Stimulant medication is not associated with increased cheating during online task performance: A field study

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Submitted to: JMIR Mental Health
on: October 07, 2024

Table of Contents

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Abstract

Background: Performance-related cheating is a common psychological side effect in settings where task attention is enhanced, for instance, through incentives. However, only a single previous study found a positive effect of stimulants commonly used to elevate attention in attention-deficit/hyperactivity disorder on cheating.

Objective: In a field study, we examined whether methylphenidate (MPH) and mixed amphetamine salts (MAS) increased prohibited usage of Internet resources during the performance of judgment and knowledge tasks.

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Results: There was a significant crossover interaction in both cheating paradigms, such that those medicated with MPH exhibited lower cheating than those unmedicated, while those medicated with MAS indicated a slight reverse effect, yet both medications did not evidence a simple effect of medication. There was also no effect or interaction of ADHD diagnosis.

Conclusions: We find no evidence for the positive effect of MPH on cheating observed previously, and instead find a trend in the reverse direction (Cohen's d = -0.31), which also sheds light on the heterogeneity in the effect of MPH on performance.

(JMIR Preprints 07/10/2024:67260)
DOI: https://doi.org/10.2196/preprints.67260

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This work was supported in part by the Max Wertheimer Minerva Center for Cognitive Studies.

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Conclusions: We find no evidence for the positive effect of MPH on cheating observed previously, and instead find a trend in the reverse direction (Cohen's d = -0.31), which also sheds light on the heterogeneity in the effect of MPH on performance.

Keywords: stimulants, methylphenidate, amphetamines, cheating, ADHD, Internet, judgment

Introduction

Recent studies in behavioral economics have shown that economic variables that enhance task attention, such as incentives and fines, also increase the tendency to improve performance through dishonest means [1-4]. Yet direct examinations of the effect of attention on cheating yield equivocal findings [5-8]. For example, van't Veer et al. [5] found that increasing load lowered cheating while Askoy and Palma [7] and Børsting et al. [8] found that increasing attention had no effect on cheating. Conversely, Hochman et al. [6] found that cheating responses were preceded by increases in physiological arousal which may be interpreted as evidence that increased attention facilitates cheating. Adopting a psychopharmacological perspective, the current research investigated whether methylphenidate and amphetamines, two central nervous system stimulants commonly used for increasing sustained attention, increase cheating during online task performance.

Central nervous system stimulants such as methylphenidate (MPH) and amphetamines are often used for boosting cognitive performance [9], particularly in the management of attention-deficit/hyperactivity disorder (ADHD), though not only. While there is a literature examining their medical adverse effects [10], there is relatively little attention to their cognitive adverse effects [11,12]. A particularly uninvestigated potential side effect is cheating, which represents a huge challenge in online tests of performance and crowdsourcing [13-15].

The only study that we are aware of that evaluated the effect of methylphenidate on cheating was conducted more than thirty years ago by Hinshaw, Heller, and McHale [16]. The participants of the study – adolescents diagnosed with ADHD and a control sample of adolescents without ADHD – were asked to perform a hidden word or picture puzzle, and were told that the research assistant had the answer sheet used for grading the task. The research assistant then left the room, leaving her clipboard with the answer sheet on the table next to the participant. The authors predicted that MPH would reduce cheating as it was previously found to reduce disruptive behaviors (see meta-analysis in [17]). However, surprisingly, more individuals looked at the answer sheet when medicated with

MPH compared to placebo, as evidenced in videotapes of participants' behavior. Hinshaw et al. [16] interpreted this finding as being indicative of the increased drive to perform well under the influence of MPH.

Indeed, this is consistent with the cognitive control model of cheating introduced by Speer, Smidts, and Boksem [18,19]. While cheating is often considered to be facilitated by over-activation of the mesocorticolimbic reward system through strong nucleus accumbens responses to anticipated reward [18,20], performance-related cheating can also paradoxically stem from activation in areas associated with cognitive control and attention (anterior cingulate cortex and inferior frontal gyrus). Activation in these areas was found to predict cheating in relatively honest participants [18,19]. Given that such activation is increased by MPH and amphetamines (e.g., [21,22]), these substances can potentially lead to cheating.

An alternative model can be proposed based on the notion that if participants believe that cheating can somehow damage or interfere with their task performance (e.g., due to the chance of it being detected), then because MPH and amphetamines increase attention to task directives [23-25], these stimulants should actually reduce cheating. Supporting this are study results showing that compared to a placebo group, individuals medicated with MPH tended to help others more frequently while sacrificing their own financial resources, when helping others was part of the task [26]. In a similar vein, if the instructions explicitly indicate that a certain dishonest behavior is not allowed and this is perceived as one of the task goals, MPH and amphetamines might reduce the likelihood of cheating even if this results in lower success rates.

