

Using Story-Based Interventions to Improve Episodic Memory in Autism Spectrum Disorder

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ABSTRACT

Episodic memory (EM) and scene construction are critical for organizing and understanding personally experienced events and for developing several aspects of social cognition including self-concept, identity, introspection, future thinking, counterfactual reasoning, theory of mind, self-regulation, flexible problem-solving, and socially adaptive behavior. This article challenges the reader to think differently about EM in children with autism spectrum disorder (ASD), as we expand our understanding of autobiographical memory that requires an ability to travel back in time and re-experience an event. The role of EM in cognitive and behavioral functioning for children with and without ASD is described. The value of story-based interventions such as Social Stories and Comic Strip Conversations for supporting EM is discussed with adaptations recommended to ensure a rich personal recall of an event. By focusing on EM and scene construction, there is potential for increasing the potency of story-based interventions for achieving maximum therapeutic impact.

KEYWORDS: Social cognition, social stories, episodic memory, autobiographical memory, elaborative reminiscing

Learning Outcomes: As a result of this activity, the reader will be able to (1) explain episodic memory (EM) and the deficits in EM for children with autism spectrum disorder (ASD); (2) describe four considerations for determining a topic for an EM social story; and (3) list three reasons elaborative reminiscing is critical for supporting the personal narratives and conversations of children with ASD.

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Enhancing Communication and Social Interaction Skills of Children with Autism Spectrum Disorders and

Their Communication Partners; Guest Editor, Amy L. Donaldson, Ph.D., CCC-SLP.

Semin Speech Lang 2018;39:125-143. Copyright © 2018 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.

DOI: <https://doi.org/10.1055/s-0038-1628365>.

ISSN 0734-0478.

"We were at school and it was a field day and our whole class took turns throwing wet spongy balls at each other. It was kind of scary at first 'cuz I saw this blue ball coming at me fast and then it hit me right in the face! But then I realized it doesn't hurt at all so I wanted to get hit. I got hit four times and it felt good. It was soooo hot outside and the water was really cold."

—an episodic memory recounted by Kenna, a neurotypical 9-year-old

Individuals with autism spectrum disorder (ASD) can demonstrate remarkably good rote memories (especially for highly specialized information that coincides with their interests), which may account for the fact that ASD is rarely understood as a condition in which memory is severely impaired. Yet, episodic memory (EM)—a special kind of declarative autobiographical memory that allows a person to travel back in time and re-experience an event—has repeatedly been shown to be impaired in ASD. During episodic recollection, the conjurer reconstructs the cognitive landscape from a first-person perspective and grounds it in time (when) and space (where). The content of EM includes other information as relevant about the “who, what, why, and how” of an event as well as any associated thoughts and emotions.^{1,2} Now, imagine a mental life where this faculty is disrupted. Without the ability to lay down a record of what the self has personally experienced, it would be difficult to relate disparate aspects of one’s experience in an adaptive way, to track one’s experiences over time to develop a continuous self-concept, and to apply the lessons from past experience to problem-solve in the present and plan for the future.

Despite the importance of EM, very few researchers have formally proposed interventions to support EM in children with language disorders or developmental disabilities (although some discuss using personal narratives to support EM),³ and speculation around how this might best be accomplished for children on the autism spectrum is still in its infancy. In this article, we (1) describe EM, its correlates, and its far-reaching implications for cognitive and

behavioral functioning in typical development and ASD; (2) discuss the theoretical bases of story-based interventions, which we will argue are well suited to address EM challenges in ASD; and (3) propose adaptations to these interventions to make them theoretically pointed and increasingly therapeutic for supporting EM. Along the way, we describe the importance of event structure and elaborative reminiscing and consider what practices might be best for individuals with ASD who vary widely in their language and intellectual abilities.

EPISODIC MEMORY

Early formulations characterized EM on the bases of how it could be distinguished from semantic memory.⁴ Semantic memory and EM are two kinds of autobiographical (about self) memory: semantic memory is concerned with the *content* of memories and what is “known” (e.g., your English teacher’s name in high school), whereas EM is concerned with the *context* of memories and what is “experienced” (e.g., what you remember about your high school graduation ceremony). More specifically, EM refers to recollections in the context of a particular time and place, and with reference to oneself as a participant in the episode.⁵ As such, EM builds and relies upon semantic memory, but it subsumes and goes beyond it. EM is multifaceted and has several requisite components. These include the capacity for mental time travel (which is not unique to EM and is also involved in episodic future thinking), the representation of self (because time travel requires a time traveler), and an awareness that one is engaged in time travel. This last essential aspect of EM is also known as autooetic (“self-knowing”) consciousness (or autooesis). As Tulving explained:

When we do travel back in time, our conscious awareness of our experience is different from our ordinary “online” awareness of our environment. We seldom confuse the feeling that we are remembering a past event with the feeling that we are looking at the world, that we are imagining what is on the other side of a mountain, or that we are dreaming. These and other

mental activities are conscious too, but the consciousness is plainly and recognizably different. The term *autonoetic* has been used to refer to this special kind of consciousness that allows us to be aware of subjective time in which events happened. *Autonoetic* awareness is required for [episodic] remembering. No *autonoesis*, no mental time travel.^{5(p.2)}

By contrast, semantic memory requires only *noetic* (“knowing”) consciousness, which is the ability to be aware of information about the world. With autobiographical semantic memory, I can “know” that I had a birthday party. I can also know who came, what we ate, and what we did, and although these contents of memory can accompany my awareness of my own knowledge, they do not require the subjective first-person vantage point that constructs the contextual framework that allows me to “re-experience,” through *autonoetic* consciousness, my own previous experiences such as a birthday party.⁶ This contextual framework grounds happenings in a particular place and time, carries with it “the experiential ‘flavor’ of remembering,”^{5(p.4)} and allows one to reflect on the perceptual origins and qualities of one’s own knowledge.⁷

