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REVIEW

Nature and Effects of Autobiographical Memory Issues in Persons with Autism Spectrum Disorders

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Video abstract

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Abstract: This comprehensive thematic review focuses on autobiographical memory (AM) in individuals with Autism spectrum disorder (ASD) with the overarching aim of informing and instructing stakeholders on this important memory structure that is often compromised in individuals with ASD. Accordingly, articles that best address the theme were selected from legitimate publishers with prime peer-reviewed journals. ASD is recognized as a neurodevelopmental disorder, often impacting on many aspects of language, cognitive, and social-emotional development. Considerable research has documented the problems children and adults with ASD frequently exhibit in language and its offshoots, the development of executive function, and theory of mind or the ability to reflect on the thoughts and feelings of self and others. These studies resulted in numerous assessments and intervention strategies designed to target the noted issues, among them problems with AM. Specialists in a variety of medical, psychological, and educational fields are exploring the nature and development of AM across the lifespan and the effects of AM weaknesses on cognitive and social-emotional factors such as self-regulation, social interactions, and self-identity. Researchers are reporting on the nature of AM deficits in persons with ASD and how AM deficits interact with or may explain other difficulties exhibited by these persons, but to date, little of this research has been incorporated into assessment and intervention strategies for persons with ASD. The aims of this article are to: 1. Describe the nature of AM, 2. Expound on assessments of AM, 3. Explain the effects of deficits in AMs on the personal narratives, self-regulation, and self-identity of persons with ASD, and 4. Explore intervention strategies to facilitate AM and the abilities of persons with ASD to tell coherent personal narratives.

Keywords: autism, autobiographical memory, personal narrative, identity

Introduction

Autobiographical memory (AM) abilities in typically developing children and adults are associated with psychological well-being, self-identity, and self-regulation.[1,2] Considerable research on children, adolescents, and adults with autism spectrum disorder (ASD) has documented their language, theory of mind, and executive function difficulties. Intervention programs have been developed to specifically address these issues.[3–6] This research is also demonstrating that persons with ASD have AM difficulties that affect their ability to tell coherent, personal stories, to self-regulate, and to reflect on and reason about their experiences which are essential to establishing a stable self-identity.[7,8] Although AM difficulties likely contribute to the language and social-cognitive differences and difficulties observed in persons with ASD, AM is not routinely assessed and AM difficulties are not typically a focus of intervention. This article will describe the nature of autobiographical memory, assessments of autobiographical memory, and effects of differences and difficulties in AM on the personal narratives, self-regulation, and self-identity of persons with ASD. Intervention strategies will be suggested to facilitate AM and the abilities of persons with ASD to tell coherent personal narratives.

What is Autobiographical Memory?

AM is memory for personally relevant events in one's own past. It entails our memories of the place of the experience (where did the event occur), the when of the experience in terms of both conventional time (eg, day of the week) and time

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in one's own life story (eg, in what life period the event occurred), and the emotions associated with the experience.[9] AM comprises two different but related types of memory: semantic memory (SM) and episodic memory (EM). Semantic autobiographical memory is memory for facts about one's self; episodic autobiographical memory is memory for past personally-experienced events. Remembering the names of the national parks and their geographical features in the state of Utah involves semantic memory. Remembering what happened on hikes in two of those parks and feelings associated with those events involves episodic memory.

Autobiographical EM (remembering) involves two components that differentiate it from autobiographical SM – the tie to a specific time and place, and autonoetic consciousness, the phenomenon of self-experiencing the event in reminiscing, which is termed mental time travel.[9] Autonoetic awareness or consciousness requires three characteristics: (1) a representation of self in the present; (2) a representation of self in the past; and (3) a representation that the self in the present is remembering the self in the past, ie, a representation of continuity of self over time. Autobiographical episodic memory is distinct from episodic memory in that (1) it relies on autobiographical consciousness, which emerges by the end of the preschool years; (2) it is formed within social interactions; and (3) autobiographical memories come to serve sociocultural functions of defining self and regulating emotion.

There are three different levels of autobiographical knowledge: lifetime periods, general events, and event-specific knowledge.[10] Lifetime periods, such as going to college or working at a particular job are at the highest level. The middle level holds general events, which are at a more specific level of autobiographical knowledge about repeated events or events extended over days, weeks, or month, eg, weekly soccer practice, yearly summer camp. Event-specific knowledge is vividly detailed information about individual events, often in the form of visual images and sensory-perceptual features. Common reports of specific events are likely to describe orientation events (the beginning of a path towards long-term goals), turning points (events that re-direct plans from original goals), anchoring events (events that affirm an individual's beliefs and goals) and analogous events (past events that direct behavior in the present).

When remembering, EM processes actively reconstruct an autobiographical experience by associating together different experiential details, including the perceptual and conceptual elements.[11] Sheldon et al 2016[11] propose that reconstructive autobiographical events can be represented and remembered as conceptual or perceptual experiences. Perceptual remembering is based on visual, somatosensory, spatial processing of contextualized detail. The rememberer forms images "as experienced" representations of personal events. Conceptual remembering involves an evaluation of an integrated, holistic representation of the event. Perceptual remembering is useful when one must make a decision regarding well-structured scenarios such as reproducing a script from a favorite movie or riding the school bus, but conceptual memory is valuable when one must make a decision in a novel scenario, such as how to play a game that one has not played before with unfamiliar children in an unfamiliar context.

