safety

Review

Driving among Adolescents with Autism Spectrum Disorder and Attention-Deficit Hyperactivity Disorder

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Abstract: Over the past several decades there has been a surge of research on the contextual, biological, and psychological factors associated with transportation safety in adolescence. However, we know much less about the factors contributing to transportation safety among adolescents who do not follow a typical developmental trajectory. Adolescents with developmental disabilities (DD) such as Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) have a wide range of behavioral and psychological deficits that may make the complex task of driving even more challenging. Because these adolescents often retain characteristic symptoms of their disorder into adulthood, it may impede their ability to achieve important milestones during the developmental transition from adolescent to adult. As the motivating force behind autonomous living and employment, the capacity for independent transportation is paramount to an adolescent's overall success. This critical review will draw from the current body of literature on adolescent drivers with developmental disabilities to determine (1) areas of impairment; (2) safety risk factors; and (3) effective interventions for improving driving safety in this vulnerable population of adolescent drivers between the ages of 15–22. This review will also identify important unanswered research questions, and summarize the current state of the literature.

Keywords: transportation safety; developmental disabilities; autism spectrum disorder; Attention-Deficit/Hyperactivity Disorder; driving

1. Introduction

Developmental disabilities (DD) affect one in six children aged 3 through 17, and are defined as a group of chronic conditions characterized by impairment in physical, learning, language, or behavior areas beginning during development [1]. Two of the most common DDs are Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD), which account for approximately half of all DDs [2]. These disorders are often accompanied by functional impairments in day-to-day activities including safe transportation and mobility [3]. Safely operating a motor vehicle can provide access to important educational, workforce, healthcare, and social opportunities. Equitable access to these societal assets is important for autonomy and connectedness. Driving facilitates mobility, which in turn increases the likelihood of those with DDs being successfully employed, making meaningful relationships, and becoming independent. Although public transportation is frequently used in large cities and urban areas, those with DDs in rural and suburban areas are forced to rely on family and friends for transportation [4]. Improving quality of life for individuals with DDs is particularly important, as more and more children are being diagnosed and will later be faced with the challenges of living independently [5]. The ability to drive is vital for success in achieving the independent lifestyle desired by the majority of those with DDs [4].

Teenage drivers with DDs, however, are a particularly vulnerable population. ASD and ADHD are unique, in that the impairments associated with the disorders largely impact driving performance rather than driving knowledge [6,7]. A variety of impairments make the cognitively demanding task of driving for these individuals even more difficult compared to typically-developing teens [8]. For adults with ADHD [9,10] and ASD [11], driving is cited as a skill that can significantly improve or hinder successful transitions into adulthood and overall quality of life. Previous literature suggests that individuals with DDs such as ADHD and ASD take longer to pass the on-road test to obtain independent license [12–14]. Thus, it is important to understand how to promote safe mobility among adolescents with DDs, who may be most sensitive to the positive and negative aspects that independent driving can offer. In this review, we summarize the literature on what is known about how adolescents diagnosed with ASD and ADHD experience the learning-to-drive process, and highlight some potential challenges of these diagnoses and important unanswered questions relating to this topic.

2. Method

This critical review included research studies related to ASD and/or ADHD and driving. Each study was evaluated using a validated, 24-item measure of methodologic quality developed by Cho and Bero [15], and assigned a method quality index (MQI) score ranging from 0 to 1, with scores closer to 1 indicating better methodological quality. The MQI score takes various aspects of study methodology into account, such as detail of study methods provided, sample size justification, appropriate statistical analyses, and accurate interpretation of results. All studies reviewed, with the exception of two, had a method quality score of 0.50 or above ($M = 0.654$; $SD = 0.079$). Cox and colleagues' study [16] received a score of 0.48 due to relying solely on reports from parents. The study with a method quality score of 0.49 was due to a lack of methodological detail in the final report [17]. Table 1 provides an overview of each of the studies reviewed. Method quality scores were not applicable to review papers; therefore, they were not assigned MQI scores. Review studies are summarized at the end of Table 1.

Table 1. Literature Review Summary.

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Almberg et al., 2015	Observational Interview; cross-sectional	To explore driving education experienced by individuals with ASD or ADHD	• Individuals with ASD (N = 19, M_{age} = 20.7) • Individuals with ADHD (N = 14, M_{age} = 20.6) • Driving instructors (N = 9)	• ASD participants reported more driving lessons and on-road tests • ASD and ADHD groups reported different challenges to obtaining a license	• Small sample size • Comorbidity of ADHD and ASD was not assessed • Questionnaire used not validated	0.68
Anstey et al., 2012	Observational; cross-sectional	To evaluate the importance of cognitive function for the Capacity to Drive Safely	• Drivers between the ages of 65–96 (N = 297)	• Capacity to Drive Safely declines as adults age are associated with declines in spatial and working memory, vision, and executive functioning and speed	• Sample bias towards a high functioning group • Screening measures may have been too challenging for higher risk drivers	0.59
Ball et al., 2010	Randomized, controlled trial (RCT)	To test the effects of cognitive training on motor vehicle collision involvement in older drivers	• Senior citizen drivers (N = 908, M_{age} = 73.1)	• Participants in the speed of processing and the reasoning intervention had lower rates of at-fault motor vehicle collisions than the control group	• No health rating scale or measure of cumulative illness was available for use	0.78
Barkley et al., 2002	Observational; cross-sectional	To examine the impact of ADHD on multiple levels of driving ability	• Young adults with ADHD (N = 105) • Control adults (N = 64, age range for groups combined = 17–28)	• Adults with ADHD reported more traffic citations than controls • ADHD adults made more errors than controls on a visual reaction task • Controls used safer driving habits than ADHD adults	• Examiners were not blind to group • Participants were young, and older drivers may have safer habits	0.69
Biederman et al., 2007	Naturalistic; cross-sectional	To examine the association between ADHD and driving	• Adults with ADHD (N = 20; M_{age} = 32.0) • Controls without ADHD (N = 21; M_{age} = 27.2)	• ADHD participants were more likely to collide with an obstacle than controls	• Small, homogenous sample that was referred to the study	0.73

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Bishop et al., 2017	Naturalistic; cross-sectional	To evaluate driving performance around hazards among adolescents with ASD	• Young adult drivers with ASD (N = 16) • Typically-developing controls (N = 16, M_{age} for groups combined = 23.17)	• Controls responded more quickly to social hazards • Participants with ASD showed no difference in reaction time between hazard types	• Small sample size • ASD participants were high functioning • Hazard types were not balanced on incidental differences	0.69
Borowsky et al., 2010	Observational; cross-sectional	To observe the effects of age and experience on identifying hazards	• Inexperienced drivers (N = 21, age range = 17–18) • Experienced drivers (N = 19, age range = 22–30) • Elderly-experienced drivers (N = 16, age range = 65–72)	• Young drivers responded less sensitively to unplanned hazards • More experienced drivers gazed more to the right at T-intersections, while young drivers gazed straight ahead	• Small sample size • Unclear study aims	0.51
Brooks et al., 2016	Naturalistic; cross-sectional	To investigate the motor aspects of pre-driving skills in young adults with ASD	• Young adults with ASD (N = 10, M_{age} = 15.9) • Neuro-typical controls (N = 31, M_{age} = 16.7)	• Participants with ASD needed more time to complete the driving simulator tasks • Minimal performance differences were observed between participants with ASD and controls	• Small sample size	0.66
Chee et al., 2015	Observational interview; cross-sectional	To understand the viewpoints of drivers with ASD	• Young adults with ASD (N = 50, M_{age} = 21.8) • Typically developed adults (N = 57, M_{age} = 23.6)	• Some ASD participants preferred non-driving modes of transportation • Anxiety was found to be a barrier to driving in the participants with ASD	• Presence of ASD was self-reported • The ASD and the control groups did not have equal driving statuses	0.68
Corbett et al., 2009	Observational; cross-sectional	To compare and contrast executive functioning in children with ASD, ADHD, and typical development.	• Children with ASD (N = 18, M_{age} = 9.44) • Children with ADHD (N = 18, M_{age} = 9.40) • TD children (N = 18, M_{age} = 9.56)	• Children with ADHD showed deficits in vigilance, inhibition, and working memory • Children with ASD showed deficits in vigilance, response inhibition, cognitive flexibility/switching, and working memory	• Unknown if the sample represents most children with ASD or ADHD • Small sample size • Some modest effects on the results may have been due to medication use	0.67

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Cox et al., 2012	Observational interview	To gain a better understanding of driving and ASD	• Caregivers of young adults with ASD (N = 123)	• Complex driving demands may be problematic for this population • Caregivers indicated that learning to drive is a substantial challenge for their children	• Responses from caregiver • Sample not representative of the entire population of young adults with ASD • No verification of ASD diagnosis	0.48
Cox et al., 2017	RCT	To investigate whether virtual reality driving simulation training improves ASD driving performance	• Novice ASD drivers (N = 51, M_{age} = 17.96)	• Virtual reality driving simulation training group improved driving and executive functioning performance over control training group	• Small sample size • A control group of neuro-typical drivers could have differentiated the effects of ASK from that of being a novice driver • Greater emphasis of on-road training during the training interval could have been encouraged	0.66
Crundall et al., 2010	RCT	To assess the effects of commentary training on learner drivers' performance in a simulator	• Learner drivers (N = 40, age range = 17–25)	• The commentary trained group had fewer crashes, reduced their speed on approach to hazards sooner, and applied pressure to brakes sooner than controls	• Small sample size • Confounds for commentary training not accounted for (e.g., IQ)	0.56
Curry et al., 2017	Retrospective cohort	To examine the association between ADHD, and licensing and crash involvement	• Adolescents with ADHD (N = 2479) • Adolescents without ADHD (N = 15,865)	• Crash hazard among newly licensed drivers with ADHD was 36% higher • Hazard ratios persisted over licensure	• Diagnosis relied on primary care clinicians and not testing of DSM-V standards • Driving exposure was not examined • Results may not be as generalizable due to New Jersey's licensing age, the urbanized area, and the higher prevalence of ADHD in the studied cohort relative to US-based estimates	0.64