From an evolutionary perspective, learning and memory are useful insofar as they inform future behavior. Thus, a primary purpose of EM is to drive and support the development of future thinking,⁸ which “considerably improves the chances of forming optimal plans of action to guide adaptive future behavior.”^{9(p.2)} Indeed, future thinking is believed to be essential for flexibility of thought and action; difficulty acting with the future in mind may result in overdependence on routinized, inflexible patterns of behavior and the restricted and repetitive behaviors often observed in ASD.^{10,11}

EM develops in parallel with (and likely casually contributes to) some of the most developmentally significant sociocognitive human achievements. These include the emergence of script and schema knowledge,^{12,13} a stable identity and self-concept, and the development of conscious awareness itself.^{14–16} These are essential to psychological continuity and make EM a *sine qua non* aspect of the “self-memory system.”^{17,18} EM also emerges around the same

time as source-monitoring abilities (e.g., knowing how you know something), which is, in turn, considered part of the (rather sprawling) construct of theory of mind.^{7,19–21} Other aspects of theory of mind that codevelop with EM include, but are not limited to, introspection, imagination, counterfactual reasoning, and future thinking.^{9,22,23} These cognitive codevelopments have led many researchers to conclude that the common psychological mechanism underlying EM is actually “scene construction.”^{19,24} *Scene construction* refers to “the process of mentally generating and maintaining a complex and coherent scene or event. This is achieved by the retrieval and integration of relevant informational components, stored in their modality-specific cortical areas, the product of which has a coherent spatial context, and can then later be manipulated and visualized.”^{19(p.299)} Although the complexity of the processes underpinning EM may be key to its flexibility and unique power for problem-solving (e.g., future-oriented planning, innovation), it may also explain why EM is highly vulnerable to insult as observed in normal aging and a variety of clinical conditions including ASD.¹⁹

Episodic Memory in Autism Spectrum Disorder

Although semantic memory (i.e., the “knowing system” responsible for encoding and retrieval of general knowledge) appears to be relatively* spared (and superior in some individuals under some circumstances),²⁵ EM has repeatedly been shown to be impaired in ASD. For example, individuals with ASD (even those with high language and intellectual skills), tend to have relatively good recognition (cued) recall (a proxy of semantic memory) but impaired free recall (a proxy of EM) and offer less specific and fewer accurate recollections of personally experienced events.^{9,15,26,27} Williams, Lind, and Happé noted that, as a result.²⁸

* We use the term *relatively* to highlight the relative strength of semantic memory compared with episodic memory while also acknowledging that deficits in autobiographical semantic memory (e.g., “What was the name of your teacher last year?”) in ASD have been documented.²⁵

Caution must be exercised when attributing to people with autism memory processes of the *episodic* kind. I may *know* that a particular event has happened to me in the past, and hence report details of the event quite accurately, without actually *remembering*[†] the event. Only this latter kind of ‘remembering’ is thought to rely on metacognition.^{28(p.162)}

Because individuals with ASD report fewer instances of episodic remembering, differences may exist in the way they make sense of information. For example, when encoding information, they may miss connections between items and fail to see how information can be flexibly manipulated, ultimately impacting their ability for self-conscious awareness.¹⁴

Indeed, the EM deficits of ASD likely contribute to difficulties making use of category (e.g., animals, plants) relations to enhance recall and problems accessing pertinent information to recall relevant aspects of a scene.^{29,30} These challenges have implications for stimulus over-selectivity and the ability to identify and use relevant contextual information to disambiguate meaning, which is a well-documented deficit in ASD.^{31,32} Even when accurate pragmatic inferences can be drawn, persons with ASD often experience difficulty justifying their correct answers, suggesting that they are poor source monitors who are not always aware of how they derive answers from contextual information.³³ Finally, problems with EM in ASD are strongly associated with difficulties in future thinking, counterfactual reasoning, and central coherence,^{22,27} leading many to believe (as described above) that mental simulation and scene construction are core EM underlying difficulties.¹⁰

[†] As Tulving cautioned, the “common sense reflected in this theory is seduced by the word ‘remember’ which, in everyday usage, does not distinguish between re-experiencing the past on one hand and all other . . . consequences of acts of learning on the other.”^{25(p.19–20)} Thus, as do the researchers and theoreticians who pursue the topic of EM, we too adopt the terms *remember* and *know* in a restricted, technical sense to refer to two different states of conscious awareness (i.e., *autonoetic* and *noetic*, respectively).

STORY-BASED INTERVENTIONS

By far, Social Stories (SSs) represent the most popular story-based intervention strategies to remediate the core deficits of ASD.^{34–37} SSs are carefully written, individualized stories that are designed to facilitate social understanding by giving individuals with autism the information they need to be successful in social situations.³⁶ SSs follow a specific format and are guided by principles for describing a person, event, or concept in the context of a social situation.³⁴ They typically follow a storybook format, are composed of simple sentences and a title, and include an introduction, a body, and a conclusion. Key messages conveyed in text are typically reinforced using visual supports (e.g., line drawings, icons, photographs). A frequent goal of SSs has been to share relevant information in the context of a challenging social situation. This information often includes a description of where and when a situation takes place, who is involved, what is happening, and why.³⁴ Gray describes her recommended process for gathering accurate and relevant historical information to inform the content and development of an SS.³⁵ Crucially, the perspective of the individual in context is integral. The information-gathering process should focus on the “relevant cues, the typical sequence of events, ideas from those involved in the situation, and the perspective” of the individual with ASD.^{34(p.174)}

SSs have a sister intervention (also developed by Gray) known as Comic Strip Conversations (CSCs).^{34,38} CSCs are designed to explain challenging social situations through writing and drawing using simple stick figures and thought and talking bubbles. SSs and CSCs share a broad theoretical orientation (to recount an experience, provide relevant and accurate contextual information from a first-person perspective, and use this information to plan for the future). The primary difference between SSs and CSCs is that the former is an independent or joint book reading activity, whereas the latter involves active child participation, which may make CSCs most appropriate for individuals with strong language and intellectual abilities.^{39,‡}

[‡] But see Hutchins and Prelock,³⁹ who reported success using SSs and CSCs to address theory of mind targets in minimally verbal children with ASD.

