How missing a treatment of Mixed Amphetamine Salts Extended Release affects performance in teen drivers with ADHD

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Introduction

Teen drivers are higher risk than any other age group1 and the risk of being in a collision while driving for teen drivers with Attention-Deficit-Hyperactivity-Disorder (ADHD) is 4 times higher than that for other teens2. Research suggests that some stimulant medications may improve performance in drivers with ADHD3, but it is not at all uncommon for teens to skip their medications. This study investigates how driving performance changes over the course 12 hours as a function of a single missed treatment of Mixed Amphetamine Salts Extended Release (MAS-XR), also known as Adderall XR4. There are relatively few studies of MAS-XR and none with samples where this medication is the treatment of choice. To determine the effects of missing a single medication, each driver was tested once with the MAS-XR and once with a placebo, with half of the drivers starting with the medication and the other half starting with the placebo.

A second goal of this study was to determine whether missing a dose of MAS-XR has different effects on different aspects of driving performance. One reason that teen drivers are at such high risk of collision is that their driving skills are not fully developed. As skills develop the processes involved demand fewer attentional resources,5 but if MAS-XR works by enhancing attentional function, there is reason to expect that missing a treatment would have especially deleterious effects on performance in domains where drivers exhibit the least skill.

Method

Participants. Participants were 14 healthy teen drivers recruited from a pediatrician's office (M age = 17 years: 2 months, 2 females). None had a full driver's license. Instead 11 had an Ontario G1 "learner's permit", which is obtained through a written test and only allows driving under the supervision of a licensed driver, and 3 had a G2, which is obtained 1 year after the G1 with an onroad test and permits unsupervised driving under restricted conditions. All drivers had been diagnosed with ADHD. Combined type and co-morbid Oppositional Defiant Disorder. MAS-XR was their treatment of choice. (MAS-XR was prescribed only after it became apparent that other more common medications were ineffective using MAS-XR and for more years: Males M dosage = 55 grams (SD = 8.2) and M weight = 73 kg, Females M dosage = 45 grams (SD = 7.1), M weight = 63 kg.)

Apparatus. Testing was carried out in a fixed base driving simulator that had a 360-degree wrap-around field of view (Figure 1). The study involved a 10-minute training drive and 7 unique 25-minute drives (a baseline drive and 6 experimental drives). All involved traveling through the country on a two-lane highway that featured scenery (farms, farms, trees, service stations, small towns), road signs, and leading and trailing traffic. Drives contained the same number of corners but the scenery and specific order of events varied (Figure 2). In each drive, speed limits varied between 50 and 90 kph. Hazards emerged periodically from the periphery (clycists, vehicles, pedestrians, and animals that went into the path of the vehicle).

Procedure. The testing occurred over one evening and two successive days. The first evening participants did the 10-minute training drive and then they did the 25-minute baseline drive. The next morning, at breakfast participants were given the placebo or their usual dose of MAS-XR, and then they were tested in the simulator, 1, and 8 hours later. The same sequence of events occurred on the following day except individuals who were given MAS-XR on the first day were given placebo on the second, and vice versa. Both participants and those testing them were kept blind to when the medication was given. To ensure there was no confusion about instructions, a technician accompanied the participants during the drive.

Results

Performance on the baseline drive was used to calculate indices of each driver's skill as compared to others in the sample. By averaging 2 scores across the performance metrics listed in parentheses below, 3 measures of faulty driving skill were derived:

- Delayed hazard response (# collisions, median hazard RT)
- Erratic braking (SD hazard RT, unnecessary stops, #rolling stops)
- Erratic steering (SD of lateral position: straight & winding sections)

There were no significant correlations among these metrics (p > .05). This indicates that individuals with strengths in one domain (e.g. steering) might have weaknesses in another (delayed hazard response).

Effects of the medication condition: Medication: MAS-XR, placebo was measured as a function of test (1, 8, 12 hours post-administration of the medication or placebo). Preliminary analyses were carried out to determine whether driving speeds were faster on placebo than on medication. They weren't (M difference in speed = 0.5 kph, F = 1).

When deprived of their usual dosage of MAS-XR, does the number of collisions go up in teen drivers with ADHD? YES, by late in day

Conclusions

Three domains of faulty driving performance were assessed on the baseline drive: delayed hazard response, erratic braking, and erratic steering. Correlations among these three domains were not significant. Individual differences between drivers in the sample on these three measures predicted the degree to which performance deteriorated off-medication. Performance deteriorated most in domains where the drivers exhibited the least skill. Thus, hazard RT deteriorated most off-medication for the participants with the most erratic braking on the baseline drive. This finding was not due to ceiling effects because performance was far from optimal for any of the drivers in this sample. Thus, in any given teen with ADHD, some aspects of performance may suffer more than others when they miss a single dose of MAS-XR.

Two main conclusions can be taken from these findings. 1) Faulty driving skills in one domain need not predict those in another. 2) For teen drivers with ADHD, missing a single dose of MAS-XR was enough to degrade performance, though the effects are strongest at the end of the day and in domains where the drivers exhibited the least skill. The highlights the importance of consistent medication use in teen drivers with ADHD when they are learning to drive.

References