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Epigenetic Factors Affecting Children with Autism Spectrum Disorder: Perspectives of Therapeutic Staff

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Abstract

This qualitative research endeavors the views of therapeutic staff on epigenetic factors affecting children with Autism Spectrum Disorder (ASD). Epigenetic mechanism, which includes DNA methylation, histone amendment, and non-coding RNA law, play a crucial position in gene expression and had been implicated inside the etiology of ASD. These factors are critical for growing need for intervention approaches and improving the quality of life for the segment of population with ASD. Therapeutic staff working with children and young adults who may be going through a difficult season in life in the Faisalabad city, Punjab province, Pakistan was taken as the population of the study. The group of twenty-three therapeutic had been selected purposefully as the sample of the study to discover the phenomenon.Sample selection criteria included gender (male and female), approached number (06-10 intervention providers), age range (35-40 Years), professional experience (05-10 Years), institution (academic schools/centers and hospitals/clinics), sector (public and private), and other characteristics specific to the research questions. Semi-structured interviews were conducted with twenty-three therapeutic staff including special educationists, psychologists, speech language therapists, psychotherapists, behavior therapists, and physicians. Thematic evaluation found out three most important subject matters: one) focus and knowledge of epigenetics, two) impact of epigenetic factors on ASD, and three) intervention approaches and guiding techniques. The findings highlighted the need for additionalresearch studies on the role of epigenetic factors in ASD and the significance interventions for affected individuals and their families.

Keywords: Autism spectrum disorder, epigenetics, special educationists, psychologists, speech language therapists, psychotherapists, behavior therapists, physicians.

Introduction

Autism Spectrum disorder (ASD) is a neurodevelopmental disordercharacterized by using chronic deficits in social conversation and interaction, in addition to restricted, repetitive patterns of conduct, pastimes, or activities (American Psychiatric affiliation, 2013). The superiority of ASD has been increasing, with current estimates suggesting that around 1 in fifty-four children in the United States of America are diagnosed with ASD (CDC, 2020). Even as the precise purpose of ASD is unknown, it's miles believed to end result from a complicated interplay of genetic, environmental, and epigenetic factors.

Epigenetics refers to the observance of changes in gene expression that don't contain changes to the underlying DNA sequence. Epigenetic mechanisms, such as DNA methylation, histone amendment, and non-coding RNA regulation, play a vital function in regulating gene expression and have been implicated in diverse neurodevelopmental issues, consisting of ASD (sun et al., 2016). The function of epigenetic factors in ASD is vital for growing centered interventions and enhancing outcomes for individuals with ASD.

The surroundings perform a crucial position in the development and reports of people with autism spectrum ailment (ASD). Environmental elements encompass an extensive range of influences, inclusive of prenatal, early youth, and ongoing reviews. For example, prenatal elements such as maternal stress or exposure to positive chemicals may additionally boom the threat of growing ASD. In early adolescence, environmental factors which include the great of early intervention services, get right of entry to supportive social environments, and exposure to sensory stimuli can considerably impact the improvement and nicely-being of individuals with ASD. At some point of life, the bodily, social, and sensory surroundings can both guide or preclude the functioning of individuals with ASD. Developing environments which are based, predictable, and sensory-friendly can help individuals with ASD thrive and reach their complete potential.

The improvement of ASD is complicated and involves a combination of genetic, environmental, and probable different elements whilst the exact causes of ASD are nevertheless no longer fully understood, several hazard elements had been identified. One of the maximum vast chance factors for developing ASD is having a family history of the disease. Genetic factors play a role in ASD, and siblings of individuals with ASD are at a higher hazard of additionally being recognized. Other cautious factors consist of superior parental age on the time of idea, certain prenatal exposures (along with maternal infections or medicinal drugs), and headaches during being pregnant or birth. It is important to observe that whilst those elements may additionally increase the probability of growing ASD, they do no longer guarantee that a child could be identified with the disorder. Additionally, many people with ASD do no longer have any acknowledged risk factors, highlighting the complexity of the disease's development.

Objectives of the Study

The goal of the studywas to obtain a deepen knowledge of the complicated interaction among epigenetics and the segment of population with ASD, with the objectives of investigating

the role of epigenetic mechanisms, together with DNA methylation and histone changes inside the behaviors of ASD; exploring how environmental elements can affect epigenetic approaches in children with ASD; and identifying potential biomarkers related to epigenetic modifications in children with ASD for early detection and intervention.