Theoretical Bases

The National Standards Project, Phase 2 and The National Professional Development Center on ASD have each independently concluded that there is sufficient quality, quantity, and consistency in the evidence base to conclude that story-based interventions are an established evidence-based practice.^{40,41} The success of story-based interventions is presumed to lie in their ability to improve the child's understanding of events and expectations and "theory of mind" more generally,^{34,35} but the precise mechanisms and key ingredients remain a topic of speculation.

Early on, Gray invoked weak central coherence as a factor in the social cognition difficulties of persons with ASD that may be remediated through the use of story-based interventions.³⁴ Weak central coherence is a cognitive style, believed to be present in ASD, in which the processing of parts takes precedence over the processing of wholes,^{42,43} which raises awareness of yet other areas of functioning that would likely be negatively impacted when weak central coherence predominates. These include impaired event, script, and schema knowledge, context immunity, and difficulty relating social knowledge to real-life situations.^{32,44,45}

In a related vein, story-based interventions may be effective because they support executive functioning. For example, SSs explicitly identify the relevant content of a targeted situation, thereby suppressing stimulus overselectivity and irrelevant aspects of a social scene.⁴⁶ Noting the slower pace of learning for some individuals with ASD, several researchers and practitioners also recommend that story-based interventions be taught using repetition. This may further support executive function because with sufficient repetition, the content of stories will be increasingly predictable. This should help support comprehension,³⁷ reduce the need to hold information online in working memory, and facilitate self-monitoring.⁴⁶

Finally, and despite not being previously identified as an active ingredient, we believe that story-based interventions may be effective because they recount historical events, relate past experience to future planning, and adopt a first-person perspective, all of which are rele-

vant to the development of EM. SSs and CSCs are written from a first-person perspective through thoughtful consideration of how a social situation has been experienced and interpreted by that person.³⁵ As such, story-based interventions are personal narratives about the past and for the future, and at the center of the narrative is the individual with ASD. This notion gains importance in light of the finding that many individuals with ASD may not appreciate the value of having first-person privileged access to their own inner states and experiences.⁴⁷ Indeed, when recalling experienced events, individuals with ASD are more likely than peers without ASD to report taking a third-person (observer) view than they are a first-person perspective.⁹

SOCIAL STORY ADAPTATIONS TO SUPPORT EPISODIC MEMORY IN AUTISM SPECTRUM DISORDER

As described previously, SSs are an established intervention for remediating the hallmark challenges characteristic of ASD, and they are theoretically potent for supporting EM as well. Because SSs demand relatively little in terms of active participation (the audience must attend to the story), they may be well suited for individuals with ASD who exhibit language and intellectual challenges.^{36,37} However, their potential benefit is *not* limited to this group. Although there is now a large number of studies documenting their effectiveness for children with language and intellectual impairments, SSs were originally intended for and are also known to be effective for individuals with higher cognitive and linguistic abilities.³⁷ As such, the proposed SS adaptations that follow should be considered for individuals from across the autism spectrum.

Important considerations when selecting a topic for an EM story include *event structure*, *typicality* and *recency*, and *distinctiveness*.

Event Structure

With regard to event structure, personal narratives typically recount an episode (e.g., going to the grocery store) that is, itself, composed of several subevents (e.g., walking through the aisles,

putting food in the cart, standing in line, paying, leaving).⁴⁸ What constitutes a higher- or lower-level component in the hierarchical event structure will depend on the purpose of the narrative (e.g., what I did last summer, how was my trip to the newly opened water park, what happened when I rode the three-story waterslide). Event structure should contain both high-order (topic) and low-order event elaborations. EM stories that will be most interesting and memorable will also likely contain a “high point.” Personal stories have purpose: “they are trying to make a point about a person’s experience.”^{3(p.265)} This is accomplished in analyses of classic narrative structure by identifying a sequence of events, a climax or high point, and the resolution to that high point. EM topic selection on the basis of its potential to illustrate a clear high point is critically important. Although many children with ASD have basic knowledge of a conventional narrative format, they consistently lack high points in their narrative productions.⁴⁹ Yet, it is the high point that often makes a story meaningful and that signals the purpose for the telling of the story.

Event Typicality and Recency

EM topic selection should take into account how typical an event is because this has importance in light of the relational binding problem that may operate in ASD. During episodic encoding, various kinds of information are first selected and then associated in memory. Newcombe and colleagues provide this example and description:

Flickering shadows created by the wind in the trees may co-occur with bird song, with the presence of certain flowers, appended both visually and by their scent, with a particular air temperature, and so on. But which of these correlations are important and which are coincidental? Sorting this issue out is fundamental to causal analysis, the formation of categories, and the acquisition of knowledge about the world.^{50(p.74)}

Relational binding is likely disrupted in ASD at all process levels, from sorting, organizing, and binding of information in memory

to the ability to “unbind” pieces of information so as to deploy event representations for flexible problem solving. Although we need to know much more about the binding problem in ASD, our nascent notions about interventions to support EM in ASD may be informed by a considerable fund of research on typical developmental processes. For example, researchers showed that event representations are influenced by variant and invariant experiences.¹³ Elements of variant experiences are predictable event alternatives (buying carrots versus buying broccoli at the grocery store). The presence of these elements in our past experiences is important because it allows new information to be organized into an event structure that, presumably, helps the child understand predictable event alternatives. Based on memory studies of TD children, there is evidence that very young children grasp the role of variance and invariance in recurring experiences to form general event representations and can distinguish these (e.g., going to the grocery store = we go there to buy things) from single variants (e.g., sometimes we buy milk, other times we buy orange juice) after a limited number of exposures (approximately four or five). There is also evidence that, after general scripts and their variants are more or less established, atypical or deviant episodes are recalled after a longer time delay compared with routine events that adhere to an established general script. With all of this in mind, one tentative suggestion based on the ASD and TD literature is to select a topic from a recent (within a day) and familiar routine event (going to the grocery store) in which high-level script-invariant activities occurred (e.g., we went to the store, bought groceries, paid, left). Elaboration of the event would then be introduced to identify details (we bought carrots) that will vary across events over time (we bought broccoli). Recollecting could subsequently be scaffolded to include unexpected or (so-called) deviant events (e.g., “Remember, we saw a little girl jumping rope in the toy aisle of the grocery store”), which could be marked to highlight their atypicality (e.g., “This doesn’t usually happen” or “This isn’t something you would expect to see in the grocery store”).

