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Assessing the Impact of Racism on Neurodiversity based on Natural Language Processing and Artificial Intelligence

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Abstract

Neurodiversity is an observed variation of neurological features identified in humans. The study of neurodiversity starts with the ability to understand and train humans, living things, and computers to be culturally diverse without bias. Bias in any form like algorithms or human activities gives rise to racist sentiments that affect humans. Until today, there are no concise solutions to the challenges associated with neurodiversity. Racism is one of the most unexploited underline challenging factors affecting neurodiversity. This study uses keywords for natural language processing to identify four racist morphologies such as prejudice, discrimination, antagonism, and marginalization, and hashtag for artificial intelligence to extract metadata on neurodiversity. Sixteen selected morphologies associated with neurodiversity have been identified. With the help of natural language processing, each racist morphology is matched with neurodiversity to examine the impact of racism on neurodiversity. Neurodiversity Satisfactory Score (NSS) and Neurodiversity Effort Score (NES) have been developed to measure the impact of racism. The metadata and keywords use the formulae, NE/RM≤4=1, NE/RM≤8=2, NE/RM≤12=3, and NE/RM≤16=4, to generate study statistics, where NE is Neurodiversity Element and RM is Racism Morphology. Recorded NSS and NES of 2.356 and 2.356 respectively, indicate that racism impact in the study is equal but harmful to neurodiversity. The study concludes that racism is dangerous to human health and its systematic factors greatly impact neurodiversity even though the human brain has to resist the racist tendency to maintain a balance between racism and brain diversity. The study recommends that more findings should be carried out to develop more substantial factors associated with neurodiversity.

Keywords: Neurodiversity, Natural Language Processing, Artificial Intelligence, racism, neuroplasticity theory, morphology

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1. Introduction

Natural language processing is a branch of computer linguistics that studies human natural language with assisted artificial intelligence systems, software, and applications. Thanks to artificial intelligence systems, applications, and software that automate human activities, human thoughts, and feelings to provide meaningful technologies that support neurodiversity. The daily human experiences and interaction with the global happening in many different ways create a mindset of multipurpose attractions and long-term conditions. Neurodiversity is an umbrella collection or unifying themes such as depression, autism, trauma, Tourette syndrome & tics, panic disorder, dyslexia, dysgraphia, bipolar disorder, anxiety, stuttering & cluttering, obsessive-compulsive disorder, downs syndrome, learning disorder, sensory integration disorder, cultural diversity, and giftedness. Neurodiversity comprises of many umbrella themes that affect humanity in one way or the other [2]. These umbrella themes make up the difficulties associated with neurodiversity that pose a shared and growing challenge internationally and at the national level. Racism is very harmful because it digs deep into a long history of people, and this is being misunderstood and misrepresented [40]. When racism is met with human diverse nature, it turns negatively reducing the way a person revolves around activities and his or her environment, especially when the level of racist tendency is very high.

There exist inextricable links between race and language, which is a person's cultural heritage that consists of their natural language which makes up natural language processing. Natural language processing using sentiment analysis is very harmful as it doesn't hold better outcomes for a community or nation's cultural diversity. Governments use sentiment analysis to make their policies more tailored and responsive to the needs of citizens with priority targets. The growing use of social media platforms such as Facebook, Twitter, Instagram, and other social platforms are now avenues for governments to track and crack down on their citizens that don’t align with their views. Applications like natural language processing and artificial intelligence are being used by most autocrats to capture ill comments about the political situation with the use of keywords and hashtags. Artificial intelligence and natural language algorithms are highly sophisticated systems that can take a few seconds to track down any person and whatever he or she posts online with a simple hashtag and keywords. Hashtags and keywords are highly used metadata that bring the limelight to information found on search queries.

Natural language processing systems such as dialogue agents can initiate conversations with humans. The dialogue agent-based systems combine both artificial intelligence processing and the generation of natural languages with a racist tendency of blacklisting certain words [48]. The artificial intelligence systems incorporated with dialogue agents that segregate certain word types hurt certain users. The victims of this type of blacklisting words turn to develop depression which is a negative health impact. Some virtual agents that are programmed to understand particular accent, make life very difficult for overseas students, especially during interviews. A virtual machine with a well-structured artificial intelligence system software developed with British English will automatically fail a foreign interviewer who studied purely American English. One of the racist tendencies is that language variations without options for adjustments turn to tremendously depressed users.

Natural language processing vectorization demonstrates stereotypes and prejudices associated with racism [49]. There are some systems for online purchases that are built with racial tendencies with basically one language. When buyers change the language, prices also change. The same goes for artificial intelligence systems incorporated with resolution sensors that identify users' skin color. These artificial intelligence-incorporated systems are government mechanisms to automatically segregate taxes on commodities for nationals and foreigners [50]. Another natural language processing approach that nations, employers, institutions, and establishments use is name identification. In most countries with fewer engagements with cultural diversity, the system administrators turn to identify certain names from particular regions for possible exclusion in national programs. These are technological advances built to make life comfortable, but the main purpose has been hijacked by the government, institutions, and many others to fulfill racist tendencies. Institutions, workplaces, churches, healthcare services, and public and private sectors still don't have public rules to govern and punish racist attitudes. The lack of a well-spelled international law that punishes and sanctions racism has not only created challenges to the world but has created more diverse health conditions that deeply affect humanity.

1.1. Neuroplasticity theory

Neuroplasticity is a health situation that is triggered by natural and artificial stimuli arising in the internal or external environment, and they may differ in quantity and quality [1]. Neuroplasticity is the ability of the brain to metamorphose due to experience [43]. Since the brain can change due to experience, there is a high tendency that positive attributes positively influence the brain while negative attributes negatively affect the brain. The term

neuroplasticity is made up of two parts which are neuro and plasticity. Neuro refers to neurons. Neurons are nerve cells that build blocks in the brain and nervous systems. Plasticity refers to the brain's ability to change. Neuroplasticity permits nerve cells to change and adjust. About one hundred billion neurons are approximated to exist in a human brain.

Types of Neuroplasticity

Two types of Neuroplasticity exist, which are functional plasticity and structural plasticity.

Functional plasticity: This is the ability of the brain to move activities from a damaged part of the brain to the undamaged part.

Structural plasticity: This is the ability of the brain to change its physical structure due to learning outcomes. Neurons frequently used turn to develop stronger connections, and those that are rarely or never used end up dying or adjust to the developing new connections.