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Curry et al., 2018	Retrospective cohort	To compare the proportion of adolescents with and without ASD who acquire a learner's permit and driver's license	• NJ residents born between 1987–1995 (N = 52,172)	• 1/3 ASD individuals obtained a license compared to 83.5% of other adolescents • ASD individuals obtain their license on a median of 9.2 months later than other adolescents • 89.7% of individuals with ASD who acquired a permit and were eligible to do so obtained a license within 2 years	• ASD diagnosis relied on electronic health records • New Jersey's licensing laws are very unique and may not make the results generalizable	0.73
Daly et al., 2014	Observational; cross-sectional	To compare driving history, preferences, and behaviors of adult drivers with ASD with controls	• Adults with ASD (N = 78, M_{age} = 32.9) • Adults without ASD (N = 94, M_{age} = 35.3)	• Drivers with ASD reported lower ratings of their ability to drive and higher numbers of traffic accidents and citations • Drivers with ASD reported higher numbers of intentional violations, mistakes, and slips/lapses	• Data relied on anonymous self-report and self-report diagnosis of ASD • Only drivers with ASD with internet access could complete the survey	0.7
Fabiano et al., 2011	Pilot intervention	To address adolescents with ADHD that have a strong desire to drive	• 16 and 17 year old adolescents with ADHD (N = 7)	• After the intervention, participants decreased hard braking during simulator drives • Parent-teen and family relationships, and driving improved after the intervention	• Small sample size of experienced, licensed drivers • The baseline data for some participants may have been too brief • Potential confound with the driving behaviors measured (e.g., hard braking) and the season of data collection (winter)	0.64

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Fabiano et al., 2016	RCT	To determine whether the Supporting the Effective Entry to the Roadway program improved family functioning and driving behavior	• Adolescents with ADHD (N = 172)	• Parents in STEER were less negative at post-treatment and 6-month follow-up • Teens in STEER reported lower levels of risky driving behaviors at post-treatment and 6-month follow-up	• There was no control group that received no intervention • Results may not generalize to families with less parental involvement • Timing of assessments was not aligned with the first month of independent driving • Medication was not directly manipulated • STEER participants received more attention and interaction with study clinicians	0.76
Fischer et al., 2006	Longitudinal, observational; cohort	To evaluate the impact of ADHD on driving ability	• Children diagnosed as hyperactive (N = 147, M_{age} = 21.1 at follow-up) • Typically-developing control group (N = 71, M_{age} = 20.5 at follow-up)	• Hyperactive drivers were more often ticketed for reckless driving, driving without a license, hit and run crashes, and more had license suspensions/revocations • Cost of initial crash was greater for the hyperactive group • The hyperactive group employed less safe driving practices	• The examiner was not blind to group membership • Reliance on self-report data • No correction was used in analysis for experiment wise error	0.56
Garner et al., 2012	Observational; cross-sectional	To understand the relationship between symptoms of ADHD and adverse driving outcomes	• Adolescents (N = 41, M_{age} = 17.18); half of which have a childhood diagnosis of ADHD-combined type	• Inattention predicted more traffic citations, more self-reported driving errors and violations, and more motor vehicle crashes	• Small sample size • Reliance on self-report data of ADHD symptoms • The study sample was self-referred	0.69

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Groom et al., 2015	Naturalistic; cross-sectional	To compare driving performance of adults with and without ADHD	• Adults with ADHD (N = 22, M_{age} = 31.4) • Adult controls (N = 21, M_{age} = 34.0)	• Participants with ADHD reported more violations, lapses, and accidents than controls • Participants with ADHD displayed higher average speed and speeding, and showed poorer vehicle control, greater levels of frustration with other road users, and a trend for less safe driving when changing lanes in the driving simulator	• Small sample size and few female participants • Study may have been underpowered to find an effect on errors	0.67
Huang et al., 2012	Observational; cross-sectional	To compare the characteristics of driving and non-driving teens with higher functioning ASD	• Parents of adolescents with ASD between the ages of 15 and 18 who drive (N = 73) and who do not drive (N = 175)	• 63% of adolescents currently drive or plan to drive and 29% of teens that are age-eligible to drive currently drive • More driving teens were in full-time education, planned to attend college, and held a paid job • Individualized education plans with driving goals, indicators of functional status, and parent experience with teaching teens to drive predicted driving status in the adolescent	• Relied on parent report • Selection bias may have occurred due to the nature of the study	0.68
Kenworthy et al., 2014	RCT	To evaluate the effectiveness of Unstuck and On Target	• 3rd–5th graders with ASD in the Unstuck and On Target group (N = 47) or the social skills intervention control group (N = 20)	• Individuals in the Unstuck and On Target group showed greater improvements in: problem-solving, flexibility, planning/organizing, and the ability to follow rules, make transitions, and be flexible • Both groups made equal improvements in social skills	• Small sample size not followed longitudinally • Did not evaluate specific characteristics of the interventionists • A task used to measure executive functioning had not been validated	0.62

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Kingery et al., 2015	Naturalistic; cross-sectional	To determine whether ADHD- and texting-related driving impairments are mediated by extended visual glances away from the roadway	• 16 and 17 year-olds with ADHD (N = 28) • 16 and 17 year-olds without ADHD (N = 33)	• Adolescents with ADHD displayed more visual inattention to the roadway during driving simulation • Increased lane variability in the ADHD group was mediated by an increased number of extended glances from the roadway	• The driving simulator may not represent actual driving • The conversation conditions may not have represented actual conversations • Cognitive distraction was not captured	0.64
Klauer et al., 2006	Naturalistic	To evaluate driver inattention using the driving data collected in the 100-Car Naturalistic Driving Study	• 100 cars	• Driving while drowsy increased near-crash/crash risk by 4 to 6 times, engaging in complex secondary tasks increased it by 3 times, and engaging in moderate secondary tasks increases it by 2 times • Driving-related inattention to the forward roadway was safer than baseline driving • Younger and less experienced drivers had high involvement in inattention-related crashes	• Conducted in only one metropolitan area • Secondary tasks were not controlled during analysis and duration of secondary tasks was not analyzed • No continuous audio feed was present	0.74
Lanzi, 2005	Pilot intervention	To develop and implement a learner's license program for adolescents with mild mental retardation or other cognitive limitations	• Adolescent students in Alabama with cognitive limitations (N = 157)	• 78% of students that had an opportunity to take the Alabama Learner's License Test passed the test	• No control group • Driving ability was not assessed	0.49
Matthews et al., 1990	Observational; cross-sectional	To map associations between individual differences in driver stress and personality variables	• Study 1: Adult drivers (N = 159) • Study 2: Adult drivers (N = 44) • Study 3: Adult drivers (N = 49) • Study 4: Adult drivers (N = 50)	• General driver stress was positively correlated with neuroticism, minor crash involvement, and higher frequency of daily hassles and aggressiveness • Higher driver stress was associated with poorer self-rated attention • Driver stress was associated with stressed mood states	• No causal interpretations can be made • All data was self-report data	0.57

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Mayhew et al., 2003	Retrospective cohort	To examine changes in collisions among new drivers	• Novice drivers (N = 40,661)	• Length of time since licensure is associated with decreasing crash rates, with declines most pronounced in the first 6 months • The involvement of certain crash types decline more rapidly than other crash types	• The results do not control for different levels of exposure for young and older novice drivers to the risk of a collision • Reasons for differential changes in crash patterns for young and older novice drivers are unknown	0.55
Merkel et al., 2016	Naturalistic; cross-sectional	To assess on-road driving behavior in a sample of young adult drivers with ADHD	• Young adults with ADHD (N = 17, M_{age} = 20.71) • Young adults without ADHD (N = 19, M_{age} = 21.16)	• Drivers with ADHD were more likely to have more crashes, minor events, and g-force events • G-force events for drivers with ADHD were more risky and illegal, hyperactive/impulsive, and had more distracted behaviors	• The video recording device was only active, therefore behaviors were only analyzed, during g-force events • Only young adults with ADHD that had a minimum record of driving difficulty were recruited for the study	0.77
Moudon et al., 2011	Retrospective cohort	To estimate the odds of a pedestrian dying or being disabled as a result of a collision with a motor vehicle	• Pedestrians involved in a collision on state routes (N = 757) and on city streets (N = 2457)	• 7.4% of pedestrians involved in collisions died and 19.0% obtained a disabling injury, with older pedestrians having an increased risk of both outcomes	• The data only estimates injury severity and does not estimate collision frequency • Data on pedestrians' age and gender, and on vehicle descriptive (e.g., vehicle type, vehicular speeds) were not complete	0.64
Narad et al., 2013	Naturalistic; cross-sectional	To investigate the risks of adolescence, ADHD, and distracted driving on driving performance	• Adolescents with ADHD (N = 28, M_{age} = 16.86) • Adolescents without ADHD (N = 33, M_{age} = 17.14)	• Adolescents with ADHD reported less driving experience and a higher proportion of driving violations • Adolescents with ADHD drove with more variability in speed and lane position during simulated drives • All drivers drove with increased variability in speed and lane position during the texting condition	• Simulator performance may not represent real-world driving behaviors • Driving settings were limited to suburban and urban roadways • The ADHD sample may not have been representative of the ADHD population	0.77