Persons may report AMs from two types of perspectives – a field (1st person) or observer (3rd person) perspective.[12] When reporting the memory from the field perspective, the remembering person does not "see" themselves, they see the situation just as they saw it when it happened, through their own eyes. The field of view in such memories corresponds to that of the original situation. When reporting the memory from the observer perspective, the autobiographical memory is recalled from an observer position, as an outsider. The remembering person "sees" the whole situation, with themselves in it. The event is viewed from an external vantage point.

AM is essential for multiple personal and social functions – directive, social, and self-identity.[13] The *directive* function consists in using past experiences to guide present and future thoughts, actions, and behaviors, and to solve problems; the *social* function of AM makes it easier for individuals to initiate, develop, and maintain social interactions and relations through conversation, and the *self-identity* function of AM enables persons to develop a sense of continuity of themselves across time.

AM enables us to travel backward and forward in time – to engage in mental time travel. This mental time travel enables the *directive* function of AM by supporting the use of past experiences as a reference for solving current problems and a guide for our actions in the present and the future. The better our AM for past experiences, the better able we are to imagine the future – to time travel to the future. This enables us to problem-solve and to regulate our emotions and behaviors. We can imagine consequences to our actions based on past experiences and thus we are able to plan better and be more prepared. Initiating interactions and forging friendships usually involves sharing our life experiences.

Memories of these experiences promote the social function of AM. Persons with more detailed AM in which both semantic and episodic memories are integrated tell more coherent personal narratives, which contribute not only to more secure attachments with friends and family, but also to better psychological well-being. By reflecting on past experiences, we develop a sense of who we are over time – a self-identity. A stable self-identity allows for evaluation of past experiences, known as life reflection, which leads to self-insight and often self-growth. Persons with a stronger self-identity exhibit better psychological well-being.[2] By using their AM to reflect on past experiences, they can employ strategies to maintain desirable moods or alter undesirable moods.

Assessing Autobiographical Memory

There are two broad methods for assessing AM in behavioral and neuroimaging research: cuing methods to assess memory access and semi-structured interviews to assess memory experience.

Cued AM Assessment Method

The cue method requires participants to recall a past personal event in response to some cue, usually a word. The Autobiographical Memory Test (AMT)[14,15] is a commonly used cue-word technique for studying the effects of emotional disorders on AM in adults. In the AMT, persons are given cue words that are positive (eg, happy, safe, interested, successful, surprised) or negative (eg, sorry, angry, clumsy, scared, blame) in emotional valence and are asked to respond to each word with an event that the word reminds them of. They are told that the event recalled can be important or trivial and recent or from a long time ago, but that it should be a specific event, something that happened at a particular place and time and lasted for a day or less. Participants are given an example of what is meant by specific (to the word angry, it would not be okay to say "I frequently get angry with my brother", because that does not mention a particular time one was angry, but it would be okay to say "I got angry with my brother when he lost the new soccer ball Dad gave me"). The evaluator alternates presenting positive and negative words to the client. Memories are classified according to a hierarchy of AM organization: as a semantic association (low specificity – the Himalaya mountains are in Nepal), a categorical event (low specificity—travel over the winter holidays), an extended event (low specificity—two weeks in Nepal last winter), or a specific event (taking a helicopter to the Annapurna base camp in the Himalayas).

Nieto[16] developed the Autobiographical Memory Test–Preschoolers (AMT-P), an adaptation of the Autobiographical Memory Tests designed by Williams and Broadbent,[14] to use with preschoolers. The AMT-P consists of 10 words that are intended to be comprehensible for preschool-age children. Five words are positively valanced (happy, loving, be friends, share, and play), and five are negatively valanced (sad, angry, take away, argue, and hit). The words used in the original AMT reflected emotions, so researchers attempted to select words reflecting basic emotions that preschoolers would have acquired already. When administering the AMT-P, the evaluator presents the words with related pictograms, alternating the positive and negative words. After each word, the children are given the following instructions: "Think of a specific moment when you felt/were/had … and tell me what happened." They are given a minute to answer. At no point does the experimenter help the children retrieve specific memories.

Using a cuing protocol, Robinson[17] developed a Semantic Episodic Autobiographical Memory task (SEAM task) to assess the retrieval of semantic personality traits and episodic autobiographical memories in pre-adolescents/adolescents with autism. To assess SM, students were asked to generate personality traits in response to five personality cues (family, school, happy, sad and in general by considering what type of person they were in response to the cues). To assess EM, they were then they were asked to recall an episodic memory that reflected them being that type of person. If students initially produce a general memory they are prompted to recall a specific example (eg, can you think of a specific time when that happened?), with children given one prompt during memory retrieval to maximize the amount of information generated (eg, can you tell me anything else about that?). The number of personality traits produced was a measure of semantic AM knowledge; the number of specific or general memories produced was a measure of episodic AM. Specific memories were defined as an event particular to one day (eg, sixth birthday). General memories were sub-classified as either categoric or extended. Categoric memories refer to multiple occurrences of an event (eg, going to scouts). Extended memories refer to a single event that occurred over an extended period of time (eg, holiday in France).