1.2. Neuroplasticity and Racism

Neuroplasticity is the ability of the brain to yield to changes due to the experience from within and outside the environment, while racism is the act of prejudice, discrimination, antagonism, and marginalization by humans against fellow human beings. The more humans are associated with racial tendency, they turn to develop certain neurons that negatively impacts neurodiversity.

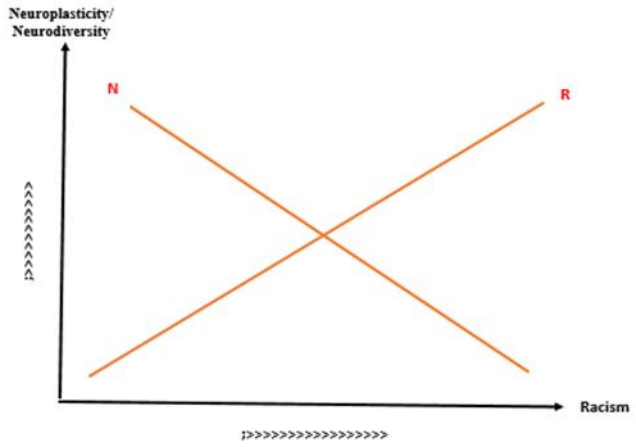

Figure 1. Neuroplasticity and Racism Relationship

Figure 1 represents an inverse curve of neuroplasticity and racist tendencies that impact neurodiversity. The greater the impact of racism on humans, the lower the neuroplasticity and neurodiversity. The lower the impact of racism on humans, the higher the neuroplasticity and neurodiversity. Positive interaction between humans turns to fosters the growth of neurons and the nervous system. Racism affects humans' brain ability to learn a new language, adjust to situations, have a cognitive impairment, have traumatic injuries, and have brain fitness. With racist tendencies, there is little or no room for self-belonging. The elements identified in this study that are associated with racism don't give room for victims to interact and associate.

1.3. Morphology

This is the study of the same language words, their structure of formation, and their relationship to other words [44]. Since humans live by way of communication and interactions, certain words turn to affect them tremendously. The types of words used, names attributed, and symbols attributed to others have an impact on their neuron cells. Since most victims of racist tendencies are usually minority, and underprivileged, there is often a probability that victims turn to hide and self-isolate themselves.

1.4. Scope of study

This study analyse racism in general terms based on a global perspective. The study's scope is limited to institutionalized, organization establishment, community, and public based perspective. The study presumes that racism exists everywhere both in white communities, black communities, developed wealth, less developed world, minority groups, amongst religious leaders, national level, and international level.

2. Literature Review

This section consists of the definition of key terms, the impact of racism, technological factors that reduce racist tendency, and the types of racisms affecting neurodiversity.

2.1. Definition of key terms

Neurodiversity: It is both an empowerment organization and a way of reflecting on disability [5]. Neurodiversity is an emerging extension of the disability rights movement to engage with those individuals who have neurological differences [6]. Neurodiversity is the associated struggle for civil rights for all those diagnosed with neurological and

neurodevelopmental disorders [7]. Neurodiversity is the recognition that difficulties experienced by autistic persons are always contextual [8].

Neuroplasticity: Neuroplasticity is the brain's ability to reorganize its structure, function, and connections [9]. Neuroplasticity describes the brain changes that occur in response to experience [10]. Neuroplasticity is linked to physical exercise-induced spatial learning and memory improvement under neurodegenerative conditions [11].

Natural language processing: It is concerned with the creation of artifacts that accomplish tasks [12]. Natural language processing is the systematic studying of human communication [13].

Artificial intelligence: It is an intelligence tool that is most applicable to engineering problems, knowledge-based systems, fuzzy logic, inductive learning, neural networks, and genetic algorithms [14]. Artificial intelligence is balanced between theory and practice, and between symbolic and numeric techniques [15].

Racism: The belief that certain human groups possess behavioral traits that correspond to inherited attributes different from others directed to the superiority of one's race [3]. Racism is related to three terms such as prejudice, discrimination, and antagonism, focusing on people of different races and ethnicity [4]. People affected by racism tend to limit their diverse skills and potential [41]. A repeated racist situation causes health imbalances that can be a result of either majority or a few themes associated with neurodiversity. The term racist may be associated with social aspects like xenophobia, segregation, nativism, supremacism, and hierarchicalism [42].

The advancements in technology have developed applications and systems that collect meaningful data in defined language using natural language processing tools [51]. Training systems and devices to transform what naturally comes out of the human brain has tremendously helped to shelter most challenges of modern-day life such as neurodiversity. Notwithstanding, computer programs such as natural language processing and artificial intelligence have and are still assisting those suffering from neurodiversity syndromes. Natural language processing and artificial intelligence-assisted programs have developed strong systems to assist persons affected with one or few of the neurodiversity issues. Even though there are assisted programs, there is still a growing challenge and higher impact of affected emerging cases associated with racism for neurodiversity [52]. Therefore, this study suggests racism be one of the rare causes of multiple growing sources of neurodiversity which has to be

fully supported with fact-finding datasets. Throughout the literature review, the definition of various umbrella themes makes up neurodiversity, and a majority of symptoms have a related cause of one or two elements identified in this study as racism. Even with the advancements in digitalization of the modern world, the literature review has shown that advanced technology will solve most of the associated causes of neurodiversity. This is to say that there are still a vast proportion of neurodiversity situations without proper access. The most developed part of the world consists of only one-fifth of the world's population while four-fifth of the world's population wallow below technological standards. The language of most applications and system design are unevenly distributed. This makes it a barrier for some underdeveloped nations to have a balanced healthcare benefit that comes alongside these applications. Some languages are not automated in this modern-day application and systems.

2.2. Impact of racism

The study identified words based on natural language processing that when in contact with racist altitude or scenario, affects neurodiversity. The impact of racism is divided into two parts negative and positive impact.

2.2.1. Negative impact of racism on neurodiversity

The following paragraphs explain the negative impact of racism on factors that support neurodiversity.