Using a field study methodology (see e.g., [27,28]) we first identified participants who are using MPH or mixed amphetamine salts (MAS; Adderall) on a weekly basis. Then, a battery of tasks or questionnaires was administered to users while some of them were on medication and some were off medication. The endogenous effect of being on medication could then be examined by controlling for such factors as the frequency of taking medications, relevant symptoms, and demographics.

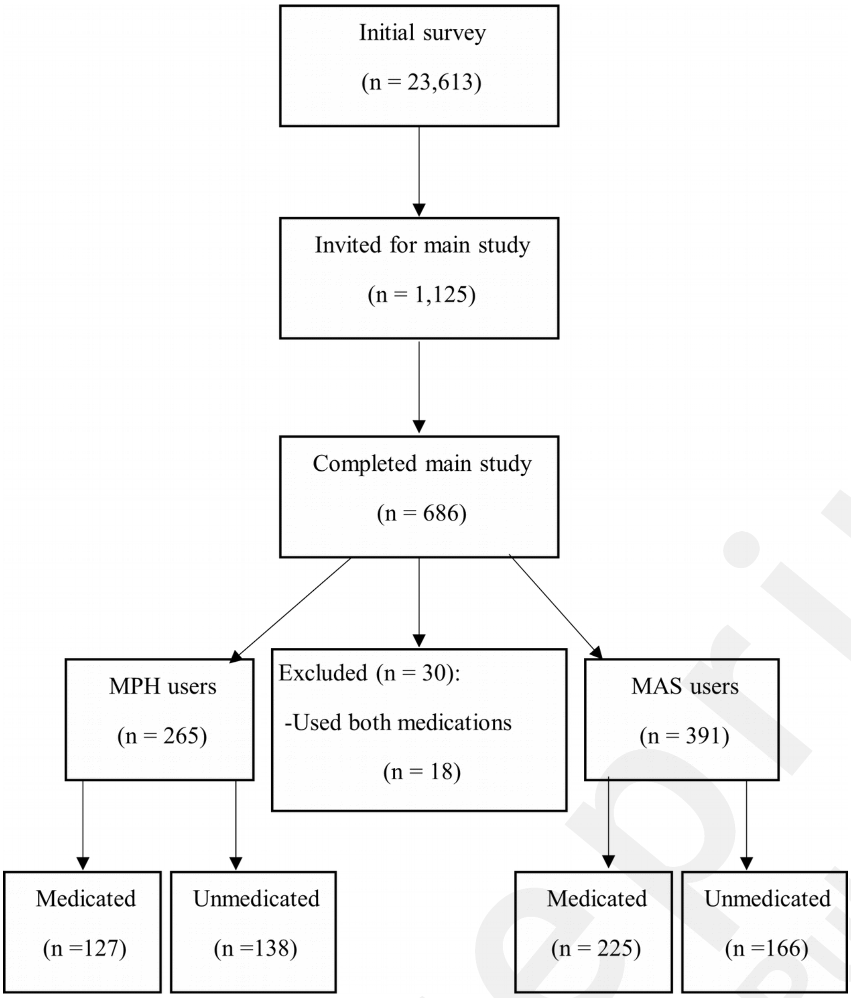
Within this framework, we implemented two paradigms to study cheating under the influence of MPH or mixed amphetamine salts (MAS; Adderall). In both paradigms participants were asked to avoid using online resources, and cheating was indexed by evidence of the participants using such resources. The first paradigm was based on two versions of the Cognitive Reflection test (CRT; [29]), a questionnaire involving numeric judgment problems in which snap judgments tend to be wrong [30,31]. One of the versions of the CRT had easily accessible online answers while the other had no such solutions. Cheating was therefore expected to result in better performance in the former version. In a previous study, when participants were incentivized for correctly answering CRT questions, test performance improved in the version where online resources were available but not where they were not available [32]. We examined if being medicated with MPH and MAS would have a similar effect.

The second paradigm we used was based on a difficult knowledge test, where cheating is indexed by comparing the participants' answers to online solutions (following [13,33]). Specifically, participants were asked to indicate the average life expectancy in Africa in 2022, a question that they were unlikely to answer correctly without using online resources [33]. Since participants were asked *not* to look at online resources, giving the precise answer appearing as the default solution to this question in Google and Bing was interpreted as cheating. With respect to the difference between MAS and MAS, a recent meta-analysis of healthy adults indicates that MPH significantly improved cognitive control more than MASs [34], suggesting that MPH should have a stronger effect on cheating, yet the predicted effect of cognitive control on cheating is not unidirectional, as indicated above.