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Factor, 2016	Naturalistic; cross-sectional	To examine differences in driving behavior between young adults with and without ASD	• Young adults with ASD (N = 50, M_{age} = 19.79) • Typically-developing young adults (N = 50, M_{age} = 19.73)	• Drivers with ASD had more difficulty with speed and lane management in the driving simulator • Engaging in secondary tasks impacted driving behavior more for drivers with ASD	• Controls reported more previous driving experience than the participants with ASD • The sample did not include many licensed drivers • The order of the secondary tasks were not counterbalanced	0.71
Poulsen et al., 2010	RCT	To develop a hazard perception training intervention for drivers with ADHD symptoms	• Young adults with ADHD in a hazard perception training group (N = 20, M_{age} = 22.2) or an intervention control group (N = 20, M_{age} = 26.5)	• Participants in the hazard perception training group displayed larger improvements in hazard perception response times	• Small sample of self-referred drivers • Effects of the intervention on specific subtypes of ADHD were not studied • Participants were not clinically assessed for ADHD	0.71
Reimer et al., 2010	Naturalistic; cross-sectional	To explore the impact of cognitive distractions on young drivers with and without ADHD	• Young adults with ADHD (N = 25, M_{age} = 20.56) • Young adults without ADHD (N = 35, M_{age} = 20.65)	• Drivers with ADHD had more difficulty driving with a hands-free device in a simulator, but did not show decreased performance • Drivers with ADHD exhibited a larger decline in performance when driving with a secondary task in a low demand setting	• There were no baseline performance measures of the cognitive tasks • Order of secondary tasks and environments were not counterbalanced	0.77
Reimer et al., 2013	Naturalistic; cross-sectional	To explore driving behavior and visual attention in young adult drivers with high functioning ASD	• Young adults with HF-ASD (N = 20, M_{age} = 20.20) • Community controls (N = 20, M_{age} = 20.70)	• Individuals with HF-ASD exhibited a higher and unvaried heart rate • Individuals with HF-ASD showed a gaze pattern suggestive of a diversion of visual attention away from high stimulus areas of the roadway	• Small sample size • Simulator driving behavior in individuals with HF-ASD may not be generalizable to actual driving behavior	0.66

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
Sheppard et al., 2010	Observational; cross-sectional	To investigate hazard perception in young adults with and without ASD	• Young adults with ASD (N = 23, M_{age} = 18.55) • Comparison controls (N = 21, M_{age} = 18.83)	• Participants with ASD identified fewer social hazards and were slower to respond to hazards	• Using videos to test perceptions may not represent real-life situations	0.62
Sheppard et al., 2016	Observational; cross-sectional	To explore attentional patterns in individuals with and without ASD	• Young adults with ASD (N = 18; M_{age} = 18.79) • Comparison controls (N = 17, M_{age} = 18.19)	• Participants with ASD were slower to orient gaze to hazards • Greater attentional capture in the time preceding the hazards' onset was associated with lower verbal IQ	• None of the participants were licensed • The hazard perception test performance is not representative of individuals with driving training/experience • The sample was only male	0.62
Sobanski et al., 2008	Nonrandomized control trial	To assess history of driving and determine whether pharmacotherapy improves driving related cognitive functions in adults with ADHD	• Adults with ADHD (N = 27, M_{age} = 34.3) • Control adults (N = 27, M_{age} = 34.3)	• Adults with ADHD drove more per year, were registered and fined by traffic authorities more, were involved in more accidents, and self-reported driving more insecure and hectic • Methylphenidate treatment improved information processing, visual orientation, and sustained visual attention	• Small sample size and controls recruited from the authors' circle of friends • Investigators were not blind to medication or control status • Some data was collected from self-reports	0.65
Wade et al., 2015	RCT	To test a gaze-contingent driving intervention	• Adolescents with ASD in the gaze-contingent intervention group (N = 6; M_{age} = 14.65) or a performance-based control group (N = 6; M_{age} = 15.93)	• Participants in the gaze-contingent group showed a lowered and left-shifted gaze • Participants in the control group showed a decrease in trial failures pre-test to post-test	• Very small sample size and more in-depth analysis of the data is required	0.54

Table 1. *Cont.*

Review Papers				
Article	**Review Type**	**Objective**	**Outcomes**	**Limitations**
Barkley and Cox, 2007	Literature Review	Review driving risks associated with ADHD	• Risks for driving offenses and crashes were increased among children with more severe ADHD symptoms • Adults with ADHD are at increased risk for adverse driving outcomes • Drivers with high aggression have been found to have a higher prevalence of psychiatric disorders, such as ADHD • MPH medications improve driving performance in adolescents with ADHD	• More research is needed on how medication, other that MPH, impacts driving performance • Other treatments need to be evaluated on their efficacy of improving driving outcomes
Elander et al., 1993	Literature Review	To review methodological issues on the study of differential crash involvement	• Hazard perception latency plays a role in how driving skill contributes to crash risk • Driving styles of driving faster and willingness to commit driving violations increase crash risk and may be explained in terms of personality and antisocial motivation	• Driver training and testing procedures need to be improved • A more comprehensive theory of crash risk needs to be developed
Lindsay, 2016	Systematic Literature Review	To review the literature on factors affecting driving for people with ASD	• Many people with ASD encounter challenges in obtaining a driver's license, driving confidence, and driving performance • Direct communication, encouraging coping mechanisms, breaking down tasks, and providing regular and consistent driving lessons are all useful strategies when teaching people with ASD to drive	• More rigorous research is needed • Confounds not often accounted for • Perspectives of individuals with ASD on challenges and their experience is inadequate
Wilson et al., 2018	Literature Review	To review driving behaviors of individuals with ASD	• Individuals with ASD drive differently than neuro-typical individuals • Individuals with ASD have shortcomings on skills related to driving, but how this affects their safety and the safety of other on the road is unclear • Training programs can improve skills related to driving	• There are few ASD-specific learner training programs available • Many studies use data from observations in driving simulator and/or virtual reality settings, or use self-report driving data

3. ASD

One of the fastest-growing neurodevelopmental disabilities in the United States is ASD, with a prevalence that has increased from 1 in 88 children in 2008, to 1 in 68 children in 2014 [18]. ASD is characterized by deficits in social communication and social interaction, the presence of repetitive behaviors and restricted interests, and a complex combination of diminished and intact cognitive abilities [19]. The majority of these characteristics have been identified and studied in children with ASD, but research suggests that these impairments also persist into adolescence and adulthood; a period in which complex tasks like driving become an essential part of everyday living [20–22].

For children diagnosed on the high-functioning end of the Autism Spectrum in the early 2000′s, who will soon be approaching driving age, the decision to drive and the challenges that will accompany this task are approaching quickly [18]. Curry and colleagues [23] recently conducted one of the largest studies to date on driver licensure among individuals with ASD. They examined licensure rates and progression through licensure in a sample of approximately 600 New Jersey residents with ASD. They found that approximately one third of individuals with ASD acquired a driver's license, but did so roughly 9 months later than typically-developing individuals. About 90% of those individuals with ASD who obtained a learner's permit also obtained a license within the next two years. This points to a discrepancy in the number of individuals with ASD who are interested in/planning on driving (approximately two thirds) [7] and the current licensure rates in this population [23]. There is however, little research to explain why this may be the case. Despite the limited number of individuals with ASD who are licensed and driving, and the importance of driving in increasing independence and quality of life, research in transportation safety among drivers with ASD is sparse. Although many of the impairments associated with ASD may negatively impact safe driving in this population, the most commonly-cited issues by parents, caregivers, and driving instructors relate to three general areas of impairment: anxiety, processing speed and executive function.

3.1. Anxiety

Previous survey data have identified anxiety as one of the most commonly reported driving barriers for individuals with ASD [12,16]. Anxiety disorder presents as a disproportionate fear or adverse reaction to relatively nonthreatening environmental stimuli, and is a common co-morbid condition seen in individuals with ASD [24,25]. Although prevalence rates of anxiety disorders in the ASD population have been varied, ranging from 47 to 84% [25,26], several studies have found higher rates of clinical and subclinical levels of anxiety in individuals with ASD as compared to typically-developing groups [26–28]. Within the population of individuals with ASD, it has also been found that individuals with High-Functioning Autism (HFA) or Asperger's Syndrome (AS) exhibit particularly high levels of anxiety [26,27]. It has been suggested that this is due to the highly cognitive nature of anxiety disorders; therefore, individuals on the Autism Spectrum with higher IQ may experience greater levels of anxiety [29]. This is an especially pertinent issue, as they are the subgroup of individuals with ASD's who are mostly likely to drive independently [22,23].

There is a large body of literature suggesting that anxiety has a negative impact on general task performance [30–32]. The worry and constant monitoring of potentially harmful stimuli reduce the efficiency of working memory, processing speed, and subsequently task performance [33]. Several of the cognitive domains impacted by high levels of anxiety are critical to the task of driving, including working memory and information processing [33–35]. Matthew and colleagues investigated the impact of anxiety on driving, and found more self-reported driving errors and poorer simulated driving performance (e.g., poor steering control) in individuals with high levels of driving anxiety [36,37]. As anxiety is a consistently-reported problem in the population of individuals with ASD, it stands to reason that their elevated levels of anxiety may negatively impact their driving performance and confidence [25,38]. A recent pilot study investigating the self-reported driving behaviors of licensed drivers with ASD revealed that compared to non-ASD drivers, drivers with ASD report significantly lower ratings of their driving abilities, suggesting that they are less confident in their driving abilities than typically-developing controls; this may be a result of driving anxiety [39].

3.2. Processing Speed

Visual processing speed has been defined as "the amount of time needed to make a correct judgment about a visual stimulus" (i.e., detecting a target, identifying a target's spatial location) [40]. As this ability is used constantly during the task of driving (e.g., detecting hazards in the environment, judging the spatial positions of other vehicles), visual processing speed is a key skill for navigating the driving environment safely [41]. Typically-developing, experienced drivers are able to quickly identify important, safety-relevant aspects of the driving environment (e.g., the cars in front of them, pedestrian crosswalks, traffic lights and road signs) [42]. Typically-developing, experienced drivers' increased attention to important areas of the driving environment, and their ability to quickly scan the scene for hazards, provides them with adequate information to drive safely, and allows them to react quickly to avoid these hazardous situations [42]. This visual processing speed has been shown in previous research to be underdeveloped in individuals with ASD [43,44].