Depression and Racism: Group behavior and social structures from the governmental system, organizational systems, educational systems, medical systems, and social services towards others based on their location, belief, intelligible, skills, ability, ethnicity, minority, and color, is racism. Racism is a hindrance to cultural diversity. Racist behavior doesn't only affect our interactions, relationships, and sense of belonging but also the victim’s health [16]. Structural racism greatly contributes to the intergenerational transmission of depression [17]. Our reactions and attitudes towards others have a very dangerous impact on their health. Racism is a dangerous disease found everywhere and can be avoided if only much knowledge is known about its impact on human health. Racism can affect psychological processes within the individual and cause negative health challenges that lead to irreversible long-term effects which as depression [18]. Nowadays, elderly persons face the worst type of racism from the younger generation. This is very dangerous to their health. Racism is associated with depression [19]. This study examined racism in an indigenous population and concluded that racism leads to depression in victims.

Autism and Racism: The child-rearing process situations invite difficult conversations with inevitable impacts such as sex education, bullying, and gun violence [20]. Children turn to imitate what they observe. Most autistic victims face racism in many cases due to their natural inability to converse like any other person in society. Constant mockery and intimidation result in anger and repeated act leads to depression. People of color remain consistently under-represented in autism research, and dialogues regarding the impact of racial and ethnic discrimination on autistic persons [21]. Racism leads to inequity [22]. Many people naturally affected by autism usually face challenges in interactive activities. In schools, people with autism hardly receive an equal opportunity to answer questions in a live traditional learning classroom. Ceremonial speeches, singing competitions, and interactive talks are a few of the areas in which a person with autism faces racism.

Trauma and racism: The experience of racism is emotionally abusive and creates consequences that are traumatic [23]. Excesses of racism lead to trauma in victims. Most people mistreat others, especially family members without knowing the long-term effects. The more a person downgrades others with the sole aim to exercise control and show the influence of their power, they don't know they instead create a burden on their future spending. Perceived racism creates emotional abuse and psychological trauma [24]. The abuse of power and dominance over people with autism results in serious health challenges.

Panic disorder and racism: Perception of racial discrimination is associated with psychopathological issues that cause panic disorder [28]. Three groups from different backgrounds such as Asian Americans, Hispanic Americans, and African Americans were examined. Even though variation exists amongst the sample population, all results indicated that racism causes the panic disorder. The study that examined panic disorder in African Americans indicated a higher risk due to racist tendencies [29]. Racism prevents better engagement and association among victims. Exposing health dangers is very important to future generations. Also, a panic disorder caused by racism leads to social isolation [30]. Social isolation is very dangerous to human health as it leads to future cognitive issues.

Bipolar disorder and racism: Bipolar disorder is a health condition that provokes extreme mood swings such as emotional highs [35]. The intergenerational impact of genetic and psychological factors on Blood Pressure was examined, and the finding shows that after suggestive associated and observed genomic control, racism influences bipolar disorder [36].

Anxiety and racism: Anxiety is a feeling of unease. Racial discrimination is a risk factor for anxiety symptoms [37]. The level of racist tendencies amongst people might differ

in the way they negatively impact unease in other people. The one undeniable fact is that racism negatively impacts people and causes anxiety.

Obsessive-compulsive disorder: There is more racial discrimination uniquely related to obsessions and compulsions in people. The study [39] examined racial discrimination on a daily basis in Africa-American population.

Downs syndrome, Learning disorder, Sensory integration disorder, etc. are a few negative impacts of racism on neurodiversity.

2.2.2. Positive impact of racism on neurodiversity

This section represents some characteristics of neurodiversity that racism doesn't have a significant impact on. Also, technological advancement can prevent the prevailing impact of racism.

Tourette syndrome & tics and racism: Tourette syndrome is a highly heritable neuropsychiatric disorder. One of the most challenging things in life is to live with heritability in a society where the majority doesn't have this heritable disorder. Some communities, especially in the less developed worlds, attribute this to witchcraft and punishment for ancestral actions which is not true. The severity of racism in people who naturally burn with Tourette syndrome & tics is high [25]. People with Tourette syndrome & tics exercise obsessive-compulsive disorder more than people with no Tourette syndrome & tics [26]. Tourette syndrome is a neurobehavioral disorder in childhood having characteristics of multiple persistent motor tics [27]. Even though the majority of research is unable to identify any racial tendency associated with Tourette syndrome & tics, this study believes it is based on the author's experience with visual impairment which is inherited.

Dyslexia and racism: Dyslexia exists everywhere and is found amongst all races, cultures, gender, race, and socio-religious-economic-political group. Dyslexia is more of a disadvantage when compounded by racism [31]. This means that at a certain level especially with technological advances and the advanced age of natural language processing and artificial intelligence, Dyslexia is less of an advantage as it leads to more developmental tools. Dyslexia posts more challenging situations in males on racial discrimination and is overrepresented in special education [32]. The study said there is seldom attention to scholarly works of black males, and findings indicated in the literature review that output of empirical research and articles indicate fewer results as compared to their overrepresentation in schools against black females with dyslexia.

Dysgraphia: This is a neurological disorder associated with writing disabilities [33]. Even though the impact is less revealing when it comes to other human attributes such as creativity, intellectual ability, and other skills, the disorder features of dysgraphia become insignificant. Technology has come with much more advanced devices, applications, and systems that have greatly overcome the challenges associated with dysgraphia. Dysgraphia's consequence of racism is that minority persons are encouraged to turn their back on their own culture in favor of the majority culture [34]. This type of racism frequently occurs in traditional learning institutions where the majority of teachers are women. They mostly force young men to abandon their old method of writing and write like most girls.

Stuttering & cluttering and racism: Stuttering is someone who knows what he or she wants to say but struggles with executing speech while cluttering is someone who knows what he or she wants to say but gets derailed in the process.

Cultural diversity: Teachers' knowledgeability about the implementation of multicultural policy does vary and is positively associated with the extent of population diversity and socio-economic status [38]. This goes to say that more racism is experienced in communities, cities, states, warship houses, countries, and continents with less diverse races. The higher exposure to different people reduces the racist tendencies.

Giftedness is yet another example of positive impacts of racism on neurodiversity.

2.3. Technological factors that reduce racist tendency

Technology advances have improved the racial discrimination tendency in the following ways:

E-learning: Easy monitoring of all types of racist tendencies is possible with e-learning. Electronic learning promotes active and independent learning, efficient methods of delivering courses anywhere and at any time, and students can interact with their choice of peers from all around the world through groups and discuss privately via chats. Information on racist attitudes can be regulated or partially solved through mechanisms of e-learning [45].