Event Distinctiveness

Another promising approach to support episodic recall in individuals with ASD is to identify a distinctive event. An event may be distinctive in either conceptual (e.g., an elephant painting with a paint brush) or perceptual terms (e.g., seeing the northern lights or smelling a forest fire). Furthermore, the more distinctive the event, the more likely it is to be episodically (as opposed to semantically) encoded in memory and, therefore, recalled in richer detail.^{15,51} For this reason, we recommend that, when possible, story-based intervention begin with examples of distinctive (and positive) events. Unlike routine or more typical events as described previously, distinctive events may be recent or in the distant past and still be recalled with detail.

Summary of Social Story Adaptations to Support Episodic Memory

A summary of the key components of SSts are enumerated in Table 1.³⁷ In the center column, the conventional recommendations for developing and implementing SS intervention are presented. In the right-hand column, our recommendations for adapting SSts to support EM are offered. The value of a SS designed around an EM is the power it has to prepare a child for future thinking or planning behavior. For example, asking a child, if he goes to the grocery store next week, will he likely see a girl jumping rope? Or, if he goes to the store and really wants to buy something, what will he do to remember and plan for the purchase?

COMIC STRIP CONVERSATION ADAPTATIONS TO SUPPORT EPISODIC MEMORY IN AUTISM SPECTRUM DISORDER

Although far fewer studies have been conducted on CSCs compared with SSts, CSCs have recently begun to accumulate evidence for affecting positive change in a child's theory of mind abilities and social behavior.^{39,52,53} During a CSC, the child engages (to the extent possible) in conversation while talking and drawing so as to coconstruct dialogue with an adult interlocutor. A set of conventions has been offered for constructing CSCs.^{34,38} The

child is first introduced to a "conversation symbols dictionary" that provides symbols for basic concepts (e.g., listening, talking, thinking). A location symbol is drawn in the upper left-hand corner of the work area to identify the setting in which the discussed event occurs. During conversation, the sequence of topic-relevant events is identified and drawn using boxes that are enumerated in the order they occurred. At each step in the sequence, the adult guides the child's writing and drawing by gathering information through questions designed to "complete the picture."^{38(p.8)} Questions usually take the form: "Who was there?"; "What happened first?"; "What happened next?"; "What did you or others say?"; and "What did you or others think?"³⁴ Because CSCs demand more active participation, they may be better suited for individuals with ASD who have strong language and intellectual abilities. As such, the proposed adaptations that follow should be considered for individuals with ASD who represent the higher end of performance. Considerations when selecting a topic for an EM conversation include the importance of elaborative reminiscing, how it may be supported during interactions with individuals with ASD, and the use of additional visual supports as discussed below. An example of an EM CSC that was completed with a typically developing 9-year-old girl is also provided in Fig. 1.

Elaborative Reminiscing

There is a rich and impressive body of research documenting the links from maternal reminiscing style to neurotypical children's socioemotional, cognitive, and language and literacy outcomes. One important dimension that distinguishes caregivers on the basis of how they engage children in talk about past events concerns their degree of elaboration. Compared with caregivers who are characterized as low in elaborative reminiscing, caregivers who are high on this dimension reminisce with their children in more detailed, evaluative, and coherent ways. More specifically, they ask many open-ended questions, invite children to participate in conversation, and integrate children's recollections into a collaboratively constructed narrative.⁵⁴

Table 1 Summary of Social Story (SS) Key Components, Conventional SS Recommendations, and Episodic Memory (EM) Story Recommendations

Key Components	Conventional SS Recommendations	EM Story Recommendations
1. Determining a topic	<ul style="list-style-type: none"> • Identify a situation in which the individual is already experiencing success. • Look for situations that result in problem behavior. • Anticipate unfamiliar situations that require new knowledge or a change in routine. 	<ul style="list-style-type: none"> • Identify situations for which the individual is likely to have some accurate recollections. • Look for personally experienced events that have a high point, that incorporate both variant and invariant elements, and that are either typical (and recent) or atypical or distinctive (recent or distal). We recommend that the first EM story be about a positive distinctive event. • Consider how this episodic memory could be useful or informative for future planning, thinking, behavior.
2. Gathering individualized information	<ul style="list-style-type: none"> • Learn about the individual's interests, strengths, and challenges and factors that may motivate current behaviors. • Observe the targeted situation from a third- and first-person perspective. • Conduct interviews with those who have direct contact with the individual (e.g., parents, teachers, or other professionals) to establish a team effort and gain accurate and detailed information. 	<ul style="list-style-type: none"> • Learn about the individual's interests, strengths, and challenges and factors that may motivate reminiscing. • 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. • If observation of the event is not possible, conduct interviews with important others to gain accurate and detailed information. • If appropriate, consider first doing a Comic Strip Conversation to elicit information from the child about his or her subjective past experiences.
3. Development of the Social Story	<ul style="list-style-type: none"> • Use <i>objective</i> statements and accurate and flexible language that is meaningful to the individual. • Develop appropriate content and format through consideration of the individual's age, reading level, and comprehension level. • Consider the use of visual supports (e.g., photographs, Mayer-Johnson symbols) that convey accurate information, are 	<ul style="list-style-type: none"> • Use <i>subjective</i> statements and accurate and flexible language that is meaningful to the individual. • Develop appropriate content and format through consideration of the individual's age, reading level, and comprehension level. • Consider the use of visual supports (i.e., photographs and videos including those provided by the family and the use of social story apps like Pictello) that are,

