Driving Readiness in Autism Spectrum Disorder: The Role of Executive Function & Intellectual Disability
DRIVING READINESS IN AUTISM SPECTRUM DISORDER: THE ROLE OF EXECUTIVE FUNCTION & INTELLECTUAL DISABILITY

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DSM-V Criteria for Autism Spectrum Disorder

Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history:

- Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.

- Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.

- Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

Restricted, repetitive patterns of behavior, interest, or activities, as manifested by at least two of the following, currently or by history:

- Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).

- Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).

- Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).

- Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).
Social Communication

• Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history:
  • Deficits in social-emotional reciprocity, ranging from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions
  • Deficits in nonverbal communicative behaviors used for social interaction, ranging from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
  • Deficits in developing, maintaining, and understanding relationships, ranging from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.
Severity Level: Social Communication

**Level 1 - Requiring Support**
Without supports in place, deficits in social communication cause noticeable impairments. Difficulty initiating social interactions, and clear examples of atypical or unsuccessful responses to social overtures of others. May appear to have decreased interest in social interactions. For example, a person who is able to speak in full sentences and engages in communication but whose to-and-from conversations with others fails, and whose attempts to make friends are odd and typically unsuccessful.

**Level 2 - Requiring Substantial Support**
Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. For example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and who has markedly odd nonverbal communication.

**Level 3 - Requiring Very Substantial Support**
Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. For example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches.
Restricted and Repetitive Behavior

- Restricted, repetitive patterns of behavior, interest, or activities, as manifested by at least two of the following, currently or by history:

  - Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
  - Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).
  - Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
  - Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).
Severity Level:

Level 1: Requiring Support
Inflexibility of behavior causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization and planning hamper independence.

Level 2: Requiring Substantial Support
Inflexibility of behavior, difficulty coping with change, or other restricted/repetitive behaviors appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action.

Level 3: Requiring Very Substantial Support
Inflexibility of behavior, extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action.
Intellectual Disability

• The majority of people with ASD (62%) do not have an intellectual disability (Daly, et al., 2014)
  – Slow speech
  – Reduced problem solving, planning, and academic skills
  – Deficits in language comprehension
  – Deficits in adaptive functioning
Intellectual Disability (Intellectual Developmental Disorder)

Deficits in intellectual functions, such as reasoning, problem solving, planning, abstract thinking, judgment, academic learning, and learning from experience, confirmed by both clinical assessment and individualized, standardized intelligence testing.

Deficits in adaptive functioning that result in failure to meet developmental and sociocultural standards for personal independence and social responsibility. Without ongoing support, the adaptive deficits limit functioning in one or more activities of daily life, such as communication, social participation, and independent living, across multiple environments, such as home, school, work, and community.

Onset of intellectual and adaptive deficits during the developmental period (p.33).

Intellectual Disability

Intellectual disability is a disorder with onset during the developmental period that includes both intellectual and adaptive functioning deficits in conceptual, social, and practical domains. The following three criteria must be met.
Intellectual Disability

• Severity is determined based on adaptive functioning, not just IQ scores, as the purpose of severity levels are to determine amount of support necessary (APA, 2013, p.33).
  
  – **Borderline**
  – **Mild**: concrete approaches to problem solving, difficulty learning academic skills, impaired short term memory, increased gullibility, need some support with daily living
  – **Moderate**: academic skill development remains at elementary levels, support is required for all academic, life, and work skills, maladaptive behaviors are present and may cause social problems
  – **Severe**: little understanding of written language and numbers, caregivers provide extensive supports, limited spoken language in terms of grammar and vocabulary, maladaptive behaviors, such as self-injury, may be present
  – **Profound**: little, if any, understanding of the symbolic world, may understand simple speech, express needs largely through nonverbal communication, dependent on others in all aspects of daily living

Autism Spectrum Disorder: Associated Features

- Individuals with ASD who do not have an intellectual impairment, still have an “uneven profile of abilities” (APA, 2013, p.55)
  - Gap between intellectual and adaptive functional skills
  - Motor deficits
  - Prone to anxiety and depression
  - Poor social skills

Driving with ASD

• Only 24% of adults with autism describe themselves as “independent drivers” (Daly et al., 2014)

• Young adults with ASD are:
  – Less likely than their peers to obtain a driver’s license.
  – More likely to become anxious while driving.
  – Less likely to identify road hazards that are socially based, such as pedestrians.
  – Less likely to monitor visual fields while driving.
Driving with ASD

https://www.youtube.com/watch?v=Ux27IVQE3Fo
Findings of Simulated Driving Studies

• Individuals with ASD demonstrate difficulties with:
  – Motor coordination
  – Speed regulation
  – Lane maintenance
  – Signaling
  – Adjustment to unexpected events (Cox et al., 2015).
Executive-Dysfunction Theory

• One cognitive theory that explains the symptoms of ASD is the “executive-dysfunction theory”.
  – Restricted and repetitive behaviors are caused by impairments in the “initiation of new actions and being stuck in certain patterns” (Roelofs et al., 2015).
  – Poor cognitive shifting has been identified as a frequent EF deficit seen in people with ASD.