Remote jobs: Remote jobs mitigate racism and other forms of oppression [46]. The study examined the role played by remote jobs on black engineering during coronavirus and results show that there is a reduction in the level of racism for remote activities. There are freedom and flexibility. Cost savings, less time consumption, peace, health, and happiness are associated with remote jobs.

Online shopping: There is more convenience in online shopping, and there's less discrimination in price allocation. It is because most racist tendencies come about when humans interact with others and portray ill comments and body gestures that show others are nothing. With the availability of online shopping, there has been a lot of comfort with shopping for minorities, persons of color, disabilities, and persons with special needs.

E-health cares: With the emergence of telehealth, a lot of people have expressed relief at their breakthrough to in-person healthcare services. Some patients in the past have declared dissatisfaction with the way health personnel interacts with them. This has been very common with women. Since the advancement in telemedicine, great satisfaction has been observed in response from women. With e-health, there is no physical interaction, and more confidence has been observed in patients' attitudes. The same goes for health personnel as many practitioners have weaknesses and a lot of rejection from certain customers based on either color or stereotype beliefs they learn. Thanks to technology that some patients now accept the same health practitioners without even knowing they were the same that they previously rejected.

E-Pharmacy: Thanks to technological advancements, physical pharmacies are now operating online. The move has tremendously helped to implement a fair balance for every customer to access certain medications. In the previous era, certain medicines were reserved for some particular set of persons such as the high class. Some countries were in the past not selling certain medicines to certain foreigners and even if they want to sell, the prices were different.

Remote delivery services: Online orders and delivery by robots and drones know no color and distinguish zones, communities, or countries. The art of segregation by humans in the past has been dropping, thanks to digital deliveries. Market segmentation was developed as a means to better understand customers, but it was derailed by some companies as a means of segregation. Remote deliveries nowadays are much better than in the past as drones can now access any zone and perform delivery services. In the past, postal mails, mailing agencies, and other companies render immediate delivery services to wealthy communities and literary do not care about poor communities. Areas that are identified as risk zones are often not visited by post agents and deliveries, for such places are often abandoned in the post offices.

Digital platforms (Zoom, MS Teams, WebEx, Skype, etc.): The upcoming of online platforms for remote meetings, conferences, seminars and other, come together has seen a rise, thanks to technological advancements. Digital platforms know no color, no race, no status, and no foundries. Thanks to these platforms, everyone can now organize, participate, and share

their views. The most important issue here is the ability of these platforms to keep track of activities, and any racist activities can be traced and duly sanctioned.

Emailing, text messaging, and chatbots: The emergence of emails replaces traditional postal mailing, the origination of text messaging reduces the gap for those who have internet access to access emails and the birth of chatbots replaces the gap between ignored replies to emails and text messages. Thanks to technology, artificially intelligent robots associated with chatbots can respond to any user at any point in time. Artificial intelligent robots always respond to every customer and user. Some companies, institutions, establishments, and government institutions have a way of ignoring emails and text messages. Artificial intelligent robots have relieved customers of this act of ignoring inquiries from most institutions.

FAQs: Frequently Asked Questions is another digital section of most platforms that have reduced the gap between service providers and customers and users of the platforms. Many users turn to understand what the company or institutions offer through frequently asked questions. The growing number of customers and their numerous inquiries have weaknesses at a rise that called a need to set up some of these questions and responses. The calls for in-person inquiries have drastically disappeared. The importance of FAQs cannot be underestimated as it has helped users obtain most of their inquiries or prior knowledge. This has helped remedy racial attitudes from some of the employers of companies.

2.4. Types of Racisms affecting neurodiversity

Political racism: It is the means of depriving indigenous peoples of their original political economies and health reservation life [47]. This is racism aimed at intimidating political opponents, and citizens with the sole aim to achieve political promises by leaders, elected officials, and heads of organizations, institutions, and establishments.

Community racism: This is racism aimed at undermining the existence, potentials, and existence of certain duelers of a tribe, state, locality, and quarter based on historical facts and their exhibition of culture.

Family racism: This is racism aimed at intimidating family members that exhibit certain qualities, characteristics, and gifts not in line with the majority belief and practices of other family members.

Institutional racism: This is racism aimed at silencing students with certain skills and knowledge not supported by their lectures, supervisors, management boards, institutions, and ministries.

Workplace racism: This is racism perpetrated by superiors and leaders to intimidate employees to yield to their demands, likes, ways of handling matters, and administrative activities.

Religious racism: This racism aims at undermining the presence of certain members coming from a background with mixed settings and limiting their desires for any future opportunities.

Individual racism is yet another type of racism affecting neurodiversity.

3. METHODOLOGY

The study uses the following to come up with the statistics examined in the results section. This section presents the stages used in the development of the study. The first step is to draft methodological architecture algorithm. Secondly, the core basic elements that interconnect all aspects of the study are identified. The steps followed are, application of natural language processing tools, identification of neurodiversity factors, and classification of racism.

3.1. Methodological Architecture Algorithm

The study uses figure 2 to obtain and search metadata for this study using digital platforms like google scholar and a host of others. This section represents the set of rules and regulations, identified computational applications relevant to the study, and puts together metadata that will help excel the study. The architecture below is carefully followed to come out with the result.