Methods

Participants: The study was preapproved by the authors' university Research Ethics Committee. Participants were United States and Canada citizens recruited through the Prolific Academic crowd-sourcing platform. We aimed for a minimum of 266 participants receiving MPH and a similar number of participants receiving MAS to enable testing a small to medium effect size in each group (d = 0.4) with 90% power. This follows a previous examination of the effect of MPH on CRT performance [27], where the effect size (Cohen's d) was 0.40. As shown in Figure 1, an initial pool of 26,613 participants completed a preliminary session that began with reading and digitally signing an informed consent statement and followed with a short survey enabling us to evaluate the study inclusion and exclusion criteria. Inclusion criteria were the reported weekly usage (i.e., one day a week or more) of MPH or MAS. Exclusion criteria were age below 18 (this was rechecked although Prolific does not allow minor participation) and reporting a diagnosis of schizophrenia or other psychotic disorder. We included both individuals who reported having ADHD or not.

Figure 1: Flowchart of the participant recruitment process.



As shown in Figure 1, a total of 1,125 participants met recruitment criteria and were invited to participate in the main session of the study. A total of 729 participants started this session and 686 completed it. From this group, 30 participants either indicated that they were using both MPH and MAS (n = 18) or used a different medication (n = 12 used Vyvanse or Strattera), and were excluded from the study. Our final sample therefore consisted of 265 MPH users and 391 MAS users. Each participant was randomly selected to perform either the standard or modified CRT (n = 329, 327, respectively). Participants' ages ranged between 18 and 74 (Mean age = 35.2, SD = 12.0) and 40.5% of them were male. Seventy-three percent of the participants reported having ADHD and this rate was slightly higher in MAS users (74.9%) compared to MPH users (70.2%), though not significantly

($\chi^2(1) = 1.81$, $p = 0.18$).

In addition to the main study of MPH and MAS users, we also tested a pilot sample of US and Canadian Prolific users who were not asked to avoid online resources, as a benchmark. This benchmark group included 197 participants (mean age = 36.48, SD = 12.2, 50.8% male). In this group only 15.5% reported having ADHD ($\chi^2(1) = 206.4$, $p < 0.001$, compared to the main study participants). All participants were compensated by $0.1 for taking part in the preliminary session and an additional $1.7 to $2.1 for completing the second session, based on their performance. The benchmark group completed only the second session.

Study design: Our aim was to examine the effect of being medicated at the time of the study as a function of the specific drug taken (MPH or MAS) and weekly usage frequency. Medication status was identified based on participants' reported usage of MPH or MAS a few hours prior to the time of Session 2. As in Yechiam and Zeif [27], a threshold of four hours was set for standard Ritalin [35], eight hours for the long-lasting version of Ritalin [35,36], and 12 hours for Concerta [35,36] and Adderall [37].

Experimental tasks: The preliminary session of the study included a brief survey of demographics, self-reported diagnosis, and medication usage (see Appendix 1). In the main session to which participants were invited three days later, we informed participants that they are requested not to use online resources. Participants then performed a battery of cognitive tests. The first test was the expanded numeracy scale [38] which assesses basic numeric ability. This was followed by the four main items where participants were incentivized for accurate performance. Incentivization was previously shown to facilitate performance-related cheating [4,6,32]. The first three items were from the CRT [29]. As detailed in the Appendix 1, we used items that were either from the standard version of the CRT or a revised version (two items from [27]; one new). The solutions to the standard items are available online by simply copying and pasting the items to a Google search box (or to other popular search engines such as Bing). The revised version items were slightly modified so that answers would not pop up in a Google search (retrieved on January 14, 2024). Each participant was randomly presented with either the standard or modified version. The fourth incentivized item asked participants to estimate the average life expectancy in Africa in 2022.

Participants then performed two tests evaluating their ADHD symptoms: The Adult ADHD Self-Report Scale (ASRS, V.1.1. Part A; [39]) and Conners' Adult ADHD Rating Scale (CAARS; [40]). The next items asked about medications, specifically whether stimulants (Ritalin, Concerta, or Adderall) were taken earlier that day, when they were taken, and what dosages (see Appendix 1; the benchmark group was not presented with these items). The final questions referred to participants' understanding of the instructions, and particularly our request not to use online resources. This was probed to clarify if the effect of medication on using online resources constitutes cheating, or merely inattention to task rules (c.f., [41-42]).