In the real-world driving environment, the inability to rapidly process a great deal of visual information in an environment and identify important target items (e.g., traffic lights, other cars, pedestrians, stop signs, etc.) could result in an increased risk of motor vehicle collision. These decrements have not only been demonstrated in children with ASD [44]; processing speed impairments have also been shown to persist into adolescence and adulthood, a time period when the task of driving becomes an important part of daily living [21]. Adults with ASD have also self-reported difficulties in "processing fast-moving visual events", a description that certainly applies to the complex and dynamic nature of the driving environment [45]. Further, the type of hazards drivers with ASD encounter may also affect the speed at which they react to and avoid them [46].

3.3. Executive Function

Executive functioning is a broad term that encompasses a myriad of tasks and abilities, and is a commonly-reported impairment among individuals with ASD [47]. Although previous research has produced mixed results as to the exact aspects of executive function affected by ASD, generalized impairment in everyday executive functioning is the general consensus throughout the autism research community [43,48,49]. Among individuals with ASD, the most commonly-cited impairments in executive functioning occur in the areas of attention, inhibition, and cognitive inflexibility [43,48,49].

Appropriate allocation of attention in the driving environment is essential to driving safety. Sheppard and colleagues [50] investigated this driving skill in non-drivers with ASD, and found that such individuals were slower to orient their attention to driving hazards than those in the typically-developing group. This study is however limited, in that it examined only non-drivers, and used video clips rather than a driving simulator paradigm. Eye tracking results in a study by Reimer and colleagues [51] examining visual attention in a driving simulator also found atypical visual attention in drivers with ASD. Findings revealed that drivers with ASD focused their eye gaze more on low stimulus areas of the driving environment (e.g., looking up towards the horizon where there are fewer cars) than high stimulus areas of the driving environment (e.g., directly at the car in front of them, at pedestrians walking to their right or left) [51]. This is particularly dangerous in a real-world driving environment, as higher stimulus areas such as city streets and suburban streets are where hazards often occur for various reasons (e.g., more pedestrian crossings and intersections) [52].

The response inhibition impairments seen in ASD may also have serious implications for driver safety. Driving requires the rapid processing of a great deal of information while simultaneously filtering out irrelevant details and inhibiting responses to those details. If this cannot be accomplished, a driver may miss important information in the driving environment, such as a pedestrian walking into the roadway, while caught up on irrelevant environmental details (e.g., a colorful arrangement of flowers on the sidewalk). Because so much of driving is reacting to the actions of other drivers, cognitive flexibility and response inhibition are essential for safe navigation [53,54]. This cognitive inflexibility and difficulty with strict rule adherence have been cited by both teens with ASD and their driving instructors when asked what the most challenging aspects of driving were [12]. Teens with ASD self-reported "interacting with other drivers" and "interpreting traffic situations" as some of the most difficult driving skills [12]. When these same teens' driving instructors were questioned about the driving situations that were most challenging for their students with ASD, they cited the inflexibility and rule following characteristics of ASD as major barriers to driving. Further, adjusting to unfamiliar situations was one of the most commonly reported problematic skills for drivers with ASD [12].

3.4. Driver Performance & Safety Considerations

Objective studies examining the driving safety of individuals with ASD have varied in both the ASD population examined (i.e., non-drivers, pre-drivers and fully licensed drivers) and the findings [55]. Reimer and colleagues [51] were among the first to test the driving capabilities of individuals with ASD using a driving simulator. Findings from this brief report suggested that compared to matched, typically-developing controls, individuals with ASD may have elevated heart rates (a possible indicator of stress and anxiety) and unsafe gaze patterns while driving. Sheppard and colleagues [56] also investigated driving safety in the ASD population by examining reaction time to hazardous events. Compared to control participants, drivers with ASD had significantly slower reaction times when identifying hazards with a response button. This is important when considering that delayed reaction time is a significant predictor of motor vehicle collision-related injury or death [57].

Although the innovative driving studies conducted by Reimer [51] and Sheppard [56] examined the vulnerable group of drivers with ASD with a comparison group, they did not examine individuals at varying levels of driving experience, a factor identified by previous literature as having a significant impact on driving performance [58]. Cox and colleagues [59] conducted a recent driving simulator study in a population of individuals with ASD who had received their learner's permit (novice drivers). The goal of the study was to examine the role of executive function and basic motor skill in tactical driving performance in 17 individuals with ASD who were not yet fully licensed, but had obtained a driver's permit, compared to 27 typically-developing controls who had just received their full driver's license. Results indicated that the ASD group exhibited poorer driving performance (i.e., increased swerving, increased lane changes); decrements were further compounded with the addition of a working memory task. Findings of the study also suggested that the ASD group had significantly slower hand/arm reaction times (i.e., swerving) when compared to typically-developing controls [59]. Not only did the ASD and typically-developing groups have inherent differences in driving experience (i.e., the ASD group had only permits, while the typically-developing group had obtained a full unrestricted license), but they also did not consider inter-group variability in driving experience.

As a follow up to their previous work, Cox and colleagues [60] also investigated the simulated driving performance of novice drivers with ASD and typically-developing, licensed, experienced drivers. As the authors expected, novice drivers with ASD performed significantly worse on all measures of driving performance (i.e., excessively low speed, crashes, off-road driving, missed turns), and had significantly lower overall driving skill scores. Not only were the ASD group's driving skill scores significantly poorer, they were nearly 6 standard deviations below driving skill scores of experienced, typically-developing drivers. However, the significant deficits in simulated driving performance noted in the ASD group may have been due to the vast differences between the ASD and typically-developing groups in terms of driving experience, along with the added impairments associated with ASD.

ASD participants have also reported more intentional violations (e.g., speeding or tailgating), driving mistakes (i.e., making a maneuver without checking mirrors, pressing the wrong pedal), and slips or lapses than did typically-developing controls [39]. In another survey, the majority (70%) of parents who had adolescents with ASD who were driving or trying to receive their driver's license reported that their child's autism "moderately" to "extremely" negatively impacted their teen's driving abilities [16]. These same parents identified multitasking (e.g., merging while maintaining speed), awareness of traffic, use of mirrors, and maintaining lane position as the most difficult (rated as "very difficult') skills to teach their son or daughter with ASD [16]. Turning, speed control, and braking were also rated as "difficult" tasks when teaching their child to drive.

Contrary to the findings of Cox and colleagues [59], a study of the on-road driving behavior of individuals with and without ASD revealed only certain areas of driving deficit (i.e., vehicle maneuvers, left turns) in drivers with ASD [38,61]. The performance of drivers with ASD was superior to that of the typically-developing group on driving behaviors related to rule following (i.e., using turn signals, checking for traffic at intersections) [38,61]. Strict rule adherence is a common characteristic of individuals with ASD, and may be useful in some driving scenarios (i.e., following the speed limit), but may also prove to be a hinderance in driving situations where rules are unclear, such as driving through yellow lights, encountering collisions, reacting to other drivers' incorrect behavior, and adapting to evolving traffic conditions. Overall however, the majority of studies conducted on ASD and driving suggest that drivers with ASD have significant decrements in driving performance, and may require additional training compared to typically-developing individuals [61].

4. ADHD

ADHD is a behavioral disorder characterized by inattention and/or hyperactivity-impulsivity [19], and is one of the most common developmental disorders, affecting approximately 8% of the population [62]. Within the population of individuals with ADHD, there are three sub-types: ADHD—Predominately Inattentive (presents with 6+ inattentive symptoms), ADHD—Predominately Hyperactive (presents with 6+ hyperactive symptoms), and ADHD—Combined (presents with 6+ of each inattention and hyperactivity) [19]. Individuals diagnosed with ADHD-C are at the greatest driving safety risk, as they present clinical levels of both inattention and hyperactivity [6]. For individuals aged 17 and older (the large majority of drivers on the road), only five of each symptom category must be present to receive an ADHD diagnosis [19]. With this reduction in the symptoms required for an ADHD diagnosis in the latest DSM, there are even more drivers with ADHD on the roadways today. The characteristic impairments in attention and impulsive behavior make the cognitively-demanding task of driving difficult for individuals with ADHD [14,63,64]. Teenagers with ADHD have almost four times as many traffic citations and car crashes than their typically-developing peers, and are seven times more likely to have a second crash [63]. Further, the relational strain often seen between teens with ADHD and their parents [65] may impact the learning-to-drive period, and reduce the quality of supervised, parental practice for these teens [66].

4.1. Inattention

Inattention is one of the hallmark characteristics of individuals with ADHD, and has been attributed by previous research to impairments in executive function [67]. Research suggests that impairments in sustained attention seen in ADHD may result in poor academic performance and delayed social development [68]. Inattention may not only prove problematic in social and academic settings, but also in the driving environment [69]. Visual attention refers to where an individual orients their gaze in a visual field, and is an especially relevant skill in the context of the driving environment [70]. Unfortunately, this is a known area of impairment among individuals with ADHD [71]. Compared to typically-developing teens, teens with ADHD exhibit significantly more inattention to the roadway in a driving simulator task [72]. This inattention to the roadway may not only impact vehicle control, but also the ability to quickly react to hazardous events.

Previous literature on reaction time in ADHD has been fairly consistent in finding greater variability on reaction time in individuals with ADHD as compared to typically-developing individuals [73,74]. It has been suggested that the slower reaction times are a result in frequent lapses in attention when responding to stimuli [73,74]. Previous studies examining reaction time in the context of a driving environment have shown mixed results, with some indicating slower and more variable reaction times in adolescents with ADHD compared to typically-developing adolescents [75], and others finding no significant differences in reaction time to hazardous events [6,76,77].