Review of the Related Literature

DNA Methylation

DNA methylation is a properly-studied epigenetic mechanism that entails the addition of a methyl institution to cytosine bases in DNA, usually occurring at CpG sites (regions where a cytosine nucleotide is observed with the aid of a guanine nucleotide). DNA methylation can regulate gene expression by using influencing the binding of transcription elements to DNA, thereby affecting the transcription of precise genes (Loke et al., 2015). One of the most studied epigenetic mechanisms in ASD is DNA methylation. DNA methylation involves the addition of a methyl institution to cytosine bases, commonly occurring in CpG dinucleotides (Keil&Lein., 2016).). Altered DNA methylation styles were located in people with ASD, specifically in genes associated with neurodevelopment and synaptic feature. for example, improved methylation of the promoter areas of genes concerned in neuronal signaling and synaptic plasticity has been stated in ASD individuals. Those aberrant methylation patterns can dysregulate gene expression, contributing to the pathogenesis of ASD. one of the maximum studied epigenetic mechanisms in ASD is DNA methylation (Kubota & Mochizuki., 2016; Tremblay & Jiang., 2019)). DNA methylation involves the addition of a methyl institution to cytosine bases, typically taking place in CpG dinucleotides (Siu &Weksberg., 2017). Altered DNA methylation patterns were located in people with ASD, in particular in genes related to neurodevelopment and synaptic characteristic. As an example, extended methylation of the promoter regions of genes worried in neuronal signaling and synaptic plasticity has been reported in ASD people (Zhubi et al., 2014). These aberrant methylation patterns can dysregulate gene expression, contributing to the pathogenesis of ASD.

Histone Amendment

Histones are proteins around which DNA is wrapped, forming a shape referred to as chromatin. Histone modification entails chemical alterations to histone proteins, which includes acetylation, methylation, phosphorylation, and ubiquitination (sun et al., 2016). these modifications can have an effect on the shape of chromatin, making it more or much less on hand to transcriptional machinery and as a consequence influencing gene expression. Histone modifications, along with acetylation, methylation, phosphorylation, and ubiquitination, alter chromatin shape and gene expression (Siniscalco et al., 2013). Dysregulation of histone adjustments has been implicated in ASD. For example, changes in the acetylation reputation of histones had been linked to changes inside the expression of genes involved in neuronal improvement, synaptic feature, and neurotransmitter signaling pathways (Tseng, 2022). moreover, aberrant histone methylation styles were associated with ASD-related phenotypes, influencing gene expression styles crucial for mind improvement and feature.

Non-Coding RNA (ncRNA) Regulation

Non-coding RNAs are RNA molecules that don't code for proteins however play essential regulatory roles in gene expression. Examples encompass microRNAs (miRNAs) and long non-coding RNAs (lncRNAs). Those ncRNAs can bind to target mRNAs, leading to their degradation or inhibition of translation, thereby regulating gene expression. Histone modifications, inclusive of acetylation, methylation, phosphorylation, and ubiquitination, alter chromatin shape and gene expression (Stott et al., 2023). Dysregulation of histone adjustments has been implicated in ASD. as an instance, changes within the acetylation repute of histones were linked to changes inside the expression of genes concerned in neuronal improvement, synaptic function, and neurotransmitter signaling pathways. moreover, aberrant histone methylation patterns had been related to ASD-related phenotypes, influencing gene expression styles important for brain improvement and feature.

Non-coding RNAs, together with microRNAs (miRNAs) and long non-coding RNAs (lncRNAs), are essential regulators of gene expression on the submit-transcriptional level (Schanen, 2006). Dysregulation of ncRNAs has been implicated in ASD pathogenesis. numerous research has recognized altered expression tiers of miRNAs and lncRNAs in ASD people, which can modulate the expression of genes involved in neuronal development, synaptic plasticity, and neurotransmitter signaling. Moreover, a few ncRNAs have been proven to have interaction with epigenetic machinery, similarly influencing gene expression patterns in ASD (Velmeshev, 2013). Non-coding RNAs, which include microRNAs (miRNAs) and lengthy non-coding RNAs (lncRNAs), are critical regulators of gene expression at the submit-transcriptional degree (Salloum-Asfar et al., 2021).

Environmental Impacts on Epigenetics and Autism Spectrum Disorder

Environmental elements, inclusive of exposure to pollution, stress, and maternal weight loss plan, can also impact epigenetic mechanisms and make a contribution to the improvement of ASD (Grafodatskaya et al., 2011). As an instance, maternal folic acid supplementation has been associated with adjustments in DNA methylation patterns in offspring and a discounted chance of ASD. Environmental factors, including prenatal publicity to toxins, maternal stress, and nutritional factors, can have an effect on epigenetic adjustments and boom the chance of ASD (Loke et al., 2015). These environmental impacts can adjust DNA methylation patterns, histone changes, and ncRNA expression, main to disruptions in neurodevelopmental techniques and contributing to ASD susceptibility (Mbadiwe& Millis., 2013). Environmental factors, which include prenatal exposure to toxins, maternal strain, and dietary factors, can impact epigenetic changes and boom the danger of ASD (Miyake et al., 2012). Those environmental affect and can regulate DNA methylation styles, histone adjustments, and ncRNA expression, leading to disruptions in neurodevelopmental processes and contributing to ASD susceptibility.