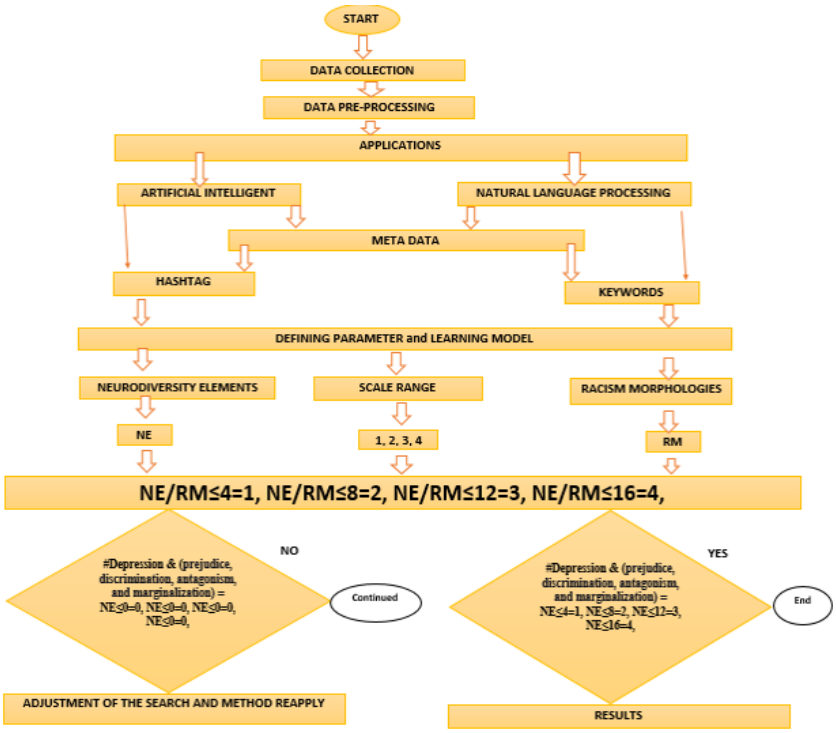

Figure 2. Architectural Algorithm

Figure 2 represents the system algorithm applied in the study. The system starts by collecting the data required for the study. The collected data goes through pre-processing. In the pre-processing, the data is identified. After preprocessing, the appropriate application of Artificial Intelligence (AI) and Natural Language Processing (NLP) is selected. To distinguish the function of the two applications, two key features are determined. Artificial intelligence focus on hashtags, and natural language processing focuses on keywords. When a distinction is made between the two applications of artificial intelligence and natural language processing, the study defines the study parameters and the learning models. The parameters and learning models focus on the sixteen neurodiversity elements {depression, autism, trauma, Tourette syndrome & tics, panic disorder, dyslexia, dysgraphia, bipolar disorder, anxiety, stuttering & cluttering, obsessive-compulsive disorder, downs syndrome, learning disorder, sensory integration disorder, cultural diversity, and giftedness}, scale range of {1, 2, 3 & 4} and racism morphologies {prejudice, discrimination, antagonism, and marginalization}. After determining the parameters and the learning model, the statistical method is applied. In the statistical method, when there is a hashtag of Neurodiversity Element (NE) with Racism Morphology (RM), if metadata shows some keywords on racism and neurodiversity, the following processes apply. When the metadata is collected, the statistical data is generated, and the formula of neurodiversity satisfactory score and neurodiversity effort score are applied.

3.2. Application of natural language processing tools

The study uses automatic summarization, predictive text evaluation, online search, documents evaluation, smart assisted AI models, language translation, and review of sentiment articles, cross-examine various chatbots, and monitoring social media comments and in-depth literature review.

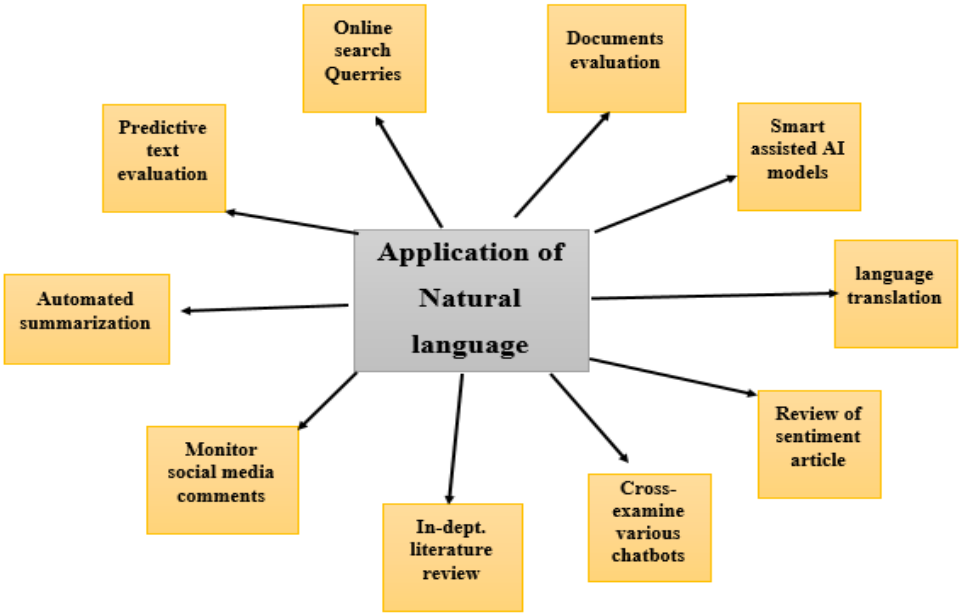

Figure 3. Application of natural language processing tools

Natural language processing tools are examined in figure 3 using the various tools above. Figure 3 is a map to help guide the search for metadata related to racism and its impact on neurodiversity. Without these tools, this study wouldn't have achieved a desired output.

3.3. Identification of neurodiversity factors

This section contains all the factors that this study identifies, that make up the term neurodiversity. Even though many factors make up the term neurodiversity, this study focuses on the following as identified prior to investigating the impact of racism on neurodiversity.

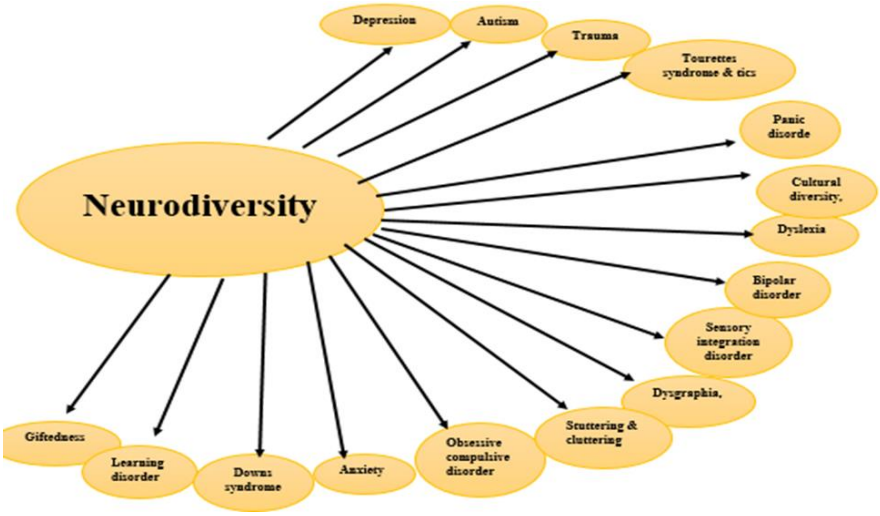

Figure 4. Identification of neurodiversity factors

Neurodiversity contains a host of factors, but this study focuses on the following umbrella themes (depression, autism, trauma, Tourette syndrome & tics, panic disorder, dyslexia, dysgraphia, bipolar disorder, anxiety, stuttering & cluttering, obsessive-compulsive disorder, downs syndrome, learning disorder, sensory integration disorder, cultural diversity, and giftedness). As indicated in figure 4, these themes are identified using automated artificial intelligence in natural language processing. The various databases visited were google scholar and other data websites like nature portfolio, IEEE, Springer, MDPI, and Elsevier.