Coding and Analysis: To evaluate both the effect of usage frequency, medication status, and drug type, all analyses used all three variables as predictors. The examination of baseline (existing) differences was conducted by running linear regressions for continuous variables (e.g., age, ASRS, CAARS) and logistic regressions for binary variables (e.g., gender, Bachelor's degree) with usage frequency, medication status, and drug type as predictors.

Cheating in the CRT was expected to improve scores in the standard but not in the modified task version. Unexpectedly, the results of our benchmark pilot group indicated no significant difference between these two CRT versions (Mann Whitney U (195) = 4,833, p = 0.97). This suggests either that control participants did not use online resources in the CRT or that the revised version was slightly more difficult but the additional usage of resources compensated for that. We therefore focused on the effect of medication on the difference between versions, rather than the magnitude of the difference. Given the three-item structure of the CRT, it was analyzed using an ordinal regression [43]. The predictors were drug type (0 = MAS, 1 = MPH), medication status (0 = unmedicated, 1 = medicated), and their interaction, usage frequency; and in addition, CRT version (0 = revised version, 1= standard version), the interaction between CRT version and medication, and the triple interaction of CRT version, medication, and drug type. The simpler interaction of medication by drug type evaluates the effect of being medicated with each drug on CRT performance, whereas the triple interaction with CRT version evaluates the potential effect on cheating, since it examines the distinct effect of the two CRT versions. This basic regression model was compared to more elaborate models that also included ADHD indices (scores on the ASRS and CAARS test) as predictors. A third model also incorporated demographic variables for robustness. Additionally, a fourth model examined the effect of self-reported ADHD and its interaction with CRT version.

Cheating in the knowledge question (estimating the average life expectancy in Africa in 2022) was analyzed by comparing participants' responses to online benchmark solutions rather than through the effect of different versions. Specifically, cheating was coded by accurately referring to the default answer appearing in Google or Bing search when copying and pasting the exact question (retrieved on January 14, 2024). This answer – 63.82 years – was presented on the main Google/Bing screen upon presenting the query without requiring to look at any specific website (see figure in Appendix 2). We also coded the rounded answer of 64 years as suggestive of cheating as well as the answer of the first website in the search list ("61 years for men, 64 for women") and the answer 64.11 which was the correct answer for 2023. The benchmark sample we piloted showed that 38.6% of the participants provided these answers when they were allowed to use online resources. The effect of medication on cheating in this item was analyzed using a logistic regression, with drug type, medication status (medicated vs. unmedicated), and their interaction, as well as usage frequency, as predictors. More elaborate models were also examined as above. Post-hoc tests in all models examined the significance of specific medications.

Results

Baseline group characteristics: Table 1 presents the baseline characteristics of participants who were either medicated or not, as well as the effect of drug type and weekly usage frequency. Usage frequencies were pooled into three categories for conciseness. There were no significant differences between medicated and unmedicated participants in education level (z = 1.28, p = 0.20) and numeracy (t(655) = 0.83, p = 0.41), as well as in age (t(650) = 0.28, p = 0.78), gender (z = 1.54, p = 0.12), or ethnicity (z = 0.14, p = 0.89). With respect to drug type, those who used MAS were more likely to have a Bachelor's degree than users of MPH (z = 2.75, p = 0.006), irrespectively of whether they were medicated or not, and there were no other significant demographic differences between those using different medications. With respect to the frequency of usage, younger participants and Caucasian participants tended to have a higher weekly usage rate (t(650) = 3.87, p < 0.001; z = 5.67, p < 0.001, respectively).

Table 1: Baseline characteristics for different usage frequencies, drug types, and medication status (medicated versus unmedicated). Each variable's mean is across categories of the other two variables. Standard errors appear in parentheses.

	Usage frequency (days/week)			Drug type		Medication status	
	1 (n = 114)	2-5 (n = 215)	6-7 (n = 327)	MPH (n = 265)	MAS (n = 391)	Medicated (n = 352)	Unmedicated (n = 304)
achelor's degree (%)†	49.0	48.1	48.4	42.4	52.5	46.5	50.6
ender (% female)	45.2	62.9	62.0	59.5	54.0	58.8	54.7
thnicity (% aucasian)ǂ	43.8	62.0	77.3	57.6	64.5	63.7	58.3
DHD (%self- ported)*ǂ	41.8	71.2	83.8	63.0	68.2	75.9	55.3
geǂ	41.0 (1.5)	35.4 (0.8)	34.0 (0.6)	38.2 (0.8)	35.4 (0.6)	36.6 (0.6)	37.1 (0.8)
SRSǂ	17.9 (0.5)	19.6 (0.3)	21.0 (0.3)	18.9 (0.3)	20.0 (0.2)	20.0 (0.3)	18.9 (0.3)