4.2. Impulsivity

Although impairments in sustained attention pose a significant driving safety risk for divers with ADHD, research also suggests that impulsivity and hyperactive behavior play a role in the driving behavior and elevated motor vehicle collision risk for drivers with ADHD [78]. Previous research has also suggested that impulsive behaviors in individuals with ADHD may be related to impairments in executive function—more specifically, inhibition [79]. This inability to inhibit inappropriate or unsafe behaviors may result in greater levels of frustration with other drivers (emotional regulation difficulties), and increase risky driving behaviors such as speeding, distracted driving, and driving under the influence [78]. A survey of 27 drivers with ADHD found that subjects had driven significantly more kilometers per year, had more traffic authority registrations, more traffic violations, more collisions, and more self-reported insecure and hectic driving styles compared to typically-developing drivers [80].

4.3. Medication

Medications are a critical component in the treatment of ADHD, and stimulant medication is often the first line of treatment for teens [81]. Previous research suggests that stimulant medications significantly reduce symptoms of ADHD (i.e., inattention, hyperactivity and impulsivity), and can improve adaptive abilities of adolescents with ADHD [82], which includes complex skills such as driving. In a repeated-measures crossover study of teens aged 16 to 18 with ADHD, stimulant medications significantly reduced inattentive driver errors (e.g., swerving into neighboring lanes) but not impulsive/intentional errors (e.g., cutting someone off) [83]. This suggests that emotion regulation may also play a role in driving safety for teens with ADHD [63,84]. The time frame of beneficial effects, 12–16 h post-ingestion, suggests that the medications must be continued on a daily basis to see sustained improvement in driving abilities. As demonstrated in the studies, stimulant medications have previously demonstrated potentially protective effects for drivers with ADHD in the areas of attention. Current research on ADHD and driving, however, is fairly inconsistent in the inclusion of medication in task performance measures (i.e., take medication before task or abstain for a time frame prior) or accounting for its effects (i.e., medication type and amount are not accounted for).

4.4. Driver Performance & Safety Considerations

Predisposition to risky driving behavior and difficulties in attention regulation place individuals with ADHD at a much higher susceptibility to driving distractions than teens without ADHD [8,14]. Reimer, Mehler [8] investigated the potentially detrimental effects of talking on a cell phone on simulated driving performance of ADHD drivers between the ages of 17 and 24. Findings suggested that under more challenging driving conditions (e.g., driving in urban areas), young adults with ADHD exhibited a more conservative driving pattern, as indicated by a greater time spent at stop signs and slower driving acceleration; however, this also led to a diminished secondary task performance (in this case talking on a cell phone) compared to controls [8]. This study, along with most other studies in the ADHD and driving literature, had a small sample of young adults with ADHD. Participants also performed the driving task without medication. As most individuals with ADHD are taking medication, it is important to consider the impact of medication on these findings. Further, these driving behaviors may not be representative of real-world driving behavior, where the threat of crashing may alter distracted driving behavior. A naturalistic study sought to examine the real world driving behaviors of young adult drivers with ADHD over a three month period using an in-vehicle camera that recorded video and g-force events (e.g., braking or accelerating suddenly). Young adults with ADHD were involved in significantly more MVCs and increased g-force events, more risky and illegal vehicle maneuvers, and distracted driving behaviors, such as removing hands from the wheel to reach for a moving object in the car [85]. Although typically-developing controls were matched to young adults with ADHD on age, gender, race, and education, individuals with ADHD were required to have had more than one previous driving violation (collision or citation), which likely biased the ADHD driver group selected.

5. Driver Training Programs

The growing body of research investigating the driving challenges of individuals with ASD and ADHD have brought to light a variety of potential predictors of poorer driving outcomes. The identification of these factors has led to various interventions to improve driving safety for this vulnerable population of drivers. These interventions include virtual reality, psychological therapeutic techniques, as well as simple modifications to current training programs.

5.1. Virtual Reality

With the recent increase in the use and availability of technological solutions, virtual reality has become a safe and ethical means of both testing and training human behavior. Virtual reality is already being used to improve social interactions among children with ASD through the use of social robots [86] and emotional-facial recognition programs [87]. Not only has previous research demonstrated the usefulness of virtual reality in reducing anxiety and social impairments, virtual reality driving environments have also shown promise in training and improving driving performance in novice drivers with ASD and ADHD [60,88,89]. More specifically, Wade and colleagues have shown improvements in the use of a driving-simulator gaze training system to teach individuals with ASD to look at safety-relevant aspects of the driving environment [90]. Although virtual reality interventions have the potential to improve various aspects of driving safety in these vulnerable populations, they are often expensive, and cannot be easily transported to families who need them.

5.2. Psychological

As discussed above, impairments in executive functioning play a significant role in the driving challenges associated with both ASD and ADHD. Executive functions can, however, be improved thorough the implementation of cognitive training programs. Cognitive training programs have been successful in reducing crash risk in other vulnerable road users such as older adults [91], which suggests that these interventions may also be useful for drivers with DDs characterized by executive dysfunction [92,93]. These improvements in executive function may, in turn, translate to improved driving performance. Individuals with DDs may also benefit greatly from the implementation of proven, therapeutic techniques, such as cognitive behavior therapy (CBT), to specifically target psychological barriers to driving [94]. For example, the driving anxiety commonly seen in individuals with ASD may be reduced with the implementation of CBT targeted at reducing fearful thoughts about driving. Computerized hazard identification and avoidance training programs have also been successful in DD populations. Drivers with ADHD demonstrated significant improvements in driving hazard identification response times following a brief computer-based intervention [95]. Other promising approaches for teen drivers for ADHD specifically include the Supporting the Effective Entry to the Roadway program [96,97], which involved driver monitoring using on-board diagnostics coupled with symptom tracking and pharmaceutical interventions which are commonly prescribed to teenagers with ADHD [98].

5.3. Program Modifications

Modifications tailored to the specific needs of individuals with DDs may also prove to be a useful tool in improving driving safety. Simple changes to the language and vocabulary level in the typical learner's permit study manual resulted in improved success rates among individuals with cognitive limitations (mean IQ of sample = 71) in passing the learner's permit portion of the driver's test [17]. This simplified approach to may also be successful in training drivers with DDs to safely obtain not only their learner's permit, but also their full driver's license. Additional practice hours and increased requirements for supervised practice hours may also be beneficial for teens with ADHD and ASD. Another cost effective and useful training program modification that has demonstrated advances for drivers with DDs is commentary training. Rather than the traditional written scenario commonly used in driver's education classes, commentary training allows the driver-in-training to give continuous feedback about what should happen next while watching a taped drive from a driver's perspective [95,99]. This allows instructors to put the trainee in dangerous situations to train responses without risking the trainee's safety.

6. Important Gaps and Unanswered Research Questions

In summary, teen driver safety research with vulnerable populations of adolescents, such as those with ASD and ADHD, is growing. Young drivers with DDs may be an increased risk for driving decrements due to symptoms commonly associated with their particular disorder. For example, young individuals with ASD are less likely to progress to independent driving [23], and the etiology may vary by person—perhaps due to anxiety about driving [12,16], low confidence in driving ability, or poorly developed cognition (e.g., executive function) known to relate to driving safety. These factors may result in greater likelihood of avoidant driving behaviors among individuals with ASD as compared to individuals with ADHD or typically-developing peers. For individuals with ADHD, the underlying mechanisms of driving risks may be different, as these individuals are more likely to engage in distracted driving, and drive at higher speeds [85], but may not avoid complex driving situations that put them at increased risk.

Several notable gaps became more apparent from this literature review. Aside from pharmacological interventions, there is a limited body of literature focused on cognitive and behavioral driver programs for families with a teen diagnosed with a developmental disability, especially those that are individualized to the needs of the teen driver. Such interventions can scaffold medical interventions, providing a stable platform to support lifelong safe transportation. Differences in how the disability is viewed by the family, parental anxiety and values, economic factors, access to health and programmatic resources, and geographic constraints may all influence adolescents' path to safe and independent mobility. Additional research on these factors is essential for providing tailored support to adolescents who want to get licensed and can do so safely.

Little attention has been given to areas of impairment noted in adolescents with ASD and ADHD that are seemingly less related to driving performance, such as social cognition or emotion regulation. Impairments and/or delays in social development and emotion regulation are commonly seen in both individuals with ASD [18,27] and individuals with ADHD [100]. Driving is a largely social task that requires interaction with other drivers and anticipation of other drivers' and road users' behavior to negotiate safely [101,102]. Very few studies have investigated the impact of these social impairments on driving performance in drivers with ASD [46,56] or ADHD [84].

The populations and methodological approaches used in the current literature on DD's and driving vary greatly, which makes it difficult to draw firm conclusions on these populations as a whole. Studies lack consistency in diagnosis confirmation (e.g., self-report, parent-report, various symptom inventories), appropriate comparison groups (e.g., control groups with equal driving experience and exposure), and driving behavior data (e.g., self-report, driving simulator, observational, parent-report). Additionally, like most psychological research, research on this topic is almost exclusively conducted with "WEIRD" samples—Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies [103]. Generalizations to populations of teens with DDs that significantly vary based on cultural, socio-political, and economical factors from those in these studies should be made with extreme caution. Cross-cultural research is essential.

Finally, we are also in an age of rapidly evolving vehicle technologies, including connected vehicles, advanced driver assistance systems (ADAS), and infotainment options. How young drivers with ASD and ADHD are affected by these innovations in vehicle design and capability is largely unknown; the same may be said of adolescents without these diagnoses. It is plausible that ADAS may prove beneficial for drivers who have cognitive limitations that might impede an effective driver response, such as a quick braking maneuver to avoid a potential hazard. On the other hand, behavioral adaptation to varying levels of ADAS could complicate matters, and could reduce the net effect on safety [104] if, for example, the automation results in declines in situation awareness and the driver exhibits delays in taking full control of the vehicle when the ADAS falters or becomes inactive. Preliminary work in this area with typically-developing teens suggests that teens report greater trust in their own skills and competences than in-vehicle technology [105]. However, it is uncertain whether teens with DDs would report similar preferences and needs. Autonomous vehicles might provide a unique, safe transportation option, and might also introduce new unforeseen problems. Important overarching questions include the need to understand what capacities and abilities young drivers with DDs must have to safely operate (or ride unsupervised) in these vehicles, what additional accommodations they might need to enhance their safety, and how inequalities in access to these technologies might differentially affect the safety of more marginalized groups of teens.