Capability of Therapeutic Features

Epigenetics, the qualitative research study of adjustments in gene expression without altering the underlying DNA collection, has gained big attention in expertise the complex

etiology of autism spectrum ailment (ASD). While the genetic basis of ASD is well-set up, rising proof suggests that epigenetic mechanisms play an essential function in its improvement and manifestation (Eshraghi et al., 2018).

Gene × Environment Interactions

Epigenetics, the study of modifications in gene expression without altering the underlying DNA collection, has received significant attention in knowledge the complex etiology of autism spectrum disease (Mbadiwe& Millis., 2013). While the genetic basis of ASD is properly-set up, emerging evidence shows that epigenetic mechanisms play a critical position in its improvement and manifestation. Epigenetic mechanisms mediate the complex interaction between genetic susceptibility and environmental factors in ASD (Williams & LaSalle., 2022). Gene-environment interactions can bring about long-lasting modifications in epigenetic marks, shaping individual susceptibility to ASD and influencing ailment phenotype variability (Wiśniowiecka-Kowalnik&Nowakowska, 2019).

Research Methodology

Research Design:This study employed a qualitative research to discover the views of therapeutic staff on epigenetic factors affecting children with ASD. Participants had been recruited throughpurposive sampling, and semi-dependent interviews have been performed to accumulate records. The interviews had been audio-recorded and transcribed verbatim forfurther analysis and drawing the conclusions.

Population and Selection of Sample:Therapeutic staffworking with children and young adults who may be going through a difficult season in life in the Faisalabad city, Punjab province, Pakistan wastaken as the population of the study. The group of twenty-three therapeutics had been selected purposefully as the sample of the study to discover the phenomenon (Robinson, 2014; Ritchie et al., 2013).

Selection Criteria of the Sample: Sample selection criteria included gender (male and female),approached number (06-10 intervention providers), age range (35-40 Years), professional experience (05-10 Years), institution (academic schools/centers and hospitals/clinics), sector (public and private), and other characteristics specific to the research questions.

Table 1

Description of the Sample

Therapeutic Staff	Gender	Approached Number	Age Range	Professional Experience	Institution	Sector
Special Educationists	03 Females + 04 Males	07	36-40 Years	06-08 Years	Government Special Education Centers	Public

Psychologists	03 Females + 02 Males	05	37-40 Years	05-07 Years	Government Special Education Centers	Public
Speech Language Therapists	01 Females + 01 Males	02	36-40 Years	07-10 Years	Government Special Education Centers	Public
Psychotherapist	02 Females + 02 Males	04	36-40 Years	06-09 Years	Private Clinic	Private
Behavioral Therapist	02 Females + 01 Males	03	38-40 Years	06-08 Years	Private Clinic	Private
Physicians	01 Females + 01 Males	02	37-40 Years	05-09 Years	Private Clinic	Private

Note. This table shows characteristics of the selected sample.

Research Tool: Ten open-ended questions had been designed to probe the respondents and to facilitate a deeper dialogue about the phenomenon ofthe study.

Quality Criteria: The investigators ensured quality criteria by means of credibility, transferability, dependability, and confirmability.

Credibility: The investigatorsbuilt credibility by means of triangulation, member checking, peer debriefing, saturation, and external audits.

Transferability: The investigators demonstrated transferability by means of utilizing thick description, which involved providing adequate details on the site, participants, methods and procedures used to collect data during the study.

*Dependability:*The investigators ensured dependability through an inquiry audit by an outside reviewer.

*Confirmability:*The investigators documented the procedures for checking and rechecking the data throughout the study to ensure the degree to which obtained results could be confirmed.

Procedure of the Study: Semi-structured interviews had been carried out with therapeutic staff, which turned into a valuable manner to collect qualitative statistics on their views, reports, and practices associated with working with children with ASD. The investigators observed the procedure in ten steps. Firstly, the investigators evolved a research plan outlining the motive of the study, research questions, and interview protocol. Secondly, the investigators obtained ethics approval from the Institutional Review Board. Thirdly, the investigators selectedtherapeutic staff who've reap the benefits of operating with children with ASD. Recruitment emails had been sent explaining the reason of the study and alluring them to participate. Fourthly, the investigators received knowledgeable consent from each player, explaining the motive of the study, the voluntary nature of participation, and confidentiality measures previous to the interview. Fifthly,

the investigators designed ten open-ended questions to probe the interviewees. Sixthly, the investigators evolved a semi-based interview guide with open-ended questions related to the research objectives. Questions have been considered about their reports working with children with ASD, their perceptions of effective interventions, challenges they face, and their perspectives on the position of epigenetics in ASD. Seventhly, interviews had been scheduled at a time and location convenient for participants. Interviews had been conducted in a quiet, non-public putting to make certain confidentiality. Every interview started by means of building rapport with the interviewee. Interview guide changed into used as a bendy framework, taking into consideration follow-up questions and probing to elicit distinctive responses. Interviews have been recorded with the interviewees' permission. Written notes were also organized for document keeping and similarly data analysis to attain the conclusions of the study.Lastly, the investigators then obtained confirmation of therapeutic staffs' responses for further coding process. Ninthly, the investigatorsgenerated emerging codes and theme based on the insights of child psychologists and developmental pediatricians. Tenthly, the investigatorsensured the quality criteria.