AARS (ADHD index)ǂ	13.3 (0.8)	15.5 (0.6)	17.5 (0.4)	14.9 (0.5)	16.0 (0.4)	16.1 (0.4)	14.7 (0.4)
umeracy	5.8 (0.2)	6.2 (0.1)	6.1 (0.1)	6.1 (0.1)	6.0 (0.1)	6.1 (0.1)	6.0 (0.1)
nderstood instruction % yes)	75.2	78.2	73.1	73.5	77.4	76.2	74.8

Notes: * = p < 0.05 for the difference between medicated and unmedicated participants. † = p < 0.05 for the difference between the MPH and MAS group (irrespective of medication status). ǂ = p < 0.05 for the effect of usage frequency. ASRS = Adult ADHD Self-Report Scale, CAARS = Conners' Adult ADHD Rating Scale. Understood instructions = Answered correctly about whether it was possible to use online resources (the Internet) during the experiment.

The medicated group included more individuals reporting having ADHD (z = 4.21, p < 0.001). Medicated participants did not, however, have a significantly higher ASRS score (t(655) = 1.40, p = 0.16) or a higher CAARS score (t(655) = 1.19, p = 0.23), indicating the absence of more severe ADHD symptoms.[1] The mean dosages taken were 19.3 mg (SE = 1.8) for Ritalin, 36.5 mg for Concerta (SE = 1.9), and 23.4 mg for Adderall (SE = 1.5). Mean dosages did not differ between medicated and unmedicated participants in either drug (all p's > 0.23). Finally, on average, 75.5% of the participants correctly indicated that it was not possible to use online resources during the experiment, while the remaining participants indicated that they were either uncertain (7.7%) or that it was possible to use such resources (16.8%). There was no difference between medicated and unmedicated participants in this respect (z = 1.28, p = 0.20), and no effect of drug type (z = 0.29, p = 0.77), or their interaction (z = 0.16, p = 0.87). Thus, differences between groups did not stem from misunderstanding the instructions.

CRT performance and cheating: The effect of medication and drug type on CRT performance across usage frequencies and test versions are shown in Figure 2 top panel. The regression analysis, presented in Table 2, showed a non-significant effect of medication (z = 1.72, p = 0.09) but a significant interaction of medication by drug type (z = 2.10, p = 0.036). The positive effect of MPH on performance is consistent with that found previously [27] but the effect size is smaller (d = 0.11)

[1] This could be due to the results of those tests being based on self-reports of behavior under medication.

and the simple effect is not significant, while MAS was found to have a negative effect (*d* = -0.13).

Figure 2: Top panel: The effect of stimulant medication on CRT performance across test versions. Bottom panel: The effect of the medications on the difference in performance between CRT versions (standard minus revised version), indicatory of potential cheating. The dotted line indicates the difference between versions in the benchmark sample. Error terms denote standard errors.