  • **Cognitive shifting** is the ability to change to a different thought or action in response to changes in the environment.
    – Poor cognitive shifting would lead to restricted and repetitive behaviors and a preference for sameness.
Executive Function (EF)

- Executive Functions are a set of skills that are necessary for creating and implementing purposeful and future-oriented behavior in reaction to a changing environment.
  - Intellectual abilities, knowledge, skills, and other cognitive functions comprise what a person knows, and executive functions comprise how a person implements such knowledge.
- When the ability to execute behaviors is impaired, it is difficult to function in daily life.
## Executive Function

### Operational Definitions of the Aspects of Executive Function

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision-making</td>
<td>Also known as judgment; assessing and prioritizing various goals and actions</td>
</tr>
<tr>
<td>Impulse control</td>
<td>Also known as inhibition; ability to suppress automatic thoughts that would be inappropriate to act upon in a given environment</td>
</tr>
<tr>
<td>Self-awareness</td>
<td>Ability to critically appraise ourselves and others</td>
</tr>
<tr>
<td>Cognitive flexibility</td>
<td>Ability to shift between thoughts, learn from mistakes, create alternative strategies, divide attention, and process multiple sources of information</td>
</tr>
<tr>
<td>Planning</td>
<td>Ability to create strategies and envision the various steps involved in carrying them out</td>
</tr>
<tr>
<td>Working memory</td>
<td>Ability to temporarily store and manipulate information, such as recalling a phone number, and complex cognitive tasks, such as coordinating two tasks at once (Asimakopulos et al., 2011)</td>
</tr>
</tbody>
</table>
Many of the Executive Functions build upon each other and work simultaneously. If there is dysfunction with one aspect of function, it will impact the effectiveness of the others (Anderson, 2002, p.73).
Executive Function Trajectory

Executive Function continues to develop into our teens and young adulthood (Anderson, 2002).

Fig. 2. Projected developmental trajectories of the executive domains.
Executive Function and Intellectual Disabilities

• EF is also impaired when an intellectual disability is present.
• Most of the research about EF and ASD exclude individuals with an IQ less than 85, so there is not consistent information about when they are co-occurring disabilities.
  – However, studies have found that intelligence can be a good predictor of severity of ASD symptomology.
As IQ decreases, ASD symptoms increase
Psychological Assessments of Executive Function

Frequently used assessments of cognition that contain information relative to executive functioning include:

• Connors Continuous Performance Test (CPT)
• Delis-Kaplan Executive Function System (D-KEFS)
• Mini Mental State Examination (MMSE)
• Wechsler Adult Intelligence Scale (WAIS)
• Wisconsin Card Sorting Test (WCST)
• Stanford-Binet Intelligence Scales
• California Computerized Assessment Package (CalCAP) (Asimakopulos et al., 2011)

WAIS-IV and Wechsler Intelligence Scale for Children (5th Edition) will have similar score summaries.

(Pearson, 2009)
# Stanford-Binet

**Stanford-Binet Intelligence Scales- Fifth Edition (SB-V)**

## IQ and Factor Index Score Results

<table>
<thead>
<tr>
<th></th>
<th>Standard Score</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IQ Scores</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale IQ (FSIQ)</td>
<td>62</td>
<td>1</td>
</tr>
<tr>
<td>Nonverbal IQ (NVIQ)</td>
<td>72</td>
<td>3</td>
</tr>
<tr>
<td>Verbal IQ (VIQ)</td>
<td>57</td>
<td>0.2</td>
</tr>
<tr>
<td>Abbreviated IQ (ABIQ)</td>
<td>58</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| **Factor Index Scores**   |                |            |
| Fluid Reasoning (FR)      | 68             | 2          |
| Knowledge (KN)            | 66             | 1          |
| Quantitative Reasoning (QR)| 61            | 1          |
| Visual Spatial (VS)       | 77             | 6          |
| Working Memory (WM)       | 68             | 2          |