Data Analysis: Reflexive thematic analysis was used to research the interview statistics and to identify styles, subject matters, and insights from the information. The analysis process involved coding the information to perceive patterns and subject matters. Subject matters were then prepared into broader classes to increase a complete understanding of the statistics.

Results and Discussion

A six-phase method that has been developed by Braun and Clarke (2012, 2013, 2014, 2020) may help with the analysis. It assists the investigators in recognizing and addressing the crucial elements of a theme analysis. In this sense, the six-phase procedure has been recognized by Braun and Clarke (2012) as a method for doing theme analysis and teaching the technique. The investigators should be aware that although the six stages are arranged in a logical sequential sequence, the analysis is not a linear process that progresses through the phases. Instead, the study is iterative and recursive, necessitating that the investigators go back and forth between the stages as needed (Braun and Clarke 2020). The process of conducting a thematic analysis takes time and changes as the investigators moves through the various stages. This may result in fresh analyses of the data, which can need going back and revising prior stages (Braun and Clarke 2013, 2020).

Familiarization with the Data and Preliminary Notes on the Insights Derived from the Views of Therapeutic Staff (Phase One)

Views of Special Educationists:Special educationists play a critical role within the evaluation, diagnosis, and treatment of children with Autism Spectrum disease (ASD). Their recognition and know-how of epigenetics, especially as it relates to ASD, can impact their approach to running with these children and their families.Special educationists play a crucial role in supporting individuals with Autism Spectrum Disorder (ASD) and often have unique perspectives on the epigenetics of ASD. They emphasize the importance of providing individualized support and

interventions for students with ASD. They understand that early intervention can lead to better outcomes and recognize the potential role of epigenetic factors in shaping early development. They are aware of the impact of environmental factors on the development of ASD.

Views of Psychologists:Psychologists are well familiar with how these mechanisms can influence gene expression and improvement. Child psychiatrists may see epigenetics as relevant to expertise the underlying causes of ASD and the variety in symptoms among people with the disease. They may view it as a promising place of research that might result in new insights into powerful interventions. They may additionally incorporate knowledge of epigenetics into their practice whilst working with childrenwith ASD and their households. This could consist of thinking about how epigenetic elements could impact remedy results and tailoring interventions thus. They may additionally be seeking out persevering with schooling possibilities to stay informed approximately the trendy research and developments in epigenetics and ASD. They also collaborate with investigators and otherspecialists in the field to deepen their expertise of the topic.

Views of Speech Language Therapists:Speech language therapists of children with Autism Spectrum disease regularly are seeking for to recognize the complicated factors contributing to their child's condition. Epigenetics, with its role in regulating gene expression without altering the underlying DNA collection, is a topic of growing hobby and relevance inside the context of ASD. Their consciousness and information of epigenetics can offer insights into their perspectives at the disorder and capacity interventions. Many speech language therapists are privy to the time period "epigenetics" and its relevance to health and improvement. They may have encountered the term in media or discussions related to genetics and fitness. Their awareness and understanding of epigenetics can also influence their choices concerning their child's healthcare and interventions. They will be greater willing to don't forget treatments or remedies that concentrate on epigenetic mechanisms.

Views of Psychotherapists:Psychotherapists' knowledge of the unique mechanisms of epigenetics, inclusive of DNA methylation and histone change, might also vary. Some may also have a fundamental expertise, at the same time as others may be much less familiar with the technical information. They can also understand epigenetics as relevant to information the causes and potential treatments for ASD. They will see it as a promising location of research that would cause new insights and interventions. They may additionally collect statistics approximately epigenetics from a spread of assets, along with books, on-line assets, and healthcare companies. Furthermore, they will be seeking out facts from advocacy businesses and assist networks for developmental pediatricians of children with ASD.

View of Behavioral Therapists:Behavioral therapists often approach Autism Spectrum Disorder from a behavioral perspective, focusing on observable behaviors and how they can be modified or improved. However, some behavioral therapists are also interested in the role of genetics and epigenetics in ASD.

Views of Physicians:Physicians, including pediatricians, neurologists, and geneticists, often have a nuanced perspective on the epigenetics of Autism Spectrum Disorder (ASD). They acknowledge that ASD is a complex neurodevelopmental disorder with a strong genetic component. They understand that multiple genetic and epigenetic factors likely interact to contribute to the development of ASD. They emphasize the importance of genetic counseling for families of children with ASD. They recognize that understanding the genetic and epigenetic factors involved in ASD can help families make informed decisions about treatment and future planning.

Extract of Preliminary Coding (Phase Two)

The investigators extracted preliminary coding schemes. This preliminary coding was where the investigators broke down the qualitative data into discrete excerpts and created codes to label them with. Therefore, investigators established short representation that captured the salient features of the principal ideas expressed by the subjects in their responses against the open-ended questions during interviews.