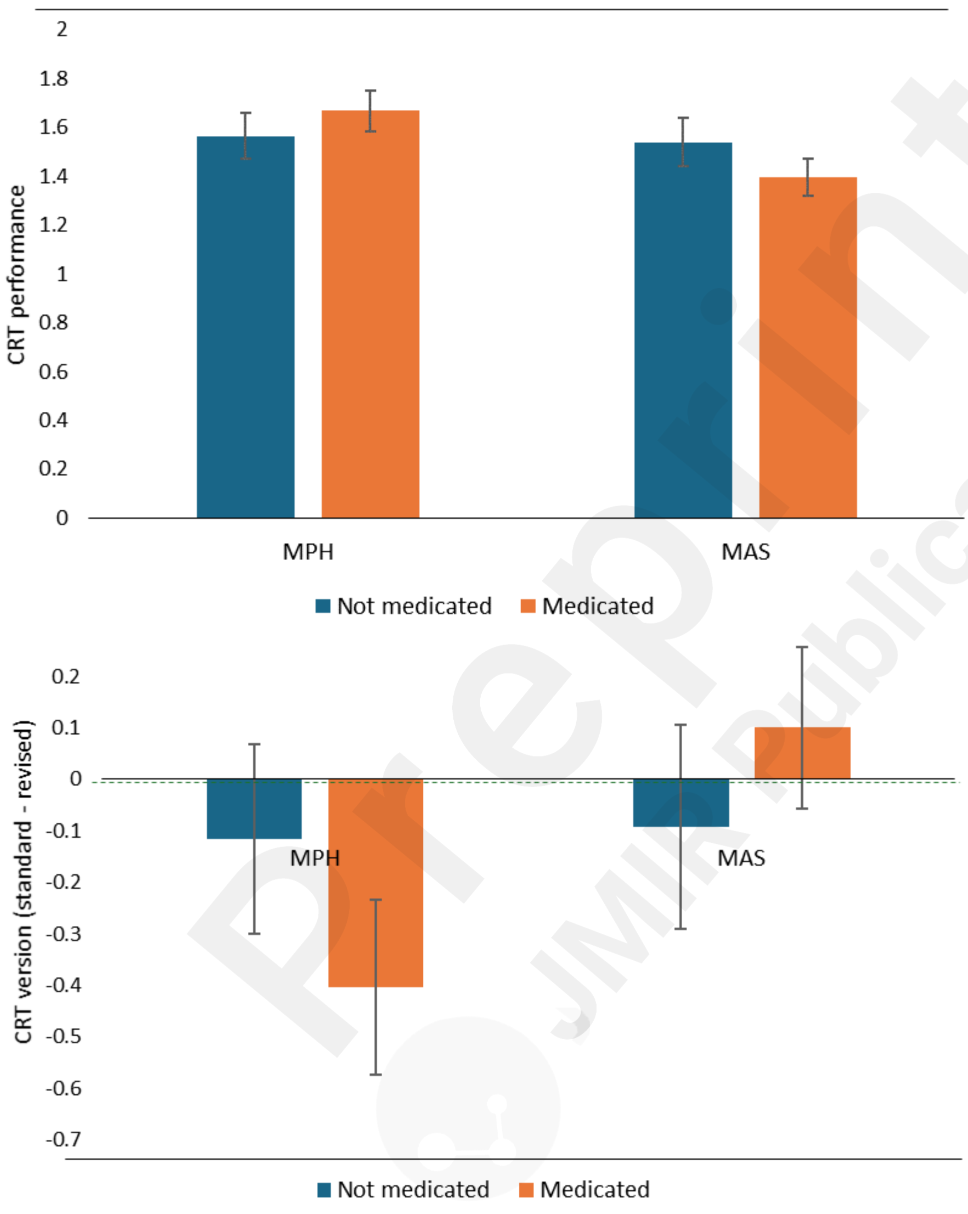


Table 2: Ordinal and logistic regressions for the effect of medication-related variables on CRT performance (where a difference between the standard and modified version is indicative of cheating), and cheating in the knowledge question (life expectancy in Africa). Standard errors appear in parentheses.

	CRT	Knowledge question
Medicated	-0.48 (0.28)	0.70 (0.46)
Drug type	0.01 (0.29)	1.23 (0.42)*
Medication × drug type	0.86 (0.41)*	-1.17 (0.59)*
Usage frequency	0.04 (0.04)	-0.14 (0.07)*
CRT version	-0.17 (0.54)	
Medication × CRT version	0.32 (0.37)	
Medication × CRT version × drug type	-0.81 (0.40)*	
Model fit (AIC)	1,826	389

Notes: * = p < 0.05.