The Autobiographical Interview

Kopelman et al[18] developed the Autobiographical Memory Interview (AMI) for adults. The AMI distinguishes between the EM and SM components of AM by conducting two separate interviews. The episodic autobiographical part of the interview asks the interviewee to describe specific incidents that occurred during given lifetime periods, such as one's first day at work. These are used by the examiner to explore episodic richness. Then the personal semantic memory interview asks general information questions about one's personal past, such as names of friends or locations of employment, from the different lifetime periods.

Piolino[19] adapted the AMI for use with children aged 7–13 years. Both the ability to recall personal information (SM) and the ability to recall personal events situated in time and space (EM) were assessed from three different periods (current school year, last school year, and previous school years). Personal information (semantic knowledge) included names of acquaintances, personally relevant names (heroes, movie/TV stars), information about school life (teachers'/friends' names, classroom characteristics) and regular activities (kinds of leisure activities, place of the activities). For the personally remembered events, children were asked to remember a specific experience that lasted less than a day and which they could relive with details and situate in time and place. Based on specificity and detail, the personal event narratives are scored 4–0:

4. Specific event (isolated, situated in time and space) with details (thoughts, emotions, images, etc.)
3. Specific event (isolated, situated in time and space) without any details
2. Generic event (repeated or continuous, situated in time and space)
1. Vague event (repeated or continuous with little detail of time or space)
0. Absence of an answer or general information

For recall of all events, sense of remembering (episodic) or sense of just knowing (semantic) was measured using the Remember/Know paradigm. Following the recall of each autobiographical event, the children indicate whether they could truly remember the event or just knew that the event had happened, by making separate Remember or Know responses for the factual content, place and date of the event (what, where and when respectively). A Remember response means that recall is accompanied by the reliving of the mental representation, whereas a Know response means that recall is just accompanied by feelings of knowing the information. Children from ages 7 to 13 performed similarly on the semantic personal information tasks. In contrast, children's scores on the remembering episodic task improved with age.

Assessment of Personal Narratives

Personal narratives are dependent on retrieval of autobiographical memories and linguistic coding of these memories. Assessment of a person's personal narratives provides insight into their AM. Because of the language demands of producing coherent personal narratives, however, one must be cautious in inferring AM abilities from personal narratives when evaluating the personal narratives of anyone with a language impairment. Assessment of personal narratives generally involves evaluation of the narrative content, specificity, and coherence.

Bliss et al[20] developed the Narrative Assessment Profile (NAP) to evaluate oral personal narratives. The NAP involves judgments on six dimensions of narrative:

1. Topic maintenance, or the relation of utterances to a central topic or theme.
2. Degree of informativeness, which refers to the completeness of a narrative
   - presentation of the essential facts of an experience
   - presentation of optional details that serve to elaborate a narrative
   - description (eg, use of adjectives or adverbs), action, and evaluation (eg, the subjective significance of an event)
3. Event sequencing – presentation of events in chronological or logical order

4. Referencing – appropriate identification of individuals, locations, features, and/or events. Inappropriate referencing occurs when pronouns are used without prior identification, when nouns are repeated where pronouns would be expected, or when erroneous pronouns are used.
5. Conjunctive cohesion – use of words or phrases for semantic or pragmatic purposes that link utterances and events, temporally or causally (eg, and, then, because, but, and so)
6. Fluency – manner of production

The degree of informativeness dimension is evaluated on a 3-point scale; the other dimensions are evaluated as yes or no.

Reese et al[21] assess three dimensions in personal narratives:

- Context: Where and when did an event being discussed take place?
- Chronology: The temporal ordering of the narrative. Can the listener infer the order in which the original actions within an event took place, either from the sequencing of these actions or from linguistic markers of temporality?
- Thematic dimension: Is the entire story on-topic and does it include a high point and a resolution, accompanied by affective and evaluative information.

Each of these dimensions is rated on a 4-point scale from 0 to 3. Table 1 provides a personal narrative system that integrates the Bliss and Reese evaluation dimensions. Preschool children include little contextual information and exhibit poor chronology in their stories. School age children, ages 6 to 8 years, provide some contextual information and better chronology in their stories. By age 8 years, children can reliably assess when two events occurred in relationships to each other and by 10–12 years, they can use calendar time to sequence events.[22] Adolescents begin to exhibit thematic coherence in their stories. They connect disparate experiences together through underlying thematic connections. They connect overarching causal-motivational themes to describe how and why certain events happened as they did, creating links in a life timeline.[23]