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References

1. Center for Disease Control and Prevention (CDC). *Developmental Disabilities*; Center for Disease Control and Prevention: Atlanta, GA, USA, 2018.
2. Boyle, C.A.; Boulet, S.; Schieve, L.A.; Cohen, R.A.; Blumberg, S.J.; Yeargin-Allsopp, M.; Kogan, M.D. Trends in the prevalence of developmental disabilities in US children, 1997–2008. *Pediatrics* **2011**, *127*, 1034–1042. [CrossRef] [PubMed]
3. Craig, F.; Margari, F.; Legrottaglie, A.R.; Palumbi, R.; de Giambattista, C.; Margari, L. A review of executive function deficits in autism spectrum disorder and attention-deficit/hyperactivity disorder. *Neuropsychiatr. Dis. Treat.* **2016**, *12*, 1191–1202. [PubMed]
4. Gaylord, V.; Abeson, A.; Bosk, E.; Timmons, J.; Lazarus, S. Meeting transportation needs of youth and adults with developmental disabilities. *Impact* **2005**, *18*, 1–34.
5. Zablotsky, B.; Black, L.I.; Maenner, M.J.; Schieve, L.A.; Blumberg, S.J. *Estimated Prevalence of Autism and other Developmental Disabilities Following Questionnaire Changes in the 2014 National Health Interview Survey*; National Health Statistics Report; U.S. Department of Health and Human Services and the Center for Disease Control and Prevetion: Atlanta, GA, USA, 2015.
6. Barkley, A.R.; Murphy, K.R.; Kwasnik, D. Motor vehicle driving competencies and risks in teens and young adults with Attention Deficit Hyperactivity Disorder. *Pediatrics* **1996**, *98*, 1089–1095. [PubMed]
7. Huang, P.; Kao, T.; Curry, A.E.; Durbin, D.R. Factors associated with driving in teens with autism spectrum disorders. *J. Dev. Behav. Pediatr.* **2012**, *33*, 70–74. [CrossRef] [PubMed]
8. Reimer, B.; Mehler, B.; D'Ambrosio, L.A.; Fried, R. The impact of distractions on young adult drivers with attention deficit hyperactivity disorder (ADHD). *Accid. Anal. Prev.* **2010**, *42*, 842–851. [CrossRef] [PubMed]
9. Gotlieb, E.M.; Gotlieb, J.S. Helping adolescents with ADHD transition toward adulthood. *Adolesc. Med. State Art Rev.* **2009**, *20*, 203–222. [PubMed]
10. Harpin, V.A. The effect of ADHD on the life of an individual, their family, and community from preschool to adult life. *Arch. Dis. Child.* **2005**, *90*, i2–i7. [CrossRef] [PubMed]
11. Renty, J.O.; Roeyers, H. Quality of life in high-functioning adults with Autism Spectrum Disorder: The predictive value of disability and support characteristics. *Autism* **2006**, *10*, 511–524. [CrossRef] [PubMed]
12. Almberg, M.; Selander, H.; Falkmer, M.; Vaz, S.; Ciccarelli, M.; Falkmer, T. Experiences of facilitators or barriers in driving education from learner and novice drivers with ADHD or ASD and their driving instructors. *Dev. Neurorehabil.* **2015**, *20*, 59–67. [CrossRef] [PubMed]

13. Feeley, C. Evaluating the transportation needs and accesibility issues for adults on the Autism Spectrum in New Jersey. In Proceedings of the Transportation Research Board 89th Annual Meeting, Washington, DC, USA, 10–14 January 2010.
14. Curry, A.E.; Metzger, K.B.; Pfeiffer, M.R.; Elliot, M.R.; Winston, F.K.; Power, T.J. Motor vehicle crash risk among adolsecents and young adults with attention-deficit/hyperactivity disorder. *JAMA Pediatr.* **2017**, *171*, 756–763. [CrossRef] [PubMed]
15. Cho, M.K.; Bero, L.A. Instruments for assessing the quality of drug studies published in the medical literature. *JAMA* **1994**, *272*, 101–104. [CrossRef] [PubMed]
16. Cox, N.B.; Reeve, R.E.; Cox, S.M.; Cox, D.J. Brief report: Driving and young adults with ASD: Parents' experiences. *J. Autism Dev. Disord.* **2012**, *42*, 2257–2262. [CrossRef] [PubMed]
17. Lanzi, R. Project drive: Supporting individuals with cognitive limitations in getting their leaner's liscense. *Impact* **2005**, *18*, 22–23.
18. Centers for Disease Control and Prevention (CDC). *Autism Spectrum Disroder (ASD): Facts about ASD*; Center for Disease Control and Prevention: Atlanta, GA, USA, 2015. Available online: http://www.cdc.gov/ncbddd/autism/data.html (accessed on 18 July 2018).
19. American Psychiatric Association (APA). *Diagnostic and Statistical Manual of Mental Disorders: Fifth Edition (DSM-V)*; American Psychiatric Association: Washington, DC, USA, 2014.
20. Howlin, P. Outcome in adult life for more able individuals with autism or Asperger syndrome. *Autism* **2000**, *4*, 63–83. [CrossRef]
21. Luna, B.; Doll, S.K.; Hegedus, S.J.; Minshew, N.J.; Sweeney, J.A. Maturation of executive function in Autism. *Biol. Psychiatry* **2007**, *61*, 474–481. [CrossRef] [PubMed]
22. Lindsay, S. Systematic review of factors affecting driving and motor vehicle transportation among people with Autism Spectrum Disorder. *Disabil. Rehabil.* **2016**, *39*, 837–846. [CrossRef] [PubMed]
23. Curry, A.E.; Yerys, B.E.; Huang, P.; Metzger, K.B. Longitudinal study of driver licensing rates among adolescents and young adults with autism spectrum disorder. *Autism* **2017**, *22*, 479–488. [CrossRef] [PubMed]
24. National Institute of Mental Health (NIMH). *Anxiety Disorders*; National Institute of Mental Health: Bethesda, MD, USA, 2016. Available online: https://www.nimh.nih.gov/health/topics/anxiety-disorders/index.shtml (accessed on 23 July 2018).
25. White, S.W.; Oswald, D.; Ollendick, T.; Scahill, L. Anxiety in children and adolescents with autism spectrum disorders. *Clin. Psychol. Rev.* **2009**, *29*, 216–229. [CrossRef] [PubMed]
26. Gillot, A.; Furniss, F.; Walter, A. Anxiety in High-Functioning Children with Autism. *Autism* **2001**, *5*, 277–286. [CrossRef] [PubMed]
27. Bellini, S. Social Skill Deficits and Anxiety in High-Functioning Adolescents with Autism Spectrum Disorders. *Focus Autism Dev. Disabil.* **2004**, *19*, 78–86. [CrossRef]
28. Vohra, R.; Madhavan, S.; Sambamoorthi, U. Comorbidity prevalence, healthcare utilization, and expenditures of Medicaid enrolled adults with Autism Spectrum Disorders. *Autism* **2016**, *21*, 995–1009. [CrossRef] [PubMed]
29. Kelleher, J.C. Anxiety Symptoms in Individuals with High Functioning Autism, in Developmental Psychology. Master's Thesis, University of Connecticut, Storrs, CT, USA, 2013; p. 37.
30. Hembree, R. Correlates, causes, effects and treatment of test anxiety. *Rev. Educ. Res.* **1988**, *58*, 47–77. [CrossRef]
31. Seipp, B. Anxiety and academic performance: A meta-analysis of findings. *Anxiety Res.* **2007**, *4*, 27–41. [CrossRef]
32. Holdnack, J.A.; Zhou, X.; Larrabee, G.J.; Millis, S.R.; Salthouse, T.A. Confirmatory factor analysis of the WASI-IV/WMS-IV. *Assessment* **2011**, *18*, 178–191. [CrossRef] [PubMed]
33. Eysenck, M.W.; Calvo, M.G. Anxiety and Performance: The Processing Efficiency Theory. *Cognit. Emot.* **1992**, *6*, 409–434. [CrossRef]
34. Pacheco-Unguetti, A.; Acosta, A.; Callejas, A.; Lupianez, J. Attention and anxiety: Different attentional functioning under state and trait anxiety. *Psychol. Sci.* **2010**, *21*, 298–304. [CrossRef] [PubMed]
35. Beck, A.T.; Clark, D.A. An information processing model of anxiety: Automatic and strategic processes. *Behav. Res. Ther.* **1997**, *35*, 49–58. [CrossRef]
36. Matthews, G.; Dorn, L.; Hoyes, T.W.; Davies, D.R.; Glendon, A.I.; Taylor, R.G. Driving stress and performance on a driving simulator. *J. Hum. Factors Ergon. Soc.* **1998**, *40*, 136–149. [CrossRef] [PubMed]