Table 1 (Continued)

Key Components	Conventional SS Recommendations	EM Story Recommendations
4. Critical review and sharing of the Social Story	<p>developmentally appropriate, and are expected to promote interest.</p> <ul style="list-style-type: none"> • Share a rough draft of the story with parents and others who have direct contact with the individual to catch inaccuracies to guide revision. • Distribute the final draft along with an implementation plan that outlines review schedules to foster shared responsibility and the involvement of a team. 	<p>themselves, literally accurate depictions of the event.</p> <ul style="list-style-type: none"> • Share a rough draft of the story with parents and others who have direct contact with the individual to catch inaccuracies to guide revision. • Distribute the final draft along with an implementation plan that outlines review schedules to foster shared responsibility and the involvement of a team.
5. Introduction, comprehension checks, and adaptations as necessary	<ul style="list-style-type: none"> • Introduce the SS in a relaxed and comfortable environment. • A simple statement such as "Here is a story that I wrote for you" is often sufficient, but the complexity and content of the introduction will vary with circumstance. • Monitor comprehension of key messages. • If misinterpretation or confusion of story content becomes apparent, the story is revised to enhance clarity. 	<ul style="list-style-type: none"> • Introduce the SS in a relaxed and comfortable environment. • Our recommended introduction is: "Here is a story that I wrote for you. It is about [insert general time frame and high point, e.g., last week when you popped a wheel on your bike]. Stories like this are just for remembering. Remembering is important for understanding ourselves and our experiences." Of course, the complexity and content of the introduction will vary with circumstance. • Monitor comprehension of key messages. • If misinterpretation or confusion of story content becomes apparent, the story is revised to enhance clarity.
6. Generalization training, maintenance, fading, and identification of new targets	<ul style="list-style-type: none"> • If improvements are demonstrated in the target behavior, the story can be expanded to include variations of the skill. • SSs are faded out following achievement of the targeted skill but can be revisited as needed. • Identify new skills to be targeted. 	<ul style="list-style-type: none"> • Once a story is comprehended, it can be adapted or expanded. For example, a story series about playing on the playground can be adapted to highlight invariant (what happened, like sliding down a slide) and variant (who was present) elements. • SSs are faded out following comprehension of the story but can be revisited as needed. • Identify new memories to be targeted.

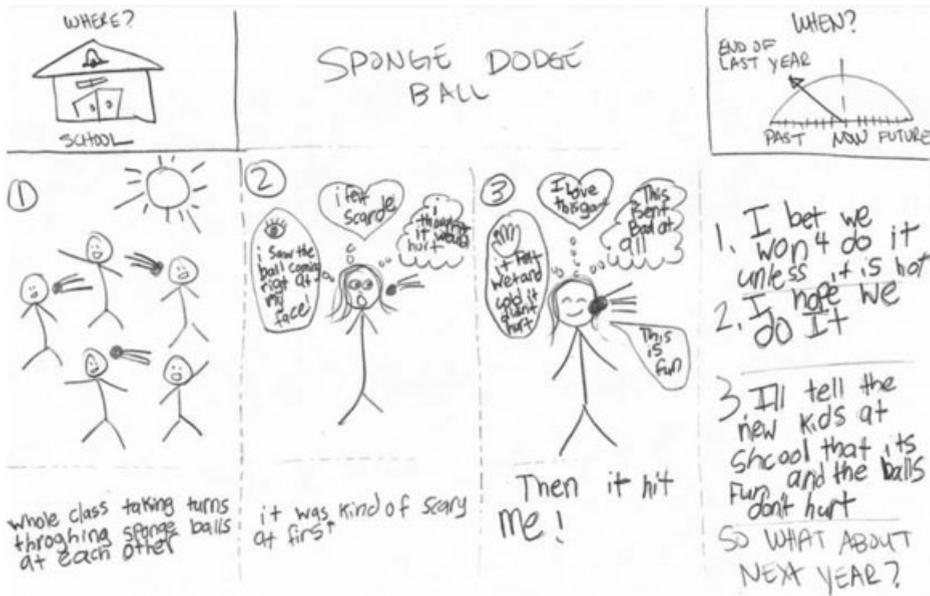


Figure 1 Example of an episodic memory Comic Strip Conversation.

Why Elaborative Reminiscing Is Critical

Caregivers who are more elaborative when reminiscing with their children about personally experienced events have children who better understand the thoughts and feelings of themselves and others and who demonstrate better self-regulation and self-concept formation. Children who experience more elaborative reminiscing also produce more complete and coherent personal narratives and have more detailed, accurate, and sophisticated autobiographical memories.^{54,55} Moreover, the links from caregivers' reminiscing style to child developmental outcome, although undoubtedly complex and transactional in nature, are *causal* and *primarily* flow from caregiver reminiscing style to child outcome.^{55,56} The effects on child development also appear to be specific to reminiscing style (as opposed to other aspects of parent-child discourse such as talkativeness or degree of elaboration during storybook reading). Research on elaborative reminiscing gains utility in light of the finding that parents (including those with ASD) can be taught to become more elaborative in their reminiscing style to support their children's memory, the quality of children's personal narratives, and motivation to reminisce in a fairly short period of time.^{57,58} Crucially, they can also

be coached to provide more autonomy support by taking the child's perspective and encouraging the child to pursue personal interests, thereby helping the child maintain intrinsic motivation and engagement. Indeed, high degrees of autonomy support leads to children feeling more competent and motivated to engage, which in turn facilitates a more active learning process and deeper level of information processing.⁵⁷