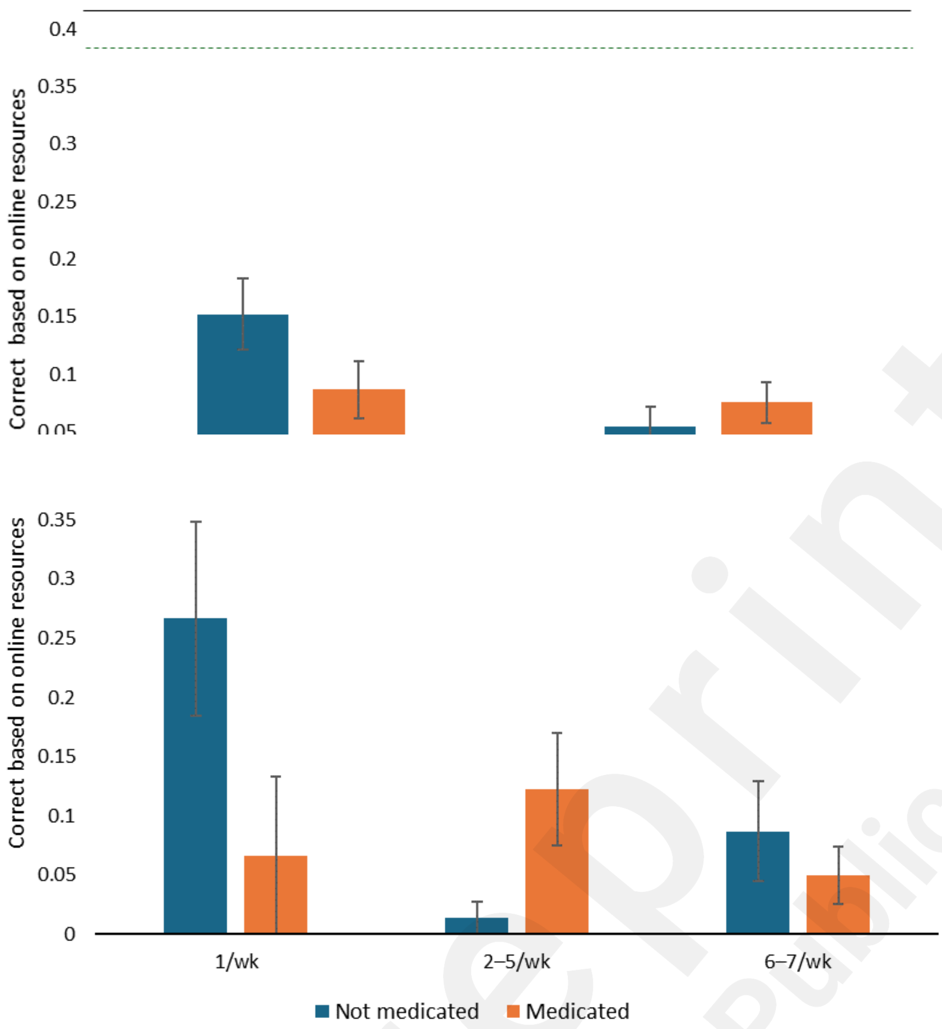
We now move to our main analysis of the difference between CRT versions indicative of potential cheating (see Table 2). There was no significant difference between CRT versions (z = 0.62, p = 0.34). However, there was a significant three-way interaction of medication, drug type, and CRT version (z = 2.01, p = .04). As indicated in Figure 2 bottom panel, the effect was in the direction of less cheating when medicated with MPH (evidenced by lower scores in the standard CRT version where online solutions are more accessible) and slightly more cheating when medicated by MAS (evidenced by higher scores in the standard version). The simple effect of MPH on the difference between the two versions was not significant, however (z = 1.12, p = 0.27, Cohen's d = -0.27)[2] indicating that the negative effect of MPH on cheating was relatively weak, and only significant in comparison to the positive effect of MAS. The effect size of MAS was likewise small, d = 0.17 and not significant.

[2] This uses the conversion formula of odds ratio to Cohen's d [44].

Nevertheless, the distinct effect of MPH on performance in the different CRT versions partly explains the weak effect of MPH on performance across versions (d = 0.11). In the revised version where cheating is more difficult, the effect size for MPH medication increased to d = 0.22, compared to 0.03 in the standard version where cheating is easy. The two significant interactions appear to be robust and remained significant when controlling for ADHD-related differences between groups (ASRs and CAARS ADHD index, self-reported ADHD) and demographic indices (gender and ethnicity), as detailed in Appendix 3. Also, interestingly, individuals with ADHD performed slightly better in the CRT (see Appendix 3), though they did so equally in the two test versions suggesting no effect of ADHD on cheating.

Cheating in the knowledge question: Figure 3 shows the effect of medication on cheating in the knowledge question and the respective analysis appears in Table 2. The dotted line in the figure indicates the rate of answering correctly in the benchmark study where participants were allowed to use online resources. As previously, the results indicated no main effect of being medicated (z = 1.52, p = 0.13) but rather a significant medication by drug type interaction (z = 1.98, p = 0.048). This interaction was again in the direction of less cheating when medicated with MPH and more cheating with MAS. The simple effect of MPH was again small (d = -0.35),[3] and not statistically significant (z = 1.62, p = 0.11), as was the simple effect of MAS (d = 0.20, z = 0.83, p = 0.41). Nevertheless, the interaction between medication status and drug type was robust and remained significance when controlling for background variables (see Appendix 3). ADHD diagnosis or symptoms were not correlated with cheating in these additional analyses.

Figure 3: Top: The effect of stimulant medication on correct answers based on online resources in the knowledge question. The dotted line indicates the results for the benchmark sample. Bottom: The effect of MPH as a function of the frequency of medication (1, 2–5, or 6–7 times a week). Error terms denote standard errors.