3.4. Classification of Racism

The term racism is broken down into four parts, and the main reason is that the various terms are handled at different levels based on their impact on human psychology. The study observed that each of the terms affects humans in different forms and can't be classified as a single impact.

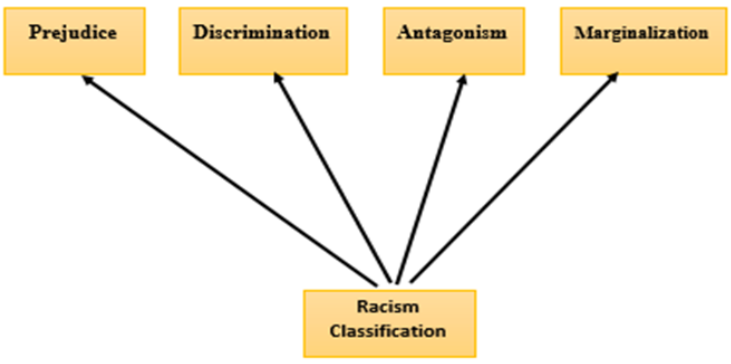

Figure 5. Classification of Racism

Figure 5 represents the four parts of natural language that when applied against each other leads to various health impact. The four parts of racism classified in this study are prejudice, discrimination, antagonism, and marginalization. Each part of the terms is matched with a single factor of neurodiversity to determine the variance based on natural language processing tools indicated in this study.

4. RESULTS

This section provides details on how the impact of racism on neurodiversity were examined and assessed, and the results were derived. The evaluation was assessed based on the observation and understanding that when more factors of racism affect neurodiversity, the higher the impact, and when less impact of racism on neurodiversity, the lower the consequences. The following paragraphs provide a step-by-step evaluation process. The study uses hashtags and keywords as part of metadata-associated algorithms of natural language processing and artificially intelligence. Within the search engines examined, each neurodiversity factors identified were a match with the morphologies of racism, and the score was determined.

4.1. Neurodiversity Satisfaction Score

Neurodiversity Satisfaction Score (NSS) is a value of associated activities or service of the human brain that interact with the daily activities or persons, that does alter or get affected by racist tendencies. The study makes use of multiple scores for different rates of racist tendency and accumulates them into an average neurodiversity satisfaction score, which tells how diverse our minds or brains are, even though living amongst people and situations that can affect them tremendously.

4.2. Calculation of Neurodiversity Satisfaction Score

On a scale of 1–4, how satisfied is a person's brain or mind evolved amongst prevalent racist situations, is the method to find out, "on a scale of 1–4, how satisfied is the neurodiversity". With the NSS question, the NSS formula below is used to calculate the mean average of all the scores.

$$\mathbf{NSS} = \frac{\mathbf{Sum\ of\ all\ scores}}{\mathbf{Sum\ of\ the\ Maximum\ Possible\ scores}} \times \mathbf{Maximum\ Score}$$

For example, the neurodiversity of the collected question is determined from a single data below and the score it gives based on the following responses is evaluated. This paper uses natural language processing and artificial intelligence techniques to come out with the details on the table based on past publications. In-depth literature and keywords search were cross-examined using neurodiversity satisfactory scores and racist indicators.

4.3. Metadata Statistical data generation approach

The following data helps to generate the statistics found in table 1. To come up with the statistic for neurodiversity satisfactory elements using racial morphologies evaluated based on obtained value for measurement range or scale range and using neurodiversity satisfactory score question, the following hashtag and keywords were used based on AI and NLP. (#depression/prejudice/discrimination/antagonism/marginalization), (#autism/prejudice/discrimination/antagonism/marginalization), (#trauma/prejudice/discrimination/antagonism/marginalization), (#tourettes syndrome & tics/prejudice/discrimination/antagonism/marginalization), (#panic disorder/prejudice/discrimination/antagonism/marginalization), (#dyslexia/prejudice/discrimination/antagonism/marginalization), (#dysgraphia/prejudice/discrimination/antagonism/marginalization), (#bipolar disorder/prejudice/discrimination/antagonism/marginalization), (#anxiety/prejudice/discrimination/antagonism/marginalization), (#stuttering & cluttering/prejudice/discrimination/antagonism/marginalization), (#obsessive-compulsive disorder/prejudice/discrimination/antagonism/marginalization), (#downs syndrome/prejudice/discrimination/antagonism/marginalization), (#learning disorder/prejudice/discrimination/antagonism/marginalization), (#sensory integration disorder/prejudice/discrimination/antagonism/marginalization), (#cultural diversity/prejudice/discrimination/antagonism/marginalization), and (#giftedness/ prejudice/discrimination/antagonism/marginalization) .

When the metadata and keywords identification were perfect, the statistics below were calculated using, NE/RM≤4=1, NE/RM≤8=2, NE/RM≤12=3, NE/RM≤16=4. For example, #Depression & (prejudice, discrimination, antagonism, and marginalization) = NE≤0=0, NE≤0=0, NE≤0=0, NE≤0=0, and #Depression & (prejudice, discrimination, antagonism, and marginalization) = NE≤16=4, NE≤16=4, NE≤16=4, NE≤12=3. This process was applied for all the identified sixteen neurodiversity elements and racism morphologies as in table 1.