Elaborative Reminiscing and Autism Spectrum Disorder

There is wide agreement that caregiver elaborative reminiscing is a causal factor for a range of child developmental outcomes. Moreover, it is well documented that even when child characteristics (e.g., language level, temperament, attachment status) and sociocultural variation are accounted for, caregiver reminiscing style uniquely predicts children's autobiographical memories.⁵⁵ Although we know individuals with ASD demonstrate episodic autobiographical memory deficits, what has rarely been considered is how caregivers may (or may not) adapt their linguistic input during interactions with their children with ASD to support such development. This is important because "children

with disabilities likely benefit from their language environment as much as, or even more than, typically developing children.^{59(p.506)} What sparse literature is available on the topic suggests that parents adopt a more directive and less elaborative reminiscing style when interacting with their children with ASD.⁶⁰ Although such adjustments may help the child verbalize more accurate recollections (a laudable goal for children with ASD who are known to be less detailed and accurate in reports of past experience), they may not be optimal for supporting the development of memory in a truly episodic way. Goldman and DeNigris suggested that parents of children with ASD may have a “greater emphasis on external, objective and factual elements of the experience” and may adopt a conversational style that “more closely resembles an interview than a natural dialogue.”^{60(pp.1469–1470)}

Although memory is a reconstructive process (and representations of past events are neither complete nor wholly veridical),¹⁹ autobiographical memory errors do occur more often in individuals with ASD compared with individuals without ASD.²⁵ Because more accurate objective (e.g., who was there) and subjective (e.g., how someone felt) memories are expected to lead to more accurate scene construction for future events, it is important to correct a child’s inaccurate memory (particularly for higher-order events, such as interpreting or analyzing the emotions of an event the child experienced). Yet, the manner in which this is done is crucially important in light of the previous finding that caregivers of children with ASD may focus on accuracy at the expense of an elaborative style whose goal is to construct a shared experience.⁶⁰ For the time being, we recommend that adult interlocutors issue gentle content corrections while adding information to the ongoing dialogue (e.g., child: “Sam was at the beach”; adult: “Sam wasn’t at the beach. Remember, he couldn’t come because he had a soccer game. Jill and Sean were there and they played a game. Do you remember that game?”). In fact, parents and professionals who engage children in elaborative reminiscing should be encouraged by the finding that this style of communication, in itself, leads to increases in memory accuracy over time.⁵⁵

Additional Visual Supports

Clinicians may also want to consider additional visual supports that will be sensitive to the individual’s learning style or may enhance motivation. One potential resource is a Remember Symbols Dictionary (Appendix A), which displays the senses as cues to recreating an event, and Remember Webs (Appendix B), which start with pictures or images and use the senses symbols to enhance knowledge about what a child did. Several apps are also available that could be used to support EM. We agree with Westby and Culatta, who originally suggested the use of Pictello to support reminiscing in children with disabilities. Pictello uses pictures in a storybook format to help recount an experience. Westby and Culatta noted that “one can take photos or videos of an experience and then write the story that goes with the pictures. The photos provide support for children with language impairments to reminisce. Having photos or videos of the experiences helps achieve accuracy of the reminiscing.”^{3(p.267)} We would also add that Pictello is cost-effective and extremely user-friendly. This makes it a popular “go-to” not only for clinicians and caregivers but for the children with social learning challenges who may be motivated to engage in—and even construct reminiscing episodes to share with others—through the use of this technology.

Summary of Comic Strip Conversation Adaptations to Support Episodic Memory

A summary of the key components of CSCs are enumerated in Table 2. In the center column, the conventional recommendations for developing and implementing CSC intervention are presented. In the right-hand column, our recommendations for adapting CSCs to support EM are offered.

ADDITIONAL SUPPORTS AND CONSIDERATIONS FOR PRACTICE USING SOCIAL STORIES AND COMIC STRIP CONVERSATIONS

How Specific Do We Need to Be about When?

When it comes to the temporal placement of the recalled event, macrotime (the timeline

Table 2 Summary of Comic Strip Conversation (CSC) Key Components, Conventional CSC Recommendations, and Episodic Memory (EM) CSC Recommendations

Key Components	Conventional CSC Recommendations	EM CSC Recommendations
1. Introduction of CSCs as an activity	<ul style="list-style-type: none"> • The first CSC acquaints the individual with the activity of “drawing while talking.” The adult matter-of-factly introduces the activity: “We are going to draw while we talk today.” The individual is asked what she or he would like to talk about or an easy topic of interest is selected for the individual. • The Conversation Symbols Dictionary is introduced to acquaint the individual with how to draw concepts such as thinking, talking, listening, interrupting, and loud and quiet words. • The Personal Symbols Dictionary begins to be developed if necessary; it is an ever-expanding collection of symbols frequently used (e.g., for specific people, places, concepts that are part of the individual’s experience). 	<ul style="list-style-type: none"> • The first CSC acquaints the individual with the activity of drawing while talking. Although the complexity and content of the introduction will vary with circumstance, our recommended introduction is: “Today we are going to share stories. First, I’ll just tell you about something that happened to me. Then we will talk about something that happened to you. When we talk about you, we will draw and talk. Drawing while we talk is important because it can help us slow down, think, and remember things better.” • The Remembering Symbols Dictionary (Appendix A) is introduced to acquaint the individual with how to draw concepts related to first-person perspective recall (i.e., what did I see, hear, smell, think, and feel (emotion and touch)). • The Conversation Symbols Dictionary and The Personal Symbols Dictionary (described on the left) are introduced if necessary.
2. Determining a topic	<ul style="list-style-type: none"> • Look for situations that result in problem behavior. • Anticipate unfamiliar situations that require new knowledge or a change in routine. • Topics may represent a challenging situation from the past or an anticipated future event. • If discussing a future event, language is carefully chosen to discourage literal interpretation and inflexible interpretation (e.g., “There will be <i>many</i> people at the party” is preferable to “There will be <i>20</i> people at the party) and qualified (e.g., “There <i>may</i> be balloons and streamers” is preferable to “There <i>will</i> be balloons and streamers”). 	<ul style="list-style-type: none"> • Identify situations for which the individual is likely to have some accurate recollections. • Look for personally experienced events that have a high point, that incorporate both variant and invariant elements, and that are either typical (and recent) or atypical or distinctive (recent or distal). We recommend that the first CSC be about a positive and distinctive event. • Consider how this episodic memory could be useful or informative for future planning, thinking, behavior. • If discussing a future event, language is carefully chosen to discourage literal interpretation