Autobiographical Memory in Persons with Autism

AM and Narratives

The content of AM and its retrieval will determine the detail and coherence in the personal narratives people tell. The majority of studies of narrative language in persons with ASD have focused on their telling of fictional stories. Although some persons with ASD tell coherent fictional narratives, a number of studies report that children with ASD produce impoverished narratives in terms of structural measures such as length and complexity of syntax,[24] evaluative measures such as the use of mental state language and causal statements,[24,25] pragmatic measures,[26,27] and coherence.[26] Other studies have shown that, when carefully matched on language ability, many of the differences between the groups with ASD and comparison groups disappear.[27,28] Telling a story using a picture book is a very different task from that of talking about an event which has been experienced personally. A personal event requires the narrator to remember and organize information. Information for personal narratives is retrieved from EM and this may be impaired in individuals with ASD.[29,30] This deficit in EM results in personal narratives that are noticeably less detailed than fictional narratives.[31] Individuals with autism tend to tell less coherent personal narratives[32] and exhibit difficulties in identifying and describing their own emotions.[33]

Individuals with ASD typically have impaired AM. They have frequently been reported to have difficulties recalling past events of their lives. Studies show that individuals with ASD tend to recall significantly fewer autobiographical memories and take longer to do so than a control group. Children and adults with ASD produce fewer specific memories, characterized by reduced specificity, elaboration, and episodic coherence. Although the SM of persons with ASD may be preserved and even superior, they consistently report fewer, less detailed EMs.[34,35] Their EMs rarely contain specific time/place/event/mental state references or points of personal significance. The content of these memories is also more semantic (eg, general or repeated event) than episodic.[36–40] Furthermore, in their autobiographical memories, persons with ASD may show reduced memory for self-performed actions compared to the actions performed by others,[41,42] and

Table 1 Criteria for Evaluating Coherence in Personal Narratives

	Context Time/Place	**Chronology Temporal Coherence**	**Causal Coherence**	**Precursors to Thematic Coherence**		
Score		Event Sequencing	Causal Links	Reference	Informativeness	Topic Maintenance
0	No information of time or place	List actions, no temporal order	No causal links	No clear referencing (place, people, features, events)	Incomplete facts of experience	Substantially off topic
1	Mention of time **OR** place	<1/2 of actions in a timeline	Inferred causal links or unclear causal links	Some clear referencing; but much unclear referencing	Limited facts of experience	Identifiable topic; causal links implied or unclear
2	Both time and place mentioned but only one specific	50–75% of actions in timeline	1–2 explicit causal links	Clear referencing	Essential facts of experience; may include irrelevant facts	Identifiable topic, 1–2 explicit, clear causal links OR report of feelings
3	Specific time and place	75%+ of relevant actions in timeline	At least 3 clear, explicit causal links; but may also include some unclear causal links	Clear referencing and elaborations with details	Essential facts; all or nearly all relevant	Substantial topic; 3 or more causal links and report of feelings
4			At least 3 clear causal links; no unclear causal links		Essential relevant facts of experience with details	Causal links and interpretations with autobiographical reasoning/ linking to other experiences
5					Relevant facts, details and evaluation of event	

are more likely to take an observer perspective than a first-person perspective.[43] Adults with ASD have exhibited minimal skills in describing how they felt about events in their lives (which is central to EM) and in reaching a conclusion or evaluation of the events, even when they were proficient in these same skills when retelling a fictional story.[44]

Other researchers have also noted that persons with high-functioning ASD have greater difficulty with causal cohesion in personal than fictional narratives with particular difficulty giving causal explanations for emotions.[45] EM is central to the ability to tell a coherent personal narrative which, in turn, is linked to an individual's sense of purpose and meaning surrounding a narrated event, one's psychological well-being more generally, and one's self-regulation.[46] Because of the reduced use of EMs in social and intrapersonal judgments, children and adolescents with ASD may fail to fully develop an interpersonal and narrative self.[47] Individuals with ASD are likely to have a reduced ability to use self-relevant cues to access episodic autobiographical memories and as a result they experience difficulty in the sense of self to organize memory retrieval to tell coherent personal narratives.[48]

AM, Mental Time Travel, and Self-Regulation

Personal narratives of individual events are the foundation for episodic autobiographical memory, which involves mental time travel (MTT) that enables both memory for oneself in the past as well as well as being able to conceive of oneself in the future.[49–51] EM (remembering past experiences) and episodic future thinking (EFT; imagining future experiences) rely on the same underlying neuro-cognitive system. MTT enables persons to learn from their past – to learn what to avoid and how to behave in the future. Individuals who generate past memories and future images with greater specificity exhibit greater social problem-solving.[52] Children with EFT can better predict both future mechanical behaviors (eg, which size ball could roll through several tubes) and future self-based behaviors (in what order will the child put on parts of a costume).[53]

Researchers have explored the ability of persons with ASD to engage in future mental time travel (FMT), that is, to imagine potential future scenarios, which involves AM.[54–56] Children and adults with ASD tend to exhibit attenuation of episodic foresight similar to their patterns in EM.[43,55,57–60] Children with ASD often exhibit difficulties with EFT when predicting both future mechanical and self-behaviors, with greater difficulties in predicting future self-behaviors than mechanical behaviors.[53,58] Problems in MTT in persons with ASD have been linked with their behavioral inflexibility.[53,56] If one cannot imagine alternative choices and behaviors, one continues to do what one has always done. Reduced AM specificity can interfere with social behaviors.