## Subtest Scores

<table>
<thead>
<tr>
<th><strong>Nonverbal Scores</strong></th>
<th>Scaled</th>
<th>%ile</th>
<th></th>
<th><strong>Verbal Scores</strong></th>
<th>Scaled</th>
<th>%ile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Reasoning</td>
<td>3</td>
<td>1</td>
<td></td>
<td>Fluid Reasoning</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Knowledge</td>
<td>5</td>
<td>5</td>
<td></td>
<td>Knowledge</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Quantitative Reasoning</td>
<td>4</td>
<td>2</td>
<td></td>
<td>Quantitative Reasoning</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Visual Spatial</td>
<td>9</td>
<td>37</td>
<td></td>
<td>Visual Spatial</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Working Memory</td>
<td>7</td>
<td>16</td>
<td></td>
<td>Working Memory</td>
<td>2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**NOTE:** All scaled scores are normalized raw scores with mean of 10 and a standard deviation of 3. NA means that insufficient information was available to calculate the score for this individual.
Assessments of Driving Readiness

• There are also assessments specific to driving readiness, frequently used with the geriatric population, that could be applied to adolescents with executive dysfunction, such as:
  • Multifactorial Model of Driving
  • Drive Aware
  • Drive Safe
  • Drive ABLE
  • Driving Habits Questionnaire (DHQ)
  • Rookwood Driving Inventory
  • Comprehensive Trail-Making Test (CTMT)
# Life Skills Checklist

This is part of the paperwork sent home prior to the first appointment with the Easterseals Crossroads New Driver Program.

<table>
<thead>
<tr>
<th>Self Management</th>
<th>Does do…</th>
<th>Does NOT do…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sets own alarm and initiates getting ready for the day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makes a to-do list that follows a reasonable set of priorities and follows through</td>
<td>⭐️</td>
<td></td>
</tr>
<tr>
<td>Makes necessary appointments</td>
<td>⭐️⭐️⭐️⭐️</td>
<td></td>
</tr>
<tr>
<td>Remains calm under pressure</td>
<td>⭐️⭐️⭐️⭐️</td>
<td></td>
</tr>
<tr>
<td>Keeps a calendar of activities (on phone or otherwise)/knows own schedule</td>
<td>⭐️⭐️⭐️⭐️</td>
<td></td>
</tr>
<tr>
<td>Manages personal grooming (shampoo, bath, shower, nails, oral care)</td>
<td>⭐️⭐️⭐️⭐️</td>
<td></td>
</tr>
<tr>
<td>Chooses appropriate clothes to wear for the weather and occasion</td>
<td>⭐️</td>
<td></td>
</tr>
<tr>
<td>Identifies activities that are time wasters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stays at home alone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Life Skills Checklist

<table>
<thead>
<tr>
<th>Home skills</th>
<th>Does do...</th>
<th>Does NOT do...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WITHOUT assistance or supervision</td>
<td>WITH some assistance or supervision</td>
</tr>
<tr>
<td>Example: Operates oven and stove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helps plan and prepare meals or makes own lunch for school/work</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Uses common kitchen tools (can opener, knife, measuring cups and spoons, grater, timer)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follows a recipe accurately</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Takes care of all his/her own laundry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Takes appropriate precautions to avoid cuts, burns, injury</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Social Processing

• Another difference in the cognitive abilities of individuals with ASD that has an impact on their readiness to drive concerns *social processing*. 
Social Processing

- People with ASD spend less time looking at social stimuli and have difficulty interpreting social information
  - Infants with ASD look at people less frequently and for shorter amounts of time than typically developing infants (Sheppard et al., 2009)
  - High-functioning adults with ASD spend less time looking at the eyes of other people, instead focusing on mouths or other bodies and objects in the environment (Sheppard et al., 2009)
Given the differences in where individuals with ASD gain information, there are bound to be dissimilarities in the way that they interpret or understand the social significance of situations (Sheppard et al., 2009).
Social Processing

While driving, it is necessary to make judgments about the intentions of other road users:

• Is that car swerving because he is about to change lanes?
• Is that child on one side of the road crying because her mother is on the other side?
• Does that car have its turn signal on by accident, or do they intend to come into my lane?
• Is there enough room to pass the person in the bicycle lane?
Social Processing

• Static stimuli may be easier for individuals with ASD to process, as research has indicated that there is little difference in the interpretations of static stimuli between those with and without ASD.

• However, given the variety of incoming stimuli one may experience while driving, it is considered to contain dynamic social stimuli, which has proven to be more challenging for individuals with ASD to process (Sheppard et al., 2009)
Social Processing and Driving Safety

• We need to be able to anticipate and predict the actions of others to avoid hazards, whether while driving or behaving as a pedestrian (Sheppard et al., 2009)
  • Studies testing typical adults on hazard perception show that longer time detecting driving hazards is associated with actual accident rates. As a result of these findings, a hazard perception test is now part of the UK driving test (Sheppard et al., 2009)
Research conducted by Sheppard et al., found that although people with ASD can identify driving hazards, they may have increased difficulty when the hazard involves a person.