Table 2 (Continued)

Key Components	Conventional CSC Recommendations	EM CSC Recommendations
3. Drawing or talking about a given situation	<ul style="list-style-type: none"> • Begin by drawing a location symbol in the upper left corner to indicate the location of the event. • Comic strip boxes (a series of enumerated boxes that frame each event and define the sequence of events) are drawn to keep the sequence of events clear. • The adult gathers information to complete the picture using a series of <i>wh-</i> questions (e.g., "Who else is here?"; "What are you or others doing?"; "What happened?"; "What did you or others say?"; "What did you think when you said that?"; "What did others think when they said that or did that?"). • When the individual experiences difficulty answering a question, she or he is guided to the logical answer. If this is unsuccessful, the adult's best guess is offered (e.g., "Maybe your teacher was thinking, 'I like Andrew'") and control of the conversation is returned to the individual as soon as possible. 	<p>and inflexible interpretation and highlight counterfactuality (e.g., "There will be <i>many</i> people at the party" is preferable to "There will be <i>20</i> people at the party) and qualified (e.g., "There <i>could</i> be balloons and streamers" is preferable to "There <i>will</i> be balloons and streamers").</p> <ul style="list-style-type: none"> • Begin by drawing a time stamp in the upper right corner to indicate when the event happened. • Then draw a location symbol in the upper left corner to indicate the location of the event. • Identify the topic and develop a title that reflects the high point of the event. Write the title of the conversation at the center top. • If the event represents a sequence of subevents (as opposed to a snapshot), draw and enumerate comic strip boxes (described on the left) to clarify the event sequence. • The adult gathers information to complete the picture using a series of <i>wh-</i> questions (e.g., "Who else is here?"; "What are you or others doing?"; "What did you see?"; "What did you feel?"; "What did you or others say?"; "What did you think when you said that?"). • The adult adopts an elaborative but patient reminiscing style (e.g., encourage elaboration with simple responses that add information to the narrative, follow the child's lead while avoiding questions that derail the conversation in favor of a child's special interest, give the child plenty of time to respond). • Key points are reviewed in their appropriate sequence. The individual is encouraged to
4. Summarizing the conversation	<ul style="list-style-type: none"> • Key points are reviewed in their appropriate sequence. The individual is encouraged to 	<ul style="list-style-type: none"> • Key points are reviewed in their appropriate sequence. The individual is encouraged to

(Continued)

Table 2 (Continued)

Key Components	Conventional CSC Recommendations	EM CSC Recommendations
5. New directions identified	<p>summarize the conversation independently but the parent or professional assists as necessary.</p> <ul style="list-style-type: none"> The individual is asked to identify new solutions to a problem and if she or he is unable, solutions are suggested by the adult. The pros and cons of each candidate solution are discussed/weighed. Solutions that are no longer viable are eliminated (crossed out) and the remaining solutions are ranked (1, 2, 3 . . .) according to when they will be tried the next time this situation occurs. 	<p>summarize the conversation independently but the parent or professional assists as necessary. Because the purpose of all communication is information sharing, the individual is encouraged to identify this goal, which is typically accomplished through a simple restatement of the topic (e.g., "So that is one thing I did over the summer").</p> <ul style="list-style-type: none"> Because the reminiscing goals are likely to involve "practical remembering,"^{55(p.1571)} the individual is asked to reflect on what happened in the story that might direct future thinking or behavior (e.g., "Next summer, I'd like to go to the beach instead of the racetrack" or "I want to go to the beach again and not swallow seawater").

against which the events of our lives play out; e.g., days, weeks, or years ago) does not appear to be nearly as important as microtime (the moment by moment order in which an event sequence unfolds; e.g., what happened first, second, third).¹⁹ Microtime has been described as an intrinsic property of episodic memory "that when recalled ensures it is played back in the same . . . temporal sequence in which it was recorded."^{19(p.300)} By contrast, recall for memories from specific time periods (macro-time) is a poor retrieval code for episodic memory. For these reasons, we encourage an emphasis on microtime (which is also foundational for the construction of well-organized event representations),⁶¹ while recognizing the importance of a *general* time stamp. For the story-based interventions reviewed here, general temporal markers such as yesterday, last week, and last year are sufficient but more general references to time (a little while ago, a long time ago) are acceptable and may be preferable in many circumstances.

What If the Comic Strip Conversations Intervention Is Too Easy or Too Hard?

If the CSC interventions to support EM seem insufficiently challenging, parents and professionals may increase demands by eliciting a greater number of details (these may be multi-modal as relevant, e.g., "What did you hear?" or "What did you smell?"), increasing the complexity of the narrative (e.g., asking for or providing information about additional sub-events using an elaborative reminiscing style), or requiring more reflection on the mental states (thoughts, feelings) of self and others.

More often, however, we suspect that intervention may be overly challenging (particularly in the beginning) but there are several strategies that can be employed to support children's performance and scaffold them to higher levels of episodic recall. One strategy is to shift to a distinctive event. As described previously, conceptually or perceptually distinctive events are more likely to be episodically encoded and recalled with richer detail.

Another general strategy is to decrease overall amount of talk while still asking those meaningful and informative *wh*- questions that characterize an elaborative reminiscing style. Even individuals with ASD with high language and intellectual abilities can benefit from increased processing time and more opportunities for writing time to support episodic recall.⁶² In addition, adult interlocutors can shift from open-ended questioning (“What did you hear?”) to close-ended questioning (“Did you hear something loud?”) and from questions that require free recall, which is difficult in ASD but also the hallmark of true episodic remembering, to a recognition recall (e.g., “Did you hear a bell?”). These recommendations are in line with the Task Support Hypothesis,^{26,30} which states that individuals with ASD will tend to perform at more typical levels on any memory task where support is provided during recall. Of course, the eventual goal will be to gradually scaffold to better free recall performance.