Table 1. Neurodiversity satisfactory score and racist indicators

Neurodiversity satisfactory factors	Racist Indicators	Measurement range				Neurodiversity Satisfactory score Question	Neurodiversity Satisfactory Score	Maximum score
Depression	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	3	4
Autism	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	3	4
Trauma	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	4	4
Tourette syndrome & tics	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	1	4
Panic disorder	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	2	4
Cultural diversity	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	3	4
Dyslexia	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	1	4
Bipolar disorder	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	3	4
Sensory integration disorder	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	2	4

	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	3	4
Dysgraphia	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	1	4
Stuttering & cluttering	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	1	4
Obsessive compulsive disorder	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	2	4
Anxiety	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	4	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	4	4
Downs syndrome	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	1	4
Learning disorder	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	1	4
Giftedness	Prejudice	1	2	3	4	How satisfied is the neurodiversity?	2	4
	Discrimination	1	2	3	4	How satisfied is the neurodiversity?	3	4
	Antagonism	1	2	3	4	How satisfied is the neurodiversity?	1	4
	Marginalization	1	2	3	4	How satisfied is the neurodiversity?	3	4

Table 1 represents the elements of neurodiversity satisfactory score and racist indicators, neurodiversity satisfactory score questions, score range, and maximum score. These elements demonstrate how racist affects human neurodiversity and how it can be evaluated. The higher the negative impact of racism on the neurodiversity (neural network), the lower the diversity.

Table 2. Satisfaction range

NSS range	1	2	3	4
Grade	Fairly	Moderate	Costly	Very costly

Table 2 provides the possible items and a grading system to measure the level of impact on neurodiversity based on the study.

Table 3. Neurodiversity satisfactory score and maximum score

Neurodiversity satisfactory factors	**Racist Indicators**	**Neurodiversity satisfactory Score**	**Maximum score**
Depression	Prejudice	4	4
	Discrimination	4	4
	Antagonism	4	4
	Marginalization	3	4
Autism	Prejudice	3	4
	Discrimination	2	4
	Antagonism	3	4
	Marginalization	3	4
Trauma	Prejudice	4	4
	Discrimination	4	4
	Antagonism	4	4
	Marginalization	4	4
Tourette syndrome & tics	Prejudice	2	4
	Discrimination	1	4
	Antagonism	1	4
	Marginalization	1	4
Panic disorder	Prejudice	3	4
	Discrimination	3	4
	Antagonism	2	4
	Marginalization	2	4
Cultural diversity	Prejudice	3	4
	Discrimination	4	4
	Antagonism	4	4
	Marginalization	3	4
Dyslexia	Prejudice	2	4
	Discrimination	1	4
	Antagonism	1	4
	Marginalization	1	4
Bipolar disorder	Prejudice	3	4
	Discrimination	2	4
	Antagonism	2	4
	Marginalization	3	4
Sensory integration disorder	Prejudice	3	4
	Discrimination	2	4
	Antagonism	2	4
	Marginalization	3	4
Dysgraphia	Prejudice	1	4
	Discrimination	1	4
	Antagonism	1	4
	Marginalization	1	4
Stuttering & cluttering	Prejudice	1	4
	Discrimination	3	4
	Antagonism	2	4

	Marginalization	1	4
Obsessive compulsive disorder	Prejudice	3	4
	Discrimination	3	4
	Antagonism	3	4
	Marginalization	2	4
Anxiety	Prejudice	4	4
	Discrimination	4	4
	Antagonism	4	4
	Marginalization	4	4
Downs syndrome	Prejudice	1	4
	Discrimination	1	4
	Antagonism	1	4
	Marginalization	1	4
Learning disorder	Prejudice	1	4
	Discrimination	1	4
	Antagonism	1	4
	Marginalization	1	4
Giftedness	Prejudice	2	4
	Discrimination	3	4
	Antagonism	1	4
	Marginalization	3	4
Grand Total		151	256

In table 3, the total neurodiversity satisfactory score of 151 is divided by a total maximum score of 256 and then multiplied by a maximum score of 4.

After using natural language processing and artificial intelligence techniques, the following statistics were realized. An in-depth literature review helps to identify rates for each neurodiversity satisfactory score and racist indicators.

Solution:

Neurodiversity satisfactory score= 4+4+4+3+3, +, + , ……..+1+1+1+1+1+1+2+3+1+3=151
Total of maximum score= 4+4+4+4+4+4+4+4+4+, + , + , +…… ,=256
Maximum score= 4

$$\textbf{NSS core} = \frac{\textbf{Sum of all scores}}{\textbf{Sum of the Maximum Possible scores}} \times \textbf{Maximum Score}$$

$$\textbf{NSS Score} = \frac{\mathbf{151}}{\mathbf{256}} \times \mathbf{4} = \mathbf{2.36}$$

4.4. Neurodiversity Effort Score

Neurodiversity Effort Score (NES) is the rate at which a neurodiversity factor encounters a racist factor. This encounter determines the metric level of the impact and ability of the brain or mindset to continue to function. The effort score measures the effort levels at which the human brain or mindset can evolve around the different risk of racist tendencies and still achieve a satisfaction functionality.

4.5. Calculation of a Neurodiversity Effort Score

Neurodiversity Effort Score = Sum of all neurodiversity satisfaction Scores ÷ Total sum of all neurodiversity satisfaction score respondent.

Sum of all Neurodiversity Satisfaction Score=SNSS

Total Sum of all Neurodiversity Satisfaction Score Respondent=TSNSSR

$$\textbf{Neurodiversity effort Score} = \frac{\textbf{Sum of all neurodiversity satisfaction score}}{\textbf{Total sum of all neurodiversity satisfaction scores respondent}}$$

Solution:

SNSS: 4+4+4+3+3, +, ……..+1+1+1+1+1+1+1+2+3+1+3=151

TSNSSR: 4+4+4+3+3, +, +, ……..+1+1+1+1+1+1+1+2+3+1+3=64

$$\textbf{Neurodiversity effort Score} = \frac{151}{64} = 2.359$$

From the statistics, the neurodiversity satisfactory score and neurodiversity effort score are equal.