Both EM and EFT rest on the capacity for mental scene construction, the ability to generate an integrated, coherent, multimodal spatial representation of the event.[61] Scene construction involves the binding of multiple elements of an imagined scene, such as feelings, thoughts, people, and objects.[62] Persons with ASD are likely to experience difficulty with scene construction which relies on visual imagery to mentally assemble the objective and subjective details of the experience. Difficulties with scene construction are sometimes referred to as weak central coherence, a specific perceptual-cognitive style described as a limited ability to integrate details to understand context or to "see the big picture".[63] Compared to typically developing adolescents, adolescents with ASD are likely to construct less specific descriptions when asked to imagine two events that may happen to them in the course of the next year and two events that may happen to their best friend in the course of the next year. Furthermore, Ciaramelli et al 2018[57] noted that the past and future constructed experiences of adolescents with ASD had a reduced episodic quality because the students focused on external actions and included few internal state details. In contrast, past and future constructions of TD students included more internal than external details. If persons have problems in MTT and associated scene constructions, they lack the foundations for self-regulation. Effective self-regulation requires the ability to reflect on and evaluate one's past behavior and envision possibilities for how to act in the future.

AM and Self-Identity

AM, as reflected in personal narratives, plays an important function in development of self-understanding and self-identity. Our sense of self is intricately linked to our memories of our personal experiences; what happened, how we understand and interpret these experiences and how we link them together into a coherent narrative of how I became the person I am.[1,23,64] The development of personal episodic memories depends on the existence of autonoetic awareness – the ability to experience the self, to construct a self from reflections on one's experiences, and to recognize oneself as an agent in the process of memory retrieval. Powell and Jordan[65] suggested that individuals with autism may be aware of what was happening, but not aware that it was happening to them – they do not have a sense of themselves in the narrative.

AM requires a subjective self-reflective consciousness that enables persons to place themselves in temporal and cultural contexts and to evaluate and interpret their past and future behavior. Using AM to time travel enables us to see ourselves in the past, the present, and the future. The relationships between AM mental time travel and self-identity are reciprocal. In reflecting on ourselves over time, we develop a sense of identity; and our sense of identity influences how we see ourselves across time. Self-identity is associated with psychological well-being. Self-identity is typically stabilized in adolescence. Development of self-identity requires that the SM and EM aspects of AM be integrated. In addition to common knowledge of time, place, and people, semantic aspects of AM include awareness of one's physical and psychological traits. Integrating trait knowledge into episodic memories promotes insight into how the behaviors and emotions of EM are influenced by the traits and how EM behaviors and emotions influence psychological traits.

The semantic knowledge of TD adolescents moves beyond descriptions of their physical self (eg, gender, height, hair/eye color; smart dresser) to descriptions of their psychological self (eg, persistent, timid, compassionate). During later childhood and adolescence, youth begin to organize their autobiographical memories temporally and causally into life stories influenced by their physical and psychological traits. They engage in autobiographical reasoning, a process of self-reflective thinking or talking about the personal past that involves forming links between the elements of one's life and the self in an attempt to relate one's personal past and present. They are going beyond autobiographical remembering by creating coherence between events and the self.[66] Autonoetic consciousness is essential for development of self-identity. Autonoetic awareness of one's AM requires at least three capabilities: (1) A capacity for self-reflection; that is, the ability to reflect on my own mental states; (2) A sense of personal agency; that is, the belief that I am the cause of my thoughts and actions and the feeling that my thoughts and acts belong to me; 3. The ability to think about time as an unfolding of personal happenings centered about the self.[67]

Compared to TD persons, adolescents and adults with ASD appear to gain less personal meaning and insight from AMs that should be self-defining, and as a consequence, they have a less stable sense of self.[68] Although, in general, persons with ASD have better SM than EM, they exhibit reduced SM, particularly regarding awareness of their psychological traits. Robinson et al 2017[17] asked 11 to 18 year-olds to generate personality traits by considering what kind of person they were in response to a cue (family, school, happy, sad, in general). The researchers reported that compared to TD controls, young people with ASD generally gave significantly fewer personality traits and, unlike TD students, there was not a relationship between their semantic traits and episodic memories. The students with ASD less frequently used episodic memories to define themselves. They had weak connections between experiences and self-understanding. This may result in a less stable self-identity due to a failure to explicitly recognize the relevance of past experiences. Although students with ASD are likely to have a reduced identification with self-defining memories, these memories nevertheless exert an influence on their self-esteem – self-esteem was lower in the ASD group compared to the typical students. Goddard et al[68] reported that adolescents with ASD tended to have a bias towards negative memories; controls toward positive memories. Lower global self-esteem was linked to a propensity towards negative self-defining memories. Positive self-esteem requires positive past images. Developing a strong and stable concept of self is implicated in self-regulation and a prerequisite for understanding others and for developing good social skills.[69]

