative Analysis. The Rubrics Journal Of Interdisciplinary Studies, Vol.6(2), March 2024. e-Journal www.therubrics.in.

Yerokun, O.M., Erukpe, O.B. & Nwanze, M.N. (2024). Design of an Automated System for Synthesis of Gold Nanoparticles from Thaumatococcus Daniellii (Sweet Prayer Leaf). Science Direct (Computer Science Review) Volume 52, May 2024. https://www.sciencedirect.com/journal/computer-science-review