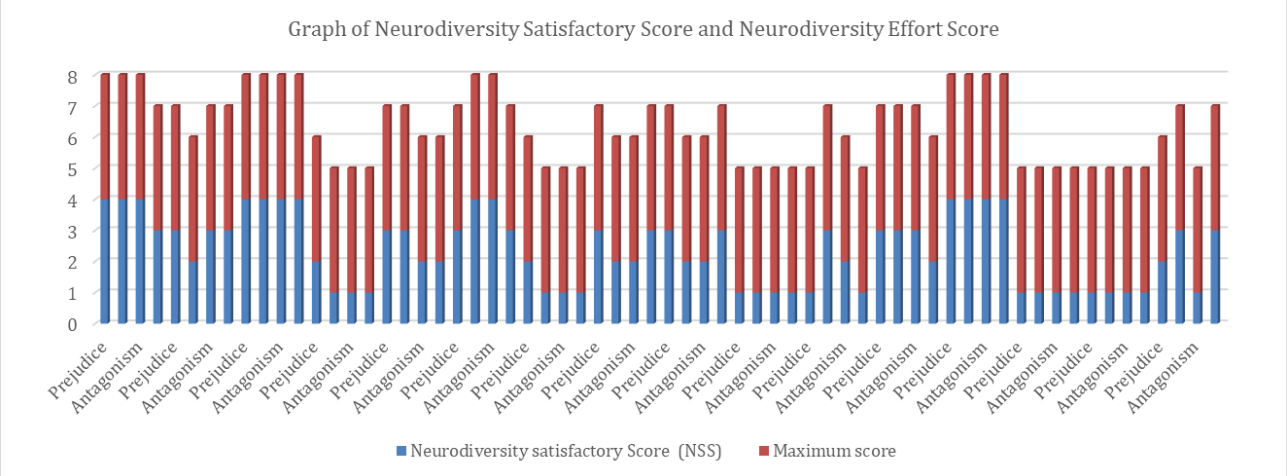

Figure 6. Neurodiversity Satisfactory Score and Neurodiversity Effort Score

Figure 6 represents the total summation for the neurodiversity satisfactory score and neurodiversity effort score, and the graph indicates that both are equal.

5. Case Study of Racism and impact on Neurodiversity

The English-speaking part of Cameroon has observed a systematic racist attitude from the Cameroon government for the past sixty years. Even though technology has not been greatly observed in Cameroon, there have been a lot of racist tactics that are directly identified as part of natural language processing at the local level. In Cameroon, certain names, identities, and persons have not enjoyed a share portion of the national freedom, existence, economic, social, religious, and political benefits because they come from one part of the country. In 2016, the English-speaking part of Cameroon declare a restoration of its independence and has been at war now for over six years. There has been international racism applied to the crisis in Cameroon as platforms like media houses, Facebook and many others that turn to ignore or block posts that relate to the crisis. There has been little coverage and acknowledgment from the majority of western countries. Many Southern Cameroons have been ignored, neglected, bullied, intimidated, and deported while seeking protection.

The only country that openly provided temporal protection and even sanction to the Cameroon government has been the United States of America. The United Kingdom which was the former colonial master of Southern Cameroon has systematically pretended that nothing is going on in Cameroon and continue to run business with the Cameroon government. The French government never left Cameroon even after independence and has never attempted a solution to the crisis, but instead block the discussion of the crisis at the United Nations. Some Cameroonians who seek protection in some western countries have weakness countless acquisitions beyond expectation compared to those levied by the Cameroon government. Some of these tendencies have left Cameroonians wandering and divested. Some and many Cameroonians from the English-speaking part have developed psychological trauma, depression, and stress that are greatly impacting their neural system.

There is no single Southern Cameroon with certainty as to when they will enjoy their national freedom, and economic, social, political, and religious rights without prejudice, discrimination, antagonism, and marginalization. It is said that no place is like home but with uncertainty. Southern Cameroonian neurodiversity has no when and where to see an end to the wandering mindset. The most amazing fact here is the application of artificial intelligence by Facebook to block posts that exposes Cameroon government crimes but expose those Cameroonians who talk against Cameroon to her government.

The neurodiversity level of Southern Cameroon is grossly affected. If there is anybody who can determine certainty in neurodiversity amongst Southern Cameroonians, then he or she

is lying because for the past six years schools have not been going on, people have been killed in their numbers, businesses have been destroyed, dreams have been shattered and hopes have become hopeless. Without education, economy's future is uncertain, and this is exactly what is prevailing in Southern Cameroon. A twitter analysis was run to evaluate the importance of twitter in exposing the evil of the Cameroon government [53]. The finding reveals very little exposure as compared to other crises found around the world. Digital platforms like twitter are the most important platform to expose serious crimes against humanity but this study doesn't understand why very limited findings could be observed.

One fact that to be considered is the lack of interest from the international community in Southern Cameroon's plight. With the lack of interest by western countries, how on earth can anyone not say that this a systematic racism of the first order in the 21st century? The media can play a big role in conflicts, but this is yet to be fully observed in the ongoing Southern Cameroon crisis in the northwest and southwest regions of Cameroons since 2016 [54]. The poor attitude towards the Southern Cameroon quest is not just a sign of bad fate from the western world but is one of the worst situations that can destroy the minds of Southern Cameroonians. This alone is helping the Cameroon government to continue undermining international laws, rule of law, international treaties, and even the importance of the United Nation. From the poor attitude of the United Nation towards the Southern Cameroon, crisis can be regarded as a bulldog that can bark but can't bite. Even though the secretary general of the United Nation, the secretary general of the commonwealth, and the Roman Catholic visit to Cameroon, there is still little attention offered to the Southern Cameroonian crisis and their request for protection abroad. Only God knows the impact of this type of racial attitude on the Anglophone crisis both at the technological perspective, organizational level, and western governance.

6. Conclusion

Based on the level of racism that impacts elements of neurodiversity and impact on human health, it is really important to create an open-source digital platform that informs the general public on the future challenges. This study concludes that racism is not all about skin color but the actions towards one another which is classified as prejudice, discrimination, antagonism, and marginalization. Neurodiversity creates enabling experiences and interactions with the world's happening that give rise to multiverse opportunities and these features turn to disappear when exposed to racist tendencies. Technology advances the togetherness with artificial intelligence and natural processing in many ways that help boost thinking, reasoning,

and interaction with multipurpose attractions, leading to long-term favorable conditions. It is important to uphold positive actions, thoughts, feelings, interactions, and beliefs that will mitigate racial tendencies. The assessment on self-developed neurodiversity satisfactory score and neurodiversity effort score which are 2.356 and 2.356 respectively, indicates that racism impact in the study is very dangerous to neurodiversity. The study concludes that racism is dangerous to human health and its systematic factors do greatly impact neurodiversity. The study recommends that more findings should be carried out to develop more substantial factors associated with neurodiversity.

Declaration Conflict of Interest

We certify that we have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. We have no financial or proprietary interests in any material discussed in this article.

Declaration of material used

All data underlying the results are available as part of the article and no additional source data are required or reserved somewhere.

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