- It could be that participants with ASD did not attend to people within the driving scene or that they looked at the people, but failed to understand their actions as possibly hazardous (Sheppard et al., 2009)
- There was no difference found between participants with and without ASD in identifying hazards where the driver was not visible (Sheppard et al., 2009)
Brief Report: Driving Hazard Perception in Autism
(Sheppard, Ropar, Underwood, & van Loon, 2009)

Results:

• Participants with ASD were slower to respond to all driving hazards than the participants without ASD, which could be due to their becoming aware of the hazards at a later stage. This could be particularly dangerous, as the ability to anticipate hazards maximizes the decision-making time to allow for safer driving.

• It is possible that participants with ASD perceived the hazards in the same amount of time as the neurotypical group but could not respond as quickly due to difficulties with motor control or planning, both of which are implicated in executive dysfunction (Sheppard et al., 2009)
Recommendations

• Acquire and discuss psychological assessments with a psychologist to gain a better understanding of the individual’s EF.
  – Target EFs that are most impaired to assess for eligibility to drive.
  – Use EF information in designing treatment plans.
• Include social hazard perception in driving instruction.
• Break tasks into smaller steps to reduce frustration and build skills relating to EF deficits and social processing differences.
• Tailor treatment plans towards ASD-specific deficits
Integrating Executive Function into Educational Planning

• Interdisciplinary teams should discuss various assessments that relate to driving readiness and make recommendations.
  – Ideally, the team would integrate the cognitive, sensory, and physical skills necessary to drive safely into the student’s IEP goals.
    • This could be completed during a Case Conference or prepared beforehand at a meeting between an occupational therapist and psychologist.
  – Skills that are important for driving would be appropriate IEP goals.
    • Such goals can be developed based upon EF deficits noted in psychological report and physical challenges described by an occupational therapist.
Tips from Temple

https://www.youtube.com/watch?v=azxDvTFSfW4
Initial Questions: Before Getting in the Car

Speak with the client or his family about his learning history to gain insight about what teaching strategies have worked best in the past.

- Visual schedules
- Mnemonics
- Verbal or visual cues
- Generalization of other skills

Speak with the client or his family about patterns of reactions.

- Is he highly reactive?
- Does he tend to become angry when others do not follow rules?
- Does he have good calming strategies?
- Is he able to calm himself down without help?
- Does the family have any calming strategies that they have found useful?
- Does he have any sensory sensitivities (noises, lights, smells, textures)? If so, how does he react to them?

Speak with the client or his family about their expectations.

- What are they hoping to accomplish?
- Does the student just need to be able to drive to work?
- How frequently would they like the student to drive? Daily? Weekly? In emergencies?
- Are their expectations realistic?
- Is the driver anxious about anything specific? The family?
- Car accidents, being alone, emergencies
**Tips for Teaching**

**Control the Environment**
- Limit the amount of people in the car
- Turn off music
- Put the cell phone out of sight and on silent
- If the student is anxious about emergencies, keep an emergency kit in the trunk (water bottles, blanket, flashlight, food, etc.)
- Limit the geographical environment in which the student drives (until mastery is achieved)

**Give explicit instructions**
- Step-by-step instructions
- Avoid sarcasm or figurative language
- Clearly explain behaviors of other drivers, even if they seem obvious
- Keep the instructions short: build on previous mastery, add new directions slowly and only once master of past skills is attained
- Use concrete language
- When possible, use numbers (MPH, distance in feet)

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Tips for Teaching

• When giving instructions, state them in positive terms, telling the student what to do, instead of what not to do.
  – “Slow down”, instead of “Stop going so fast”

• Give instructions as commands, instead of suggestions or questions.
  – “Stop at the stop sign”, instead of “Why don’t we start slowing down for that stop sign?”

• Discuss the route beforehand, going over possible challenges, driving behaviors of others, strategies to use, etc. (think of social narratives)
  – Decreases anxiety
  – Controls expectations
  – Create visual or verbal scripts (Cox et al., 2012)

• Explain social aspects of driving.
  – That although there are rules for driving, not everyone follows them.
  – Use of the horn in different situations.
  – Waving, flashing headlights, distance from cyclists
  – Road rage (Lushington & Harrison, 2015)

Tips for Teaching

Build a routine into driving sessions
- Helps to build mastery
- Predictability reduces anxiety
- Clarifies expectations

Teach what to do in case of panic
- Calming strategies
- Pulling over to call parents

Teach student to use GPS
- Reduces anxiety when driving in new environments
- Provides strategy for what to do when lost
References


References