Another strategy to support episodic recall is to conduct controlled episodic encoding and retrieval sessions. This may be a particularly apt strategy when the child demonstrates poor free recall, poor recall for details, poor recall accuracy, or source amnesia. Indeed, this may indicate that the child is relying on semantic memory as opposed to truly episodic recall. During a controlled episodic encoding procedure, the individual is engaged in a series of tasks (e.g., making a figure out of clay, lifting barbells for one minute, throwing a foam ball into a hoop, smelling or tasting fragrant foods) and then immediately asked to report on his or her experiences.^{d, 21,51,63} These kinds of encoding procedures will likely encourage episodic remembering because they are sensory in nature and thus require a first-person perspective. Note that individuals with ASD often assume an observer perspective, but this is not possible when asked to recall the taste of a speckled Jelly Belly, for example, that can only be known to and experienced by the self. Episodic retrieval may also be facilitated through the use of visual supports, including photographs or videos from the enco-

ding procedure. These can be shown to the individual along with a Remember Web (see Appendix B) that can be completed in collaboration with the child.

Additional General Memory Supports

Several well-documented general recommendations are considered good prescriptions to support any kind of declarative memory. These include:

- getting regular aerobic exercise
- engaging in recall activities when relaxed: stress and anxiety negatively impact recall
- writing things down: this makes journaling another great way to support EM in a way that helps the child take responsibility for the intervention
- returning to the scene (aka transfer-appropriate processing): if you are asking the child to recall an event that happened on the playground, recall will be improved if you actually go to the playground!

What about Remembering Negative, Difficult, or Traumatic Experiences?

It is important to point out that SAs and CSCs have typically focused on recounting challenging situations, and so speech-language pathologists and related professionals will be familiar with the conventional range of difficult topics (e.g., a disagreement a child had at school, a transitional event that causes anxiety for the child, an aggressive or challenging behavior) that are pursued using these interventions. Furthermore, compared with talk about positive events, talk about negative events presents special opportunities for child learning. Not surprisingly, adults tend to be naturally more elaborative when they reminisce about difficult subjects, presumably because the adult’s goal is to encourage the child to understand the event in a coherent way.⁵⁵ Nevertheless, service providers need to be aware of the potential perils that may accompany a reminiscing activity. Indeed, clinicians may unintentionally engage an individual in the recall of a traumatic event (personal communication with Carol Westby, 2017), in which case they must respond with

^d For detailed information about how to structure prompts and evaluate children’s responses, readers are referred to McIsaac & Eich⁵¹ and Piolino et al.⁶³

disclosure and referral to other agencies and professionals as required by ethical standards for practice. As a final word on this topic, we agree with Gray,³⁵ who recommended that a majority of story-based intervention sessions focus on a *positive* topic or social situation. These “affirmative stories” and conversations are incredibly important to maintain meaningful exchanges and to ensure child motivation to engage in these interventions.³⁵ Indeed, you (the reader) would probably conclude that reminiscing with others is no fun if all you ever reminisced about were things that were difficult or unpleasant; the individual with ASD is no different.

CONCLUSIONS AND FUTURE DIRECTIONS

The purpose of this article was to contribute to the sparse literature concerned with helping individuals with ASD to form memories in a truly episodic way. Like many before us, we imagine that EM and scene construction are critical for organizing and understanding personally experienced events and for the development of self-concept, identity, introspection, future thinking, counterfactual reasoning, theory of mind, self-regulation, flexible problem-solving, and socially adaptive behavior. What has, to this point, been lacking is an articulation of how parents and professionals might capitalize on the success of story-based interventions to support EM. Indeed, story-based interventions are theoretically and practicably well suited for this purpose. By honing our focus to pinpoint EM and scene construction as candidate core mechanisms, there is potential for increasing the potency of story-based interventions for achieving maximum therapeutic impact. This notion gains importance in light of our final recommendation: the proposed interventions are essentially prostheses that may ultimately work to support the development of the stable sense of self and life continuity that emerge in typical development over a protracted timetable. If effective for supporting EM in ASD, intervention that is high dosage and of long duration would likely yield maximum benefit. The expectation (indeed hope) is that what originates as a

collaborative (albeit supervised and structured) reminiscing activity will develop into a more natural and spontaneous ability to encode memories as self-experienced and to make good use of this information.

DISCLOSURES

Drs. Hutchins and Prelock have no relevant financial or nonfinancial relationships to disclose.

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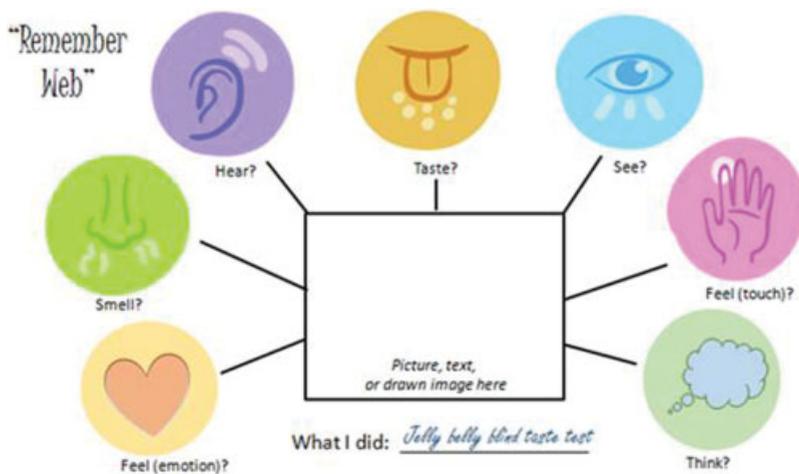
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 See	 Smell	 Hear	 Think
 Feel (emotion)	 Taste	 Feel (touch)	 Say

Appendix A Remember Symbols Dictionary.



Appendix B Remember Web.