0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
Correct based on online resources
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Correct based on online resources
1/wk
2–5/wk
6–7/wk
Not medicated
Medicated

Another interesting finding is that MPH users tended to cheat more in the knowledge question than MAS users irrespective of medication status ($z = 2.94$, $p = 0.003$), while those who used stimulants more frequently tended to cheat less ($z = 2.01$, $p = 0.045$). As shown in Figure 3 bottom panel, for MPH users there was a rather monotonic negative effect of usage frequency on cheating ($z = 2.00$, $p = 0.045$), and the strongest effect of medication was on those who were medicated one day a week. The interaction between being medicated with MPH and usage frequency was not significant, however ($z = 0.25$, $p = 0.81$).

Discussion

Our findings in both paradigms evidenced a weak negative effect of MPH on performance-related cheating compared to a weak positive effect of MAS. Specifically, we find that being medicated with MPH resulted in significantly greater success in the revised version of the Cognitive Reflection test than in the standard version (which is more receptive to cheating) compared to a reverse effect in MAS users. Similarly, in the knowledge test about the life expectancy in Africa, those medicated with MPH tended to report less accurate solutions commensurate with online resources, compared to a reverse effect for those medicated with MAS. In both paradigms, the crossover interaction between the effect of the two drugs was significant. However, the simple effect of each of the medications was not significant when comparing medicated to non-medicated users.

Importantly, we find no evidence for the previously observed positive effect of MPH on cheating [16]. Our findings of a negative trend for the effect of MPH on cheating are consistent with the evidence that MPH reduces a variety of disruptive behaviors (see meta-analysis in [17]) and with the notion that MPH may improve socially oriented behaviors when such behaviors are part of the task directives [26] owing to its effect on the reward system [25]. A negative effect of MPH on cheating may also be facilitated by additional brain networks affected by MPH. Specifically, MPH was found to regulate the activation of the frontal-striatal network of healthy individuals, leading to negative effects on impulsivity and delay discounting [45,46]. Impulsive cheating is modulated by activation of the nucleus accumbens [18,20], a subcortical brain structure that is functionally connected to the frontal-striatal network. A similar frontal-striatal effect was not reliably recorded for d-amphetamine [47,48] which potentially explains the disparate effect of the two substances on cheating.

Another finding of Hinshaw et al. [16] that was not observed in our study is that individuals with ADHD did not cheat more often than others. We find null effects for ADHD-related symptoms and diagnosis as predictors of cheating in both experimental paradigms. This is consistent with the results of Hinshaw et al.'s later study where they did not replicate the effect of ADHD on cheating [49]. Notice, though, that our study targeted adults whereas Hinshaw et al. [16,49] focused on adolescents and there were also some differences in the research approaches.

Finally, and surprisingly, our findings only partially replicate the positive effect of MPH on judgment performance in the CRT recorded previously in a similar Internet-based field study [27]. This can be partly explained by the fact that this previous study used a modified version of the CRT where it is difficult to use online resources (similar to the modified version of the present study). Nevertheless, in that study the positive effect size of MPH was $d = 0.40$ while in the present study the effect size in the modified CRT version was smaller, $d = 0.21$. Still, this is consistent with the notion that across studies the effect of MPH on cognitive performance tends to be small [34], similarly to the effect of incentives [50,51].

Our results thus suggest that the thirty-year-old findings of Hinshaw et al. [16] do not appear to stand the test of time. We find no evidence that MPH increases cheating in online task performance, and indeed find that it significantly reduces cheating in comparison the effect of MAS, which slightly elevates cheating. We view our findings as preliminary and as an impetus to systematically study the effect of MPH and MAS on cheating behavior using double-blind placebo-controlled experiments. These medications are very commonly taken to improve scholastic test performance [12], and it would be important to ascertain whether they also have negative psychological “side effects” in the form of cheating behavior. The current study shows that at least for MPH this is not the case, but further studies should verify these findings.

Additionally, the current findings seem to be inconsistent with the notion that enhanced cognitive control and attention increase cheating [18,19]. However, it should be emphasized that the instructions of the current study explicitly indicated that participants should not use online resources. Potentially, when honesty-related instructions are not part of the explicit task directives this can give rise to the facilitative effect of attention on cheating.

Declarations

Conflict of interest The authors declare no competing interests.

Data The data and all study materials are publicly available at https://osf.io/x3mge/?view_only=4b53b5ee03dc478d8d63b682ded1704c.

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Supplementary Files

Multimedia Appendixes

Task instructions.
URL: http://asset.jmir.pub/assets/5c9e2b03412f35e8f9885ea79852ecdd.docx

Supplementary Figure.
URL: http://asset.jmir.pub/assets/905ff8c2cb174cfdabc1810c22f3ba24.docx

Supplementary tables.
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