safety

MDPI

Correction

Correction: Bishop, H. et al. Driving among Adolescents with Autism Spectrum Disorder and Attention-Deficit Hyperactivity Disorder. *Safety* 2018, *4*, 40

Haley Bishop *, Logan Boe, Despina Stavrinos and Jessica Mirman

Department of Psychology, University of Alabama at Birmingham, Birmingham, AL 35233, USA; lboe@uab.edu (L.B.); dstavrin@uab.edu (D.S.); jhmirman@uab.edu (J.M.)

* Correspondence: haleyj89@uab.edu; Tel.: +205-975-0083

Received: 13 November 2018; Accepted: 14 November 2018; Published: 16 November 2018

The published version of the paper [1] had incorrect bibliographic information in Table 1 (e.g., author names; citations). The information has been corrected by the authorship team.

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
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

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
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
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

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
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
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. 2007	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
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

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
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
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

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
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. 1991	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
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

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
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
Patrick et al. 2018	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

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

Table 1. *Cont.*

Research Studies						
Article	**Type of Study**	**Objective**	**Participants**	**Key Findings**	**Limitations**	**MQI**
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	

The authors apologize for any inconvenience caused to the readers by these changes. The changes do not affect the scientific results. The original manuscript will be updated and will remain online on the article webpage, with a reference to this correction.

References

1. Bishop, H.; Boe, L.; Stavrinos, D.; Mirman, J. Driving among Adolescents with Autism Spectrum Disorder and Attention-Deficit Hyperactivity Disorder. *Safety* **2018**, *4*, 40. [CrossRef]