Deficits in theory of mind (ToM) are a hallmark characteristic of autism.[3] ToM and AM are intertwined.[47,70] The autonoetic awareness aspect of AM, which is essential for construction of a self-identity, is an aspect of self-related or intrapersonal ToM - the ability to recognize and reflect on one's own thoughts and emotions. AMs tell us about who we are as an individual that is consistent over time. There is considerable evidence of interpersonal or other-related ToM impairments in autism, that is the recognition and interpretation of the thoughts and feelings of others. In contrast, however, there is less research addressing intrapersonal or self-related ToM impairments.[71] AM and intrapersonal ToM are reciprocal, each critical for the development of the other. ToM is essential for the three components of autonoetic awareness in AM – an awareness that in the present, one is remembering, as distinct from knowing or imagining; an awareness of that the present self is recalling a past self; linking the present self as rememberer with the previous self as experiencer to connect the previous event as something that happened to the current self. ToM is not activated if the scene construction of AM is not present; but the constructed scene cannot be interpreted without ToM.

Interventions

Interventions for AM difficulties address three types of objectives: (1) strategies to facilitate development of AM; (2) strategies to facilitate retrieval of AM; and (3) strategies to promote autobiographical reasoning.

Reminiscing for AM and Personal Narrative Development

There is a reciprocal relationship between the quality of persons' personal narratives and their AM – detailed, coherent AM provides the basis for detailed, coherent personal narratives and sharing coherent personal narratives develops better AM. Children who experience more elaborative reminiscing with caregivers have more specific, detailed, accurate, and sophisticated autobiographical memories.[72,73] Even when child characteristics (eg, language level, temperament, attachment status) and sociocultural variation are accounted for, caregiver reminiscing style uniquely predicts children's

autobiographic memories. Mothers of children with ASD tend to engage in less elaborative reminiscing than mothers of typically developing children. They are likely to produce more direct questions, corrections, unrelated turns, and closed-ended off-topic utterances than mothers of typically developing children.[40,74]

Several researchers have recommended that adults engage in elaborative reminiscing with children and adults with ASD to promote AM and development of personal coherent narratives.[75,76] Prelock and Hutchins[76] suggested that parents use a "social story" framework when reminiscing with children with ASD:

- Identify an event for which the child is likely to have some recollection.
- Look for a recent personally experienced event that has a positive high point. Choose an event that involves the person's interests and strengths. If possible, observe a targeted situation (that can later be used in an EM story) and consider that experience from the child's subjective perspective.
- Consider the child's language level to formulate and write the story. Use subjective, evaluative statements. Consider supporting the story with drawings or photos.
- Have the child tell the story to you. Revise the story as necessary to enhance clarity.
- Share the written story with parents and teachers with strategies for eliciting and guiding the story from the child.
- As the child becomes better at comprehending and sharing the story, adapt or expand it. For example, if telling a story about playing on the playground, adapt by highlighting different activities the child may have engaged in, eg, sliding, swinging, playing soccer.

McCabe et al 2017[75] trained parents of adolescents/young adults with ASD in strategies to reminisce with their sons and daughters as a way to increase the quality of their personal narrative skills. Parents rated their sons' and daughters' narrative skills before and after training. Training involved explaining to parents the types of interactions that promote narrative skills and instructions for how to reminisce:

Talk to your son/daughter frequently and consistently about past experiences;

1. Spend a lot of time talking about each topic and give your child sufficient time to respond; Give them plenty of time to respond, do not rush them;
2. Be sure to always ask your son/daughter to describe how he or she felt about an experience;
3. Ask many wh- questions and few "yes/no" questions about the context or setting of the events, especially where and when they took place;
4. Encourage your son/daughter to say more than one sentence at a time by using backchannel responses (uh-huh, oh) or repeating what your son/daughter has just said;
5. Follow your son/daughter's lead by talking about what they want to talk about;
6. Avoid questions that derail the narrative from your son/daughter's interests.

Compared to parents who were not part of the training, parents who participated in the training provided more elaborations when reminiscing with their children and reported their children's narrative skills significantly improved at the end of the study.

Visual Supports for AM Retrieval

Clinicians and researchers recognize that persons with ASD often exhibit difficulties on tasks requiring autobiographical memories. There is evidence that some of these difficulties with AM involve retrieval difficulties, rather than exclusively a deficit in storage of AM.[77] Retrieval of AMs requires scene construction, which is the process of mentally generating and binding together the who, what, where, when elements of a scene in mind.[62] Several researchers have recommended interventions employ visual cues to trigger AM scene construction.[76–78] Anger et al[77] asked 10–18 year old typically developing (TD) students and students with ASD to produce descriptions of memories with as many details as possible, focusing on the past (one event that happened yesterday and one last summer vacation) and the future (ie, one event that could happen tomorrow and one next summer vacation). If children did not respond after 1 minute, they were given

a verbal prompt, and if they still did not respond, they were given a visual cue. Visual cues were provided for detailing personal events, contents and perceptions (ie, colors, smells, tactile feelings, sounds, tastes). Contents could refer to temporal situations, spatial locations (eg, home, school, beach, etc.), modes of transport (eg, car, plane, train, etc.), activities (eg, video games, football, musical instrument, etc.) and people present (eg, parents, children, etc.). In addition, five types of perceptions were illustrated with drawings. For example, colors were associated with a color chart; smells were indicated with a trash can or a flower; sounds with a musical note or bell; tastes with a lemon or a sweet; and tactile feelings with a finger placed on a pillow (mushy) or on ice (cold). Results showed that the ASD group performed more poorly than TD students on free recall for recent periods, but performed more similarly to them when provided with visual cues. It should be noted that although the students with ASD were successful in recalling more episodic features with the visual cues, they exhibited difficulty in integrating these details together to generate a feeling of reliving the experience.