Figure 1

Extract of preliminary coding

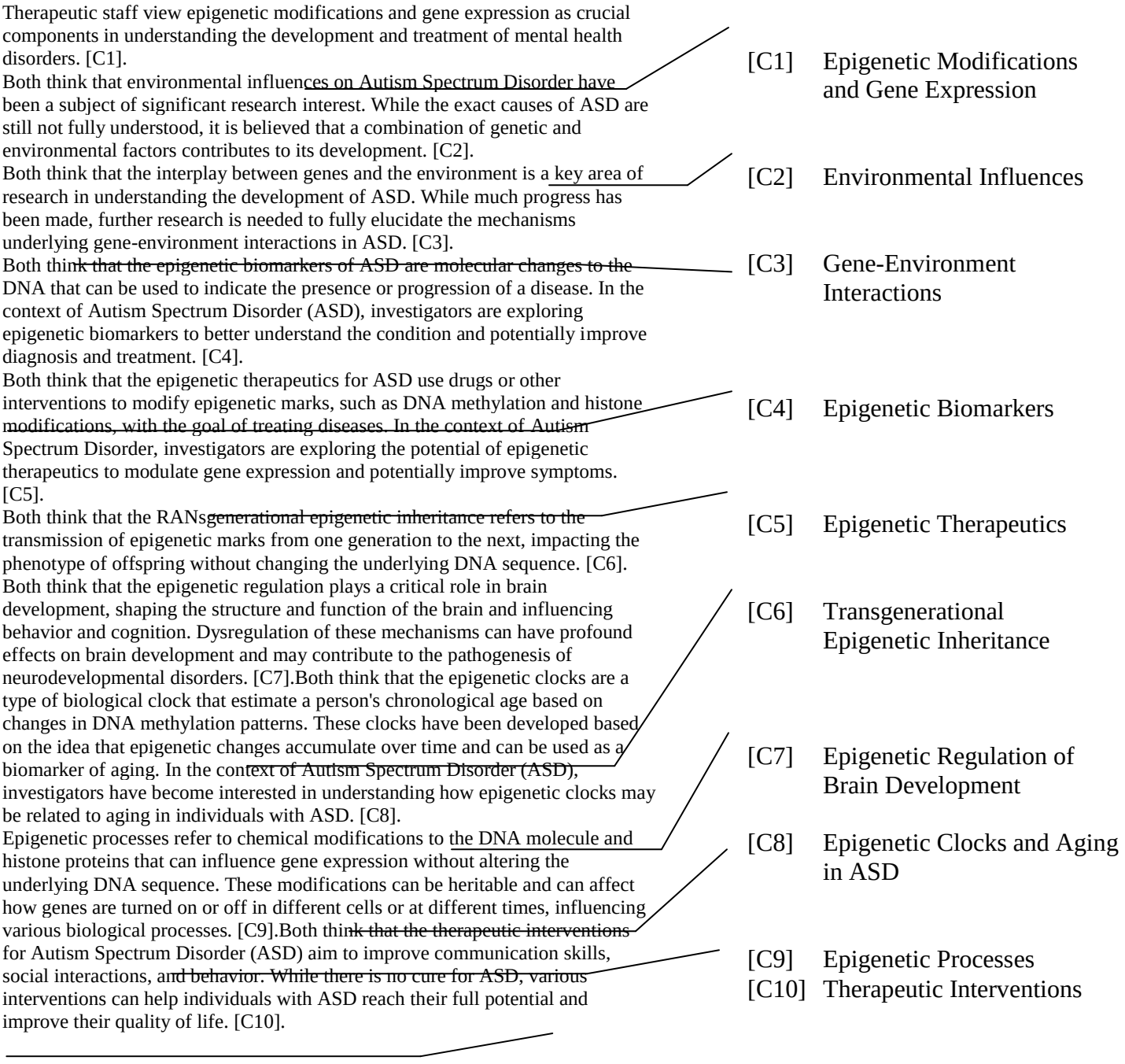

Figure 1 Extract of preliminary coding

Reviewing Coding and Description: The investigators reviewed coding which involved systematically examining the codes assigned to data during the analysis process to ensure accuracy, consistency, and reliability and later described them.

Epigenetic Modifications and Gene Expression: Discuss how epigenetic mechanisms, such as DNA methylation and histone modifications, can regulate gene expression patterns associated with ASD.

Environmental Influences: Explore how environmental factors, such as prenatal exposures and early life experiences, can interact with genetic predispositions to modify epigenetic marks and contribute to the development of ASD.

Gene-Environment Interactions: Examine the interplay between genetic susceptibility and environmental influences in the context of ASD, focusing on how epigenetic changes mediate these interactions.

Epigenetic Biomarkers: Discussed the potential use of epigenetic biomarkers for early detection, diagnosis, and prognosis of ASD, highlighting their utility in personalized medicine approaches.