37. Matthews, G.; Dorn, L.; Glendon, A.I. Personality correlates of driver stress. *Pers. Indiv. Differ.* **1991**, *12*, 535–549. [CrossRef]
38. Chee, D.Y.; Lee, H.C.; Falkmer, M.; Barnett, T.; Falkmer, O.; Siljehav, J.; Falkmer, T. Viewpoints on driving of individuals with and without Autism Spectrum Disorder. *Dev. Neurorehabil.* **2015**, *18*, 26–36. [CrossRef] [PubMed]
39. Daly, B.P.; Nicholls, E.G.; Patrick, K.E.; Brinckman, D.D.; Schultheis, M.T. Driving behaviors in adults with Autism Spectrum Disorders. *J. Autism Dev. Disord.* **2014**, *44*, 3119–3128. [CrossRef] [PubMed]
40. Owsley, C. Visual processing speed. *Vis. Res.* **2013**, *90*, 52–56. [CrossRef] [PubMed]
41. Anstey, K.J.; Horswell, M.S.; Wood, J.M.; Hatherly, C. The role of cognitive and visual abilities as predictors in the multifactorial model of driving safety. *Accid. Anal. Prev.* **2012**, *45*, 766–774. [CrossRef] [PubMed]
42. Borowsky, A.; Shinar, D.; Oron-Gilad, T. Age, skill, and hazard perception in driving. *Accid. Anal. Prev.* **2010**, *42*, 1240–1249. [CrossRef] [PubMed]
43. Corbett, B.A.; Constantine, L.J.; Hendren, R.; Rocke, D.; Ozonoff, S. Examining executive functioning in children with Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder and typical development. *Psychiatry Res.* **2009**, *166*, 210–222. [CrossRef] [PubMed]
44. Yi, L.; Liu, Y.; Li, Y.; Fan, Y.; Huang, D.; Gao, D. Visual scanning patterns during the dimensional change card sorting task in children with Autism Spectrum Disorder. *Autism Res. Treat.* **2012**, *2012*, 1–11. [CrossRef] [PubMed]
45. Gepner, B.; Mestre, D. Rapid visual-motion integration deficit in Autism. *Trends Cognit. Sci.* **2002**, *6*, 455. [CrossRef]
46. Bishop, H.J.; Biasini, F.J.; Stavrinos, D. Social and non-social hazard response in drivers with Autism Spectrum Disorder. *J. Autism Dev. Disord.* **2017**, *47*, 905–917. [CrossRef] [PubMed]
47. Rosenthal, M.; Wallace, G.L.; Lawson, R.; Wills, M.C.; Dixon, E.; Yerys, B.E.; Kenworthy, L. Impairments in real world executive function increases from childhood to adolescence in Autism Spectrum Disorder. *Neuropsychology* **2013**, *27*, 13–18. [CrossRef] [PubMed]
48. Chan, A.S.; Cheung, M.C.; Han, Y.M.; Sze, S.L.; Leung, W.W.; Man, H.S.; To, C.Y. Executive function deficits and neural discordance in children with Autism Spectrum Disorders. *Clin. Neurophysiol.* **2009**, *120*, 1107–1115. [CrossRef] [PubMed]
49. Geurts, H.M.; Verte, S.; Oosterlaan, J.; Roeyers, H.; Sergeant, J.A. How specific are executive functioning deficits in attention deficit hyperactivity disorder and autism? *J. Child Psychol. Psychiatry* **2004**, *45*, 836–854. [CrossRef] [PubMed]
50. Sheppard, E.; van Loon, E.; Underwood, G.; Ropar, D. Attentional differences in a driving hazard perception task in adults with Autism Spectrum Disorder. *J. Autism Dev. Disord.* **2016**, *47*, 405–414. [CrossRef] [PubMed]
51. Reimer, B.; Fried, R.; Mehler, B.; Joshi, G.; Bolfek, A.; Godfrey, K.M.; Biederman, J. Brief report: Examining driving behavior in young adults with high-functioning Autism Spectrum Disorders: A pilot study using a driving simulation paradigm. *J. Autism Dev. Disord.* **2013**, *43*, 2211–2217. [CrossRef] [PubMed]
52. Moudon, A.V.; Lin, L.; Jiao, J.; Hurvitz, P.; Reeves, P. The risk of pedestrian injury and fatality in collisions with motor vehicles, a social ecological study of state routes and city streets in King County, Washington. *Accid. Anal. Prev.* **2011**, *43*, 11–24. [CrossRef] [PubMed]
53. Barkley, R.A.; Murphy, K.R.; DuPaul, G.J.; Bush, T. Driving in young adults with Attention Deficit Hyperactivity Disorder: Knowledge, performance, adverse outcomes, and the role of executive functioning. *J. Int. Neuropsychol. Soc.* **2002**, *8*, 655–672. [CrossRef] [PubMed]
54. Anstey, K.J.; Wood, J.; Lord, S.; Walker, J.G. Cognitive, sensory and physical factors enabling driving safety in older adults. *Clin. Psychol. Rev.* **2005**, *25*, 45–65. [CrossRef] [PubMed]
55. Wilson, N.J.; Lee, H.C.; Vaz, S.; Vindin, P.; Cordier, R. Scoping review of the driving behaviour of and driver training programs for people on the Autism Spectrum. *Behav. Neurol.* **2018**, *2018*, 1–17. [CrossRef]
56. Sheppard, E.; Ropar, D.; Underwood, G.; Van Loon, E. Brief report: Driving hazard perception in Autism. *J. Autism Dev. Disord.* **2010**, *40*, 504–508. [CrossRef] [PubMed]
57. Elander, J.; West, R.; French, D. Behavioral correlates of individual differences in road-traffic crash risk: An examination method and findings. *Psychol. Bull.* **1993**, *113*, 279–294. [CrossRef] [PubMed]
58. Mayhew, D.R.; Simpson, H.M.; Pak, A. Changes in collision rates among novice drivers during the first months of driving. *Accid. Anal. Prev.* **2003**, *35*, 683–691. [CrossRef]

59. Cox, S.M.; Cox, D.J.; Kofler, M.J.; Moncrief, M.A.; Johnson, R.J.; Lambert, A.E.; Reeve, R.E. Driving simulator performance in novice drivers with Autism Spectrum Disorder: The role of executive functions and basic motor skills. *J. Autism Dev. Disord.* **2016**, *46*, 1379–1391. [CrossRef] [PubMed]
60. Cox, D.J.; Brown, T.; Ross, V.; Moncrief, M.; Schmitt, R.; Gaffney, G.; Reeve, R. Can youth with autism spectrum disorder use virtual reality driving simulation training to evaluate and improve driving performance? An exploratory study. *J. Autism Dev. Disord.* **2017**, *47*, 2544–2555. [CrossRef] [PubMed]
61. Patrick, K.E.; Hurewitz, F.; McCurdy, M.D.; Agate, F.T.; Daly, B.P.; Tarazi, R.A.; Schultheis, M.T. Driving comparisons between young adults with autism spectrum disorder and typical development. *J. Dev. Behav. Pediatr.* **2018**, *39*, 451–460. [CrossRef] [PubMed]
62. Centers for Disease Control and Prevention (CDC). *Attention-Deficit/Hyperactivity Disorder (ADHD): Diagnosis Data*; Center for Disease Control and Prevention: Atlanta, GA, USA, 2014. Available online: http://www.cdc.gov/ncbddd/adhd/prevalence.html (accessed on 2016 January 2016).
63. Barkley, R.A.; Cox, D. A review of driving risks and impairments associated with Attention-Deficit/Hyperactivity Disorder and the effects of stimulant medication on driving performance. *J. Saf. Res.* **2007**, *38*, 113–128. [CrossRef] [PubMed]
64. Nada-Raja, S.; Langley, J.D.; McGee, R.; Williams, S.M.; Begg, D.J.; Reeder, A.I. Inattentive and hyperactive behaviors and driving offenses in adolescence. *J. Am. Acad. Child Adolesc. Psychiatry* **1997**, *36*, 515–522. [CrossRef] [PubMed]
65. Alizadeh, H.; Applequist, K.F.; Collidge, F.L. Parental self-confidence, parenting styles, and corporal punishment in families of ADHD children in Iran. *Child Abuse Negl.* **2007**, *31*, 567–572. [CrossRef] [PubMed]
66. Bishop, H.J.; Curry, A.E.; Stavrinos, D.; Mirman, J.H. Characterizing the learning-to-drive period for teens with attention-deficit/hyperactivity disorder of trouble staying focused. *Dev. Psychol.* **2018**, submitted.
67. Barkley, R.A. Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychol. Bull.* **1997**, *121*, 65–94. [CrossRef] [PubMed]
68. Barkley, R.A.; DuPaul, G.; McMurray, M.B. Comprehensive evaluation of attention deficit disorder with and without hyperactivity as defined by research criteria. *J. Consult. Clin. Psychol.* **1990**, *58*, 775–789. [CrossRef] [PubMed]
69. Garner, A.A.; Gentry, A.; Welburn, S.C.; Fine, P.R.; Franklin, C.A.; Stavrinos, D. Symptom dimensions of disruptive behavior disorders in adolescent drivers. *J. Atten. Disord.* **2012**, *18*, 496–503. [CrossRef] [PubMed]
70. Klauer, S.G.; Dingus, T.A.; Neale, V.L.; Sudweeks, J.D.; Ramsey, D.J. *The Impact of Driver Attention on Near-Crash/Crash Risk: An Analysis Using the 100-Car Naturalistic Driving Study Data*; National Highway Traffic Safety Administration: Washington, DC, USA, 2006; p. 193.
71. Munoz, D.P.; Armstrong, I.T.; Hampton, K.A.; Moore, K.D. Altered control of visual fixation and saccadic eye movements in Attention-Deficit Hyperactivity Disorder. *J. Neurophysiol.* **2003**, *90*, 503–514. [CrossRef] [PubMed]
72. Kingery, K.M.; Narad, M.; Garner, A.A.; Antonini, T.N.; Tamm, L.; Epstein, J.N. Extended visual glances away from the roadway are associated with ADHD-and texting-related driving performace deficits in adolescents. *J. Abnormal Child Psychol.* **2014**, *43*, 1175–1186. [CrossRef] [PubMed]
73. Tamm, L.; Narad, M.E.; Antonini, T.N.; O'Brien, K.M.; Hawk, L.W., Jr.; Epstein, J.N. Reaction time variability in ADHD: A review. *Neurotherapeutics* **2012**, *9*, 500–508. [CrossRef] [PubMed]
74. Kofler, M.J.; Rapport, M.D.; Sarver, D.E.; Raiker, J.S.; Orban, S.A.; Friedman, L.M.; Kolomeyer, E.G. Reaction time variability in ADHD: A meta-analytic review of 319 studies. *Clin. Psychol. Rev.* **2013**, *33*, 795–811. [CrossRef] [PubMed]
75. Fischer, M.; Barkley, R.A.; Smallish, L.; Fletcher, K. Hyperactive children as young adults: Driving abilities, safe driving behavior, and adverse driving outcomes. *Accid. Anal. Prev.* **2007**, *39*, 94–105. [CrossRef] [PubMed]
76. Narad, M.; Garner, A.A.; Brassell, A.A.; Saxby, D.; Antonini, T.N.; O'Brien, K.M.; Epstein, J.N. Impact of distraction on the driving performance of adolescents with and without Attention-Deficit/Hyperactivity Disorder. *J. Am. Med. Assoc. Pediatr.* **2013**, *167*, 1–6. [CrossRef] [PubMed]
77. Biederman, J.; Fried, R.; Monuteaux, M.C.; Reimer, B.; Coughlin, J.F.; Surman, C.; Faraone, S.V. A laboratory driving simulation for assessment of driving behavior in adults with ADHD: A controlled study. *Ann. Gen. Psychiatry* **2007**, *6*, 4. [CrossRef] [PubMed]