Research on AM indicates that some persons experience a disconnection between SM and EM.[79] Many persons with ASD exhibit better semantic memories that are not well-linked to episodic memories. Westby[80] recommends using questions and icons matched to semantic and episodic components of AM to facilitate integrated retrieval of these two AM components. See Figure 1.

Developing Autonoetic Awareness of Psychological Traits

By adolescence, the coherence of personal narratives people produce is related to their autobiographical reasoning – the process of self-reflective thinking or talking about the personal past that involves forming links between the elements of one's life and the self in an attempt to relate one's personal past and present.[66] Autobiographical reasoning requires that persons have a sense of themselves – a self-identity/self-concept, which is based on perception of one's physical and psychology traits (eg, strong, compassionate, persistent, procrastinator, clumsy, etc.). They must be able to identify cause-effect relationships between events and their physical and psychological traits. Students with ASD are highly likely to have limited trait term vocabulary, limited awareness of their own psychological traits, and difficulty recognizing and explaining cause-effect relationships between their traits and their actions.[17,47,81]

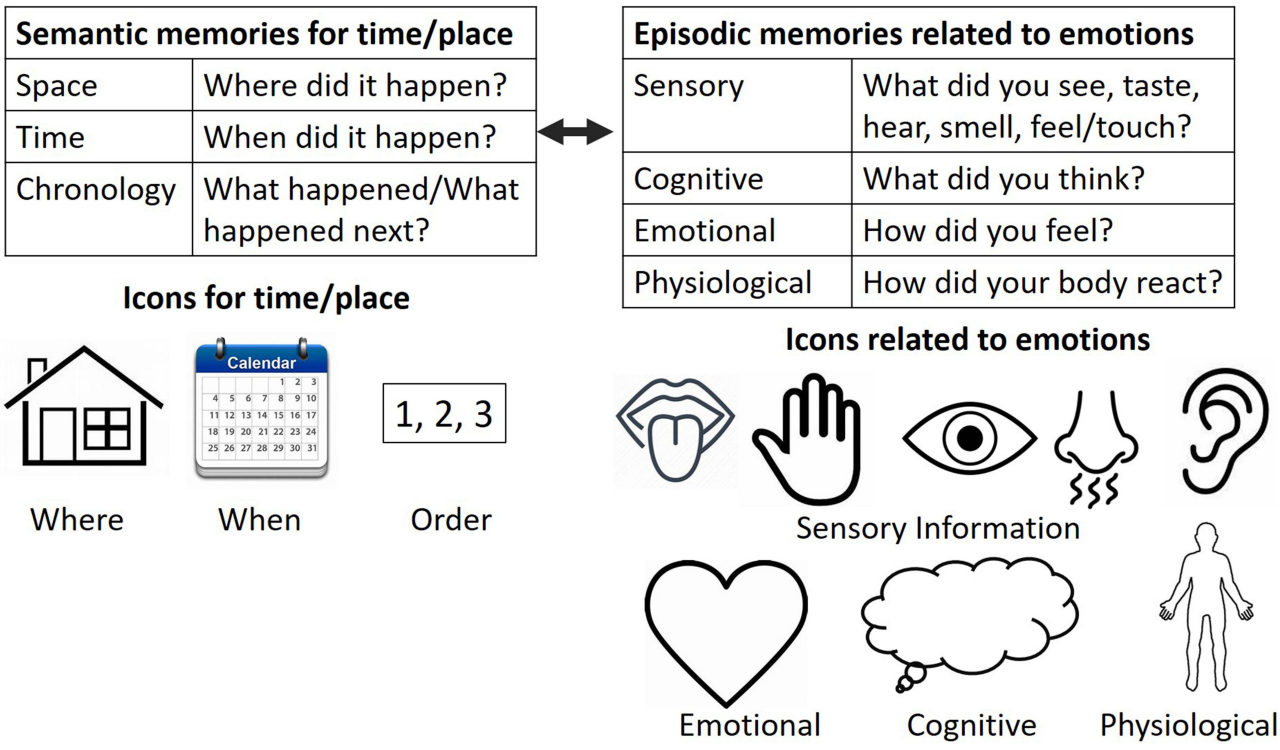

Figure 1 Questions and icons to elicit semantic and episodic autobiographical memories.