Epigenetic Therapeutics: Explored emerging epigenetic-based therapies for ASD, including pharmacological agents targeting epigenetic enzymes or pathways, and their potential impact on symptom management and neurodevelopmental outcomes.

Transgenerational Epigenetic Inheritance: Considered the possibility of transgenerational epigenetic inheritance of ASD susceptibility, and its implications for understanding familial patterns and designing preventive interventions.

Epigenetic Regulation of Brain Development: Investigated how epigenetic mechanisms regulate neurodevelopmental processes critical for ASD pathogenesis, such as neuronal differentiation, synaptogenesis, and synaptic pruning.

Epigenetic Clocks and Aging in ASD: Examined the role of accelerated epigenetic aging and age-related changes in DNA methylation patterns in individuals with ASD, and its potential impact on health outcomes and lifespan.

*Epigenetic Processes:*Epigenetic processes are the chemical modifications of DNA and histone proteins that can change the structure of chromatin, the complex of DNA and proteins in the nucleus of a cell, without altering the underlying DNA sequence. These modifications can regulate gene expression by influencing the accessibility of genes to the transcriptional machinery, thereby affecting the production of proteins. These epigenetic processes are dynamic and can be influenced by various environmental factors, such as diet, stress, and exposure to toxins. Dysregulation of epigenetic mechanisms has been implicated in a wide range of diseases, including cancer, neurological disorders, and developmental disorders such as Autism Spectrum

Disorder (ASD). Understanding epigenetic processes is therefore essential for unraveling the molecular mechanisms underlying these conditions and developing targeted therapies.

Therapeutic Interventions: Therapeutic interventions targeting epigenetic factors in autism spectrum disorder (ASD) are an area of active research. Epigenetics refers to changes in gene expression that occur without alterations to the underlying DNA sequence, and these changes can be influenced by various factors, including environmental exposures and behavioral interventions. It's important to note that while these interventions show promise, more research is needed to fully understand their effects on epigenetic factors in ASD and their potential for improving outcomes in individuals with the disorder.

Ethical and Social Implications: Discussed the ethical and social implications of epigenetic research in ASD, including issues related to consent, privacy, and genetic determinism.

Future Directions and Challenges: Highlighted future research directions and challenges in the field of epigenetics and ASD, including the need for longitudinal studies, integration of multi-omics data, and translation of findings into clinical practice.

Potential Themes (Phase Three)

There are four potential themes that could be explored in the context of epigenetic factors affecting children with Autism Spectrum Disorder (ASD), based on the perspectives of therapeutic staff. These themes captured something important about the data in relation to the research purpose. It also represents a pattern or relationship across the data set.

Consciousness and Expertise of Epigenetics:Consciousness and Expertise of Epigenetics (*PT1) was explored as the first potential theme. Both therapeutic staff expressed a preferred recognition of epigenetics however had constrained know-how of its specific function in ASD. They highlighted the need for more training and schoolingon epigenetic elements in ASD.

Impact of Epigenetic Factors on ASD:Impact of Epigenetic Factors on ASD (**PT2 was) inquired as the second potential theme.Participants discussed the ability effects of epigenetic factors on the development and development of ASD. They emphasized the need for more studies to recognize the particular epigenetic mechanisms concerned in ASD.

Interventions and Aided Strategies:Interventions and Aided Strategies (***PT3) was investigated as the third potential theme**.** Participants mentioned the significance of tailored interventions and guide techniques for children with ASD. They emphasized the want for a holistic approach that considers the function of epigenetic elements in ASD.

Empowering Voices on ASD: Empowering Voices on ASD (****PT4) was inspected as the fourth potential theme. Participants advocated empowering the raised voices on ASD for inclusion and representation. They emphasized the importance of self-advocacy.

Sub-themes

Sub-themes described the different facets of the view points across the potential themes.Consciousness and expertise of epigenetics flowed four sub-themes such as instrumental role in human consciousness throughout the lifespan (*ST1PT1), environmental pollutants (**ST2PT1), psychological stress (***ST3PT1) and epigenetic adaptations. Impact of epigenetic factors on ASD generated two sub-themes such as a sibling with ASD (*ST1PT2) and certain genetic conditions, such as Down, fragile X, and Rett syndromes (**ST2PT2). Interventions and aided strategies produced two sub-themes such as actionable guidance (*ST1PT3) andProfessional growth and development on Practice-based strategies (**ST2PT4).Empowering voices on ASD raised two sub-themes such as expressing needs of ASD segment (*ST1PT4)and contributing insights on matters that affect them directly (**ST2PT4).