78. Groom, M.J.; van Loon, E.; Daley, D.; Chapman, P.; Hollis, C. Driving behavior in adults with attention-deficit/hyperactivity disorder. *BMC Psychiatry* **2015**, *15*, 175. [CrossRef] [PubMed]
79. Willcutt, E.G.; Doyle, A.E.; Nigg, J.T.; Faraone, S.V.; Pennington, B.F. Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biol. Psychiatry* **2005**, *57*, 1336–1346. [CrossRef] [PubMed]
80. Sobanski, E.; Sabljic, D.; Alm, B.; Skopp, G.; Kettler, N.; Mattern, R.; Strohbeck-Kuhner, P. Driving-related risks and impact of methylphenidate treatment on driving in adults with Attention-Deficit/Hyperactivity Disorder (ADHD). *J. Neural Transm.* **2008**, *115*, 347–356. [CrossRef] [PubMed]
81. Guevara, J.; Lozano, P.; Wickizer, T.; Mell, L.; Gephart, H. Psychotropic medicaiton use in a population of children who have attention-deficit/hyperactivity disorder. *Pediactrics* **2002**, *109*, 733–739. [CrossRef]
82. Faraone, S.V.; Buitelaar, J. Comparing the efficacy of stimulants for ADHD in children and adolescents using meta-analysis. *Eur. Child Adolesc. Psychiatry* **2010**, *19*, 353–364. [CrossRef] [PubMed]
83. Cox, D.J.; Humphrey, J.W.; Merkel, R.L.; Penberthy, J.K.; Kovatchev, B. Controlled-release methylphenidate improves attention during on-road driving by adolescents with attention-deficit/hyperactivity disorder. *J. Am. Board Fam. Med.* **2004**, *17*, 235–239. [CrossRef]
84. Richards, T.L.; Deffenbacher, J.L.; Rosen, L.A.; Barkley, R.A.; Rodricks, T. Driving anger and driving behavior in adults with ADHD. *J. Atten. Disord.* **2006**, *10*, 54–64. [CrossRef] [PubMed]
85. Merkel, R.L.J.; Nichols, J.Q.; Fellers, J.C.; Hidalgo, P.; Martinez, L.A.; Putziger, I.; Cox, D.J. Comparison of on-road driving between young adults with and without ADHD. *J. Atten. Disord.* **2013**, *20*, 1–20. [CrossRef] [PubMed]
86. Kim, E.S.; Berkovits, L.D.; Bernier, E.P.; Leyzberg, D.; Shic, F.; Paul, R.; Scassellati, B. Social robots as embedded reinforcers of social behavior in children with autism. *J. Autism Dev. Disord.* **2013**, *43*, 1038–1049. [CrossRef] [PubMed]
87. Hopkins, I.M.; Gower, M.W.; Perez, T.A.; Smith, D.S.; Amthor, F.R.; Wimsatt, F.C.; Biasini, F.J. Avatar assistant: Improving social skills in students with an ASD through a computer-based intervention. *J. Autism Dev. Disord.* **2011**, *41*, 1543–1555. [CrossRef] [PubMed]
88. Brooks, J.; Kellett, J.; Seeanner, J.; Jenkins, C.; Buchanan, C.; Kinsman, A.; Pierce, S. Training the motor aspects of pre-driving of young adults with and without Autism Spectrum Disorder. *J. Autism Dev. Disord.* **2016**, *46*, 2408–2426. [CrossRef] [PubMed]
89. Bruce, C.; Unsworth, C.; Tay, R. A systematic review of the effectiveness of behavioural interventions for improving driving outcomes in novice drivers with attention deficit hyperactivity disorder (ADHD). *Br. J. Occup. Ther.* **2014**, *77*, 348–357. [CrossRef]
90. Wade, J.; Bian, D.; Fan, J.; Zhang, L.; Swanson, A.; Sarkar, M.; Sarkar, N. A Virtual Reality Driving Environemnt for Training Safe Gaze Patterns: Application in Individuals with ASD. In Proceedings of the International Conference on Universal Access in Human-Computer Interaction, Los Angeles, CA, USA, 2–7 August 2015.
91. Ball, K.; Edwards, J.D.; Ross, L.A.; McGwin, G.J. Cognitive training decreases motor vehicle collision involvement among older drivers. *J. Am. Geriatr. Soc.* **2010**, *58*, 2107–2113. [CrossRef] [PubMed]
92. Klingberg, T.; Fernell, E.; Olesen, P.J.; Johnson, M.; Gustafsson, P.; Dahlstrom, K.; Westerberg, H. Computerized training of working memory in children with ADHD—A randomized, controlled trial. *J. Am. Acad. Child Adolesc. Psychiatry* **2005**, *44*, 177–186. [CrossRef] [PubMed]
93. Kenworthy, L.; Anthony, L.G.; Naiman, D.Q.; Cannon, L.; Wills, M.C.; Luong-Tran, C.; Wallace, G.L. Randomized controlled effectiveness trail of executive function intervention for children on the autism spectrum. *J. Child Psychol. Psychiatry* **2013**, *55*, 374–383. [CrossRef] [PubMed]
94. Bruggink, A.; Huisman, S.; Vuijk, R.; Kraaij, V.; Garnefski, N. Cognitive emotion regulation, anxiety and depression in adults with autism spectrum disorder. *Res. Autism Spectrum Disord.* **2016**, *22*, 34–44. [CrossRef]
95. Poulsen, A.A.; Horswill, M.S.; Wetton, M.A.; Hill, A.; Lim, S.M. A brief office-based hazard perception intervention for drivers with ADHD symptoms. *Aust. N. Z. J. Psychiatry* **2010**, *44*, 528–534. [CrossRef] [PubMed]
96. Fabiano, G.A.; Hulme, K.; Linke, S.; Nelson-Tuttle, C.; Pariseau, M.; Gangloff, B.; Buck, M. The supporting a teen's effective entry to the roadway (STEER) Program: Feasibility and preliminary support for a psychosocial intervention for teenage drivers with ADHD. *Cognit. Behav. Pract.* **2011**, *18*, 267–280. [CrossRef]

97. Fabiano, G.A.; Schatz, N.K.; Morris, K.L.; Willoughby, M.T.; Vujnovic, R.K.; Hulme, K.F.; Pelham, W.E. Efficacy of a family-focused intervention for young drivers with attention-deficit hyperactivity disorder. *J. Consult. Clin. Psychol.* **2016**, *84*, 1078–1093. [CrossRef] [PubMed]
98. Sibley, M.H.; Kuriyan, A.B.; Evans, S.W.; Waxmonsky, J.G.; Smith, B.H. Pharmacological and psychosocial treatments for adolescents with ADHD: An updated systematic review of the literature. *Clin. Psychol. Rev.* **2014**, *34*, 218–232. [CrossRef] [PubMed]
99. Crundall, D.; Andrews, B.; van Loon, E.; Chapman, P. Commentary training improves responsiveness to hazards in a driving simulator. *Accid. Anal. Prev.* **2010**, *42*, 2117–2124. [CrossRef] [PubMed]
100. Rich, E.C.; Loo, S.K.; Yang, M.; Dang, J.; Smalley, S.L. Social functioning difficulties in ADHD: Association with PDD risk. *Clin. Child Psychol. Psychiatry* **2009**, *14*, 329–344. [CrossRef] [PubMed]
101. Guéguena, N.; Eyssartierb, C.; Meineria, S. A pedestrian's smile and drivers' behavior: When a smile increases careful driving. *J. Saf. Res.* **2016**, *56*, 83–88. [CrossRef] [PubMed]
102. Wilde, G.J.S. Social interaction patterns in driver behavior: An introductory review. *Hum. Factors* **1976**, *18*, 477–492. [CrossRef]
103. Henrich, J.; Heine, S.J.; Norenzayan, A. The weirdest people in the world? *Behav. Brain Sci.* **2010**, *33*, 61–83. [CrossRef] [PubMed]
104. Sullivan, J.M.; Flannagan, M.J.; Pradhan, A.K.; Bao, S. *Literature Review of Behavioral Adaptation to Advanced Driver Assistance Systems*; AAA Foundation for Traffic Safety: Washington, DC, USA, 2016.
105. Weiss, E.; Thiel, M.F.; Sultana, N.; Hannan, C.; Seacrist, T. Advanced driver assistance systems for teen drivers: Teen and parent impressions, perceived need and intervention preferences. *Traffic Inj. Prev.* **2018**, *19* (Suppl. S1), S120–S124. [CrossRef] [PubMed]