Researchers have sought to assess adolescents' awareness of their personality traits in several ways. Some have asked adolescents to complete the Twenty Statements Test (TST).[47] The TST asks the question "Who am I?" and the individual responds with twenty statements about themself. Each individual response shows how that child perceives oneself and their social environment in different ways. Students are asked to fill out each of the twenty numbered lines with a statement beginning with "I am." Some examples are given to the students such as I am Catholic, Protestant, a happy person, or a pretty person. Robinson et al 2017[17] asked adolescents to generate personality traits in response to cues (family, school, happy, sad and in general). "What type of person are you when you are with your family?" When you are at school? In general?.

Students with ASD often lack the necessary language and vocabulary for these tasks or find the tasks too abstract. Griffo et al 2021[81] developed the My Multiple Selves (MMS) trait assessment that leads respondents to systematically explore who they are. They propose a set of probes to get students to think about their traits. For example, persons are asked to think about:

- Persons who have influenced them, who are role models for them, who they like being around, who may be a part of their self-concept
- Roles they have at home, school, work, in sports, recreational activities, community activities
- Three things they are really very good at and three things they are really lousy at
- Five things they really like to do
- What they are like on the inside—their personality, attitudes, values, philosophy of life, feelings
- Their physical self - what they do to their body (eg, grooming, exercising) and put on it (eg, clothing). Do they have concerns about how their body looks or how it works?
- Their less desirable side: Taking into consideration all aspect of their life (school, personal and family relationships, work, etc.), list up to five components of yourself that you are not happy with, not proud of, or would like to change
- Their personal background that is important to their sense of themselves – race, ethnicity, gender, age, grade, social class, where they live/have lived
- Aspects of their current situation that provides important aspects of their sense of self

Adolescents can be supported in developing self-reflective thinking by learning vocabulary for physical and psychological traits by recognizing these traits in characters/persons in books, and making connections between the book characters' traits and their own traits. Based on the book, *Manya's Dream: A Story of Marie Curie*,[82] Table 2 displays

Table 2 Curie's Psychological Traits with Evidence from Supporting Text

Trait	Evidence
Resilient/adaptable	Family moved many times; spoke multiple languages; continued science work when husband killed
Insightful	Knew what to say and what not to say to Russians so she did not get herself or her family in trouble
Independent	Moved to Paris alone so she could study
Determined	As a child she decided to study science; never lost that goal; planned how she could earn money and move to Paris; followed through on her plan
Industrious/tireless/ conscientious	She worked long hours, under poor conditions, for hours each day, for many years
Brilliant	She was the first woman to teach science at Sorbonne University. She won two Nobel Prizes and won them in different fields
Compassionate/brave/ courageous	She x-rayed injured soldiers on the front lines of the war; saved countless lives
Patriotic/loyal	Loved Poland; returned to Warsaw to dedicate Radium Institute

Marie Curie's traits and supporting text evidence that reveals her behavior in response to particular events. Her traits guided her behavior throughout her life; and the events of her life reflected her traits.

Following discussion of the trait vocabulary and evidence that supports the traits, students are asked to reflect on their own traits and how they display these traits through their words, their thoughts, their feelings, and their actions. Students are asked to complete the sentence: "I am _____ (trait word) because _____ " (what the student does, says, thinks, feels). Students are then asked to tell or write personal narratives, referring to their traits and explaining how those traits are related to the events. Awareness of one's psychological traits contributes to the ability to engage in autobiographical reasoning and to tell coherent personal narratives which contribute greater self-regulation. Greater self-regulation can result in improved social relationships and social problem solving skills.

Conclusion

Educators and speech-language pathologists are aware that persons with ASD typically exhibit difficulties when attempting to tell coherent narratives.[7] The ability to tell coherent fictional stories is associated with academic performance;[83] the ability to tell coherent personal narratives is critical for self-identity development, development and maintenance of social relationships, and psychological well-being.[1,2] Although persons with ASD usually exhibit difficulty telling fictional narratives, they are likely to exhibit even greater difficulty in telling personal narratives.[31] Narrative goals are a frequent component of intervention protocols. Much of the narrative intervention for persons with ASD has focused on two objectives: (1) developing awareness of the macrostructure of fictional narratives (ie, the components of stories such as setting, initiating event, internal response to the event, plan to act, attempts, consequences of the attempts) and (2) improving interpersonal ToM to infer the thoughts and feelings of characters in fictional stories.

Telling coherent personal narratives requires skills in addition to knowledge of narrative macrostructure and interpersonal ToM. The ability to tell coherent personal stories is dependent on the formation and retrieval of autobiographical memories. A focus on the macrostructure of stories and interpersonal ToM will be insufficient to develop skills in telling personal narratives if the foundations for AM are not considered. To design appropriate therapeutic objectives to promote persons' ability to tell coherent personal narratives, interventionists need to understand the nature and role of AM. Intrapersonal ToM and scene construction abilities are aspects of AM that are critical foundations for production of coherent personal narratives. Hence, educators and speech-language pathologists seeking to promote persons' ability to tell coherent personal narratives need to evaluate clients' semantic and episodic AM (noting strengths and difficulties in these two aspects of AM), intrapersonal ToM, and scene construction abilities. Then, using the information gained from such assessments, they need to employ strategies that will promote development and integration of the SM and EM aspects of AM development and retrieval, scene construction, and intrapersonal ToM.

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Disclosure

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