Table 2

Sub-themes across potential themes

Consciousness and Expertise of Epigenetics	Impact of Epigenetic Factors on ASD	Interventions and Aided Strategies
Instrumental role in human consciousness throughout the lifespan	A sibling with ASD	Actionable guidance
Environmental pollutants	Certain genetic conditions, such as Down, fragile X, and Rett syndromes	Professional growth and development on Practice-based strategies
Psychological stress		
Epigenetic adaptations		

Note. This table shows sub-themes across potential themes

**PT1 denotes for Potential Theme One, **PT2 denotes for Potential Theme Two, ***PT3 denotes for Potential Theme Three, ****PT4*

*ST1PT1 denotes sub-theme one under potential theme one, **ST2PT1 denotes sub-theme two under potential theme one, ***ST3PT1 denotes sub-theme three under potential theme one, ****ST4PT1 denotes sub-theme four under potential theme one

*ST1PT2 denotes sub-theme one under potential theme two, **ST2PT2 denotes sub-theme two under potential theme two

*ST1PT3 denotes sub-theme one under potential theme three, **ST2PT3 denotes sub-theme two under potential theme three

*ST1PT4 denotes sub-theme one under potential theme four, **ST2PT4 denotes sub-theme two under potential theme four

Figure 2

Thematic Relationship map

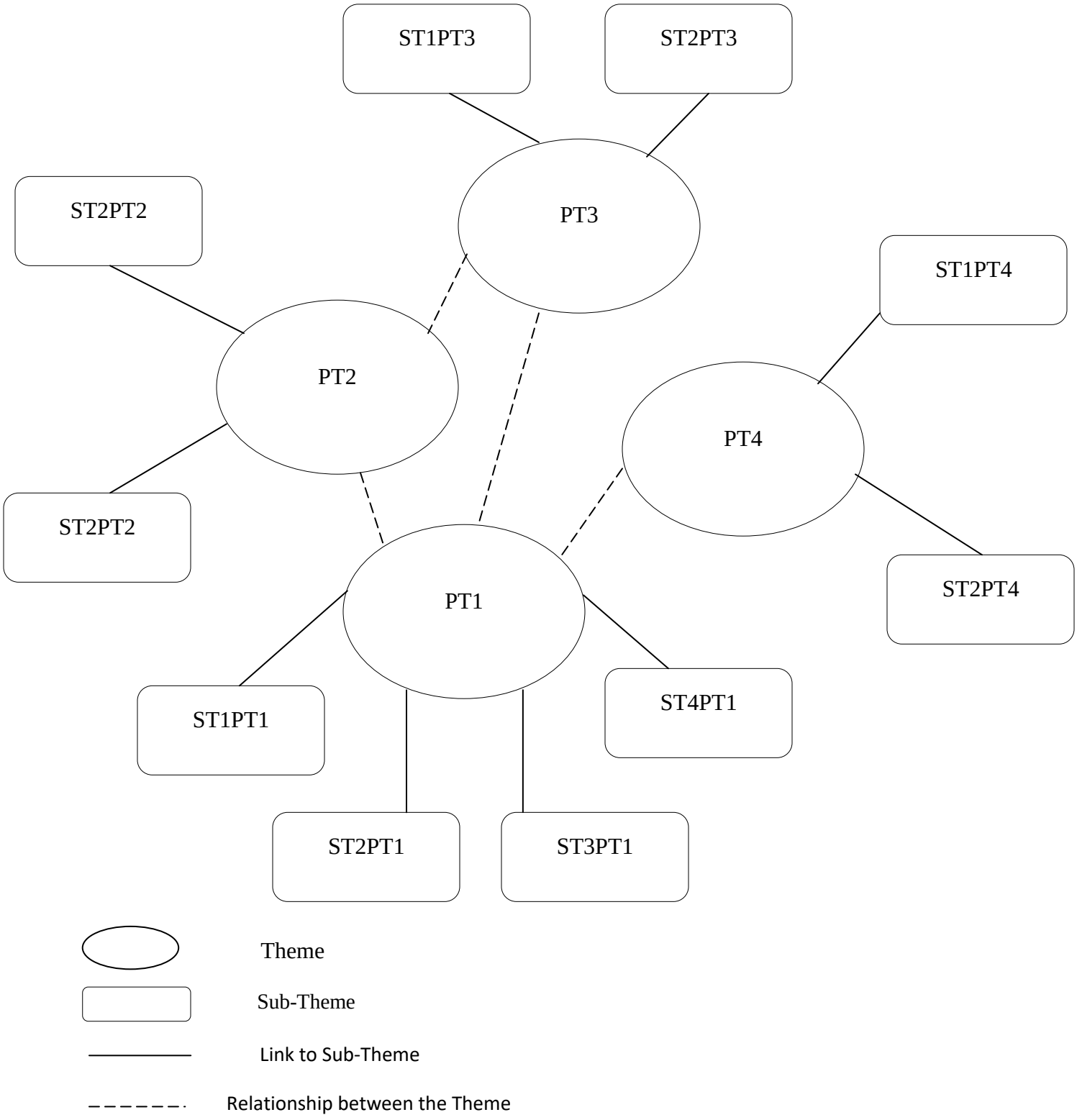
ST1PT3
ST2PT3
PT3
ST2PT2
PT2
ST1PT4
PT4
ST2PT2
PT1
ST2PT4
ST1PT1
ST4PT1
ST2PT1
ST3PT1
Theme
Sub-Theme
Link to Sub-Theme
Relationship between the Theme

Figure 2 Thematic relationship map

Reviewing Potential Themes (Phase Four)

The investigators reviewed potential themes by identifying recurring patterns or topics in the data that can provide insight into the research question or topic of interest. The investigators followed following steps to review potential themes in study to inquire the phenomenon:

Familiarize with the Data: The investigators began by thoroughly reading and familiarizing yourself with the qualitative data, such as interview transcripts, field notes, or documents. This helped understand the context and content of the data.

Generate Initial Codes: The investigators started by coding the data, which involves identifying and labeling specific pieces of data that are relevant to your research question. This was done using a coding scheme or software designed for qualitative analysis.

Identify Potential Themes: As the investigators were coding the data, looked for patterns, similarities, and connections between codes. These indicated potential themes or overarching ideas that emerge from the data.

Review and Refine Themes: Once the investigators have identified potential themes, reviewed them to ensure they accurately reflect the data and capture the essence of the information. The investigators refined the themes as needed to make them more coherent and meaningful.

Organize Themes Hierarchically: The investigators organized the themes hierarchically, with broader, overarching themes at the top and more specific sub-themes underneath. This helped to create a clear and structured framework for understanding the data.

Defining and naming Theme (Phase Five)

The investigators defined each theme clearly, describing what it represents and how it relates to the research question and gave each theme a descriptive name that captures its essence. The investigators wrote a brief description or narrative for each theme, explaining its significance and providing examples from the data to illustrate it. To ensure the trustworthiness of the themes, the investigators considered employing strategies such as member checking (seeking feedback from participants), peer debriefing (discussing findings with colleagues), and keeping an audit trail (documenting decisions and data analysis processes). Once the investigators have reviewed, refined, and organized the themes, finalize them for reporting in your research findings and ensure that the themes are well-supported by the data and contribute meaningfully to answering your research question. Lastly, the investigators considered alternative interpretations of the data and themes to ensure that the analysis is robust and comprehensive.

Producing the Report (Phase Six)

The investigatorsreported results that identified the main analytic findings.The findings of this qualitative research study highlight the want for further studies on epigenetic elements in ASD.

Even as participants were privy to the ability role of epigenetics in ASD, they expressed a need for greater schooling and schooling on the subject. Future studies should cognizance on figuring out unique epigenetic mechanisms concerned in ASD and developing centered interventions based totally on those findings. Epigenetics, in gene expression that don't contain alterations to the underlying DNA collection, has shed new mild on autism spectrum disorder (ASD) in recent years.

Advance research frequently centered on genetic elements, such as identifying precise genes associated with ASD. It became understood that ASD has a strong genetic issue, with heritability estimates around 50-90%. While environmental factors had been recognized as playing a position, the particular mechanisms were no longer properly understood. Treatment techniques had been largely behavioral, focusing on therapy and academic interventions. Epigenetics has highlighted the importance of gene-surroundings interactions in ASD development. Factors like prenatal publicity to environmental pollution, maternal stress, and nutrition can have an effect on gene expression. Research studies have diagnosed particular epigenetic modifications, inclusive of DNA methylation and histone adjustments, which might be related to ASD. Those modifications can modify gene expression styles without changing the DNA collection.The expertise of ASD has grown to be greater nuanced, spotting that it is a complex disorder prompted by a aggregate of genetic, epigenetic, and environmental elements. Epigenetic markers might also serve as ability biomarkers for early analysis and personalized treatment processes. They offer new avenues for developing centered interventions based on a man or woman's epigenetic profile. Whilst past studies on ASD focused on the whole on genetic and behavioral elements, the mixing of epigenetics has supplied a deeper knowledge of the disorder's complexity and the position of gene-surroundings interactions. Epigenetic studies open up new opportunities for greater customized and focused interventions for individuals with ASD.

In conclusion, this qualitative research has a deeper insight into the perspectives of therapeutic staff on epigenetic elements affecting children with ASD. The findings spotlighted the want for further research and education on epigenetics in ASD, in addition to the significance of tailored interventions and assist techniques for affected people and their families. Consequently, epigenetic factors play a vital role within the development of ASD. These factors and their interactions with genetic and environmental elements are vital for growing effective interventions and improving consequences for individuals with ASD. Therapeutic staffs' recognition and understanding of epigenetics can affect their method to operating with children with ASD. By staying knowledgeable about the present day research and trends on this subject, child psychiatrists can enhance their capacity to offer powerful, proof-based care for children with ASD and their families. Similarly research on this vicinity is wanted to completely elucidate the complicated interaction of epigenetic factors in ASD and to increase focused therapies based totally on those findings. Finally, the study gained a deeper understanding toexplore the range and nature of epigenetic factors and provided an insight tothe therapeutic staff with regard to lesson planning, task compliance, enhancing attention span and to understand other personality traits of the segment with ASD.

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