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Self-reported criminal and anti-social behavior on a dating site: the importance of cognitive ability

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Abstract

The relationship between criminal and antisocial (CAS) behaviors and cognitive ability (CA) were examined in a large online sample of dating site users (complete sample n = 68,371). 12 question items were found that measured CAS to some degree. Of these, 11 showed a negative relation to CA. The answers to the CAS items were all positively related, suggesting the existence of a general factor of CAS behavior. Scores for this factor were estimated using multiple methods. The resulting scores were then subjected to a series of regression models to examine whether the link between CA and CAS would hold up in the presence of other predictors. The results showed that the link between CA and CAS scores was robust to model specifications with standardized betas of -.15 to -.20. Furthermore, a CA x sex interaction was found such that the CA x CAS relationship was stronger for men (r's -.20 and -.13, for men and women, respectively).

Keywords: cognitive ability, intelligence, IQ, crime, antisocial behavior, dating site, OKCupid, sexual orientation

1 Introduction

Numerous studies show that criminal and antisocial (CAS) behaviors are negatively related to cognitive ability (Ellis et al. 2009, p. 150; Frisell et al. 2012; Herrnstein & Murray 1994; Hirschi & Hindelang 1977; Høgh & Wolf 1983; Levine 2011; Schwartz et al. 2015).

Although there does not seem to be a proper quantitative meta-analysis yet (but see Ttofi et al. (2016)), effect sizes tend to be around -.10 to -.20 on the Pearson correlation/standardized beta scale. As far as the author knows, no previous study has examined self-reported CAS behaviors in an online dating sample. As such, the purpose of the present study was to examine the validity of cognitive ability (CA) in this population.

2 Data

The data came from the dating site OKCupid (www.okcupid.com) and is described in detail in Kirkegaard & Bjerrekær (2016). Users on this site answer questions (multiple choice format with 2-4 options) in order to be better matched with potential mates using the site's algorithm. Most users answer the questions in public, meaning that other users can see the selected answers, and they were so obtained by web scraping the site (i.e. using a script that automatically visits users and saves their information to a spreadsheet-like database). Most users were living in English-speaking countries, in particular the United States (65 %), the United Kingdom (12 %) and Canada (3 %). In total, there are data for 68,371 users. However, since answering questions is voluntary, many users don't answer any or only a limited number. For this reason, most of the cells are missing (77 %; 42 million cells with data available).

CAS behaviors To identify relevant items among the ~ 2,500 in the dataset, the following keywords were used to search on the question text: *crim*, *steal*, *stole*, *hit*, *kick*, *violen*, *police*, *arrest*, *prison*.[1] A total of 12 plausible items were found:

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[1] Drug use items were found but were excluded on purpose due to the special nature of such behavior.

1. Arrested (q252): Have you ever been arrested, even if just for a small crime or misdemeanor?
    - Yes
    - No
2. Prison (q1138): Have you ever been to prison?
    - Yes
    - No
    - Just to visit / I was working
3. Punched in face (q196): Excluding childhood fights, have you ever punched someone in the face?
    - Yes
    - No
4. Cheated exam (q400): Have you ever cheated on an exam?
    - Yes
    - No
5. Would tax cheat (q180): Would you cheat on your taxes, if you were absolutely 100 % sure you could get away with it?
    - Yes
    - No
6. Stole glass from bar (q59919): Have you ever stolen a glass from a bar?
    - Yes
    - No
7. Used fake ID (q22569): Have you ever used a fake ID to do or acquire something you were legally barred from as a result of your age?
    - Yes
    - No
8. Torture animal for fun (q19928): Honestly, did you ever torture a cat, dog, or any other furry animal for pleasure?
    - Yes, but I regret it.
    - NO WAY!
    - Yeah, that's fun.
    - No, but I would do it.
9. Steal newspapers (q39226): You stop to pick up a newspaper and notice that the coin-operated dispenser was not completely closed. No one is around so you have the opportunity to take a paper without paying. Which of the following would you do?
    - Pay for a paper and close the dispenser.
    - Steal a paper and close the dispenser.
    - Steal a paper and leave the dispenser open.
    - Steal all of the remaining papers.
10. Litter (q17017): Do you litter?
    - Often
    - Rarely
    - Never
11. Cigarette littering (q74381): Do you consider the act of leaving cigarette butts on the ground to be littering?
    - Yes
    - No
12. Hit significant other in anger (q81783): Have you ever hit a significant other in anger?
    - Yes
    - No

The items were recoded into dichotomous form to simplify the analysis, with 1 as indicating that the user affirms having done the CAS behavior. For items with >2 response options, a judgment call was made how to recode them. This was done based on the distribution of scores within the response categories (not too small, and avoid heterogeneity). For instance, item 9 was coded to combine all the responses that involved stealing. Table 1 shows descriptive statistics for the items.

Table 1: Descriptive statistics for criminal or antisocial outcomes.

CAS var	n	Proportion
arrested	12456	0.24
prison	15236	0.02
punched in face	18128	0.34
cheated exam	5155	0.40
would tax cheat	15581	0.42
stole glass from bar	16747	0.44
used fake id	14067	0.28
torture animal for fun	10725	0.03
steal newspapers	2111	0.43
litter	35221	0.31
cigarette littering	18983	0.11
hit SO in anger	3405	0.03

Age Users state their age in their profiles. The mean age for users with data for cognitive ability was 32 with a standard deviation of 7.8. This is somewhat lower than the general population which is around 40, but substantially higher and more varied than typical college samples (Henrich et al., 2010).

Sex/gender and sexual orientation Users almost always state their sex/gender(s) in their profiles. Because very few users selected a gender other than "Man" or "Woman", data for these users were excluded (0.24 %). A previous study found that sexual orientation was a useful predictor of criminal outcomes (Beaver et al., 2016). Because this variable likely interacts with sex/gender, the two were combined yielding 6 combinations between hetero-, bi- and homosexual, and male/female. Table 2 shows the breakdown of the gender-sexual orientation variable.

Table 2: Distribution of gender-sexual orientation.

Group	Count	%
Heterosexual male	16249	62.94
Heterosexual female	5859	22.70
Bisexual female	1426	5.52
Homosexual male	1236	4.79
Bisexual male	548	2.12
Homosexual female	301	1.17
(missing)	196	0.76

Self-identified race/ethnicity (SIRE) Users report their SIRE on their profiles. Since it was possible to select more than one, this presented a coding problem. Two different codings were used. In common combinations, persons were classified as their chosen combination of SIREs. After this, the combinations with less than 100 persons were recoded into 'Other combos'. In dummy coding, a new binary variable was created for each atomic SIRE in the data as well as 'Multi SIRE', which was a dummy for whether the user had selected more than one option. This dummy was included based on previous research indicating that multi-racial persons are at elevated risk for a variety of bad outcomes (Choi et al., 2006; Udry et al., 2003). Table 3 shows the breakdown of SIRE using the combinations coding.

Cognitive ability (CA) CA was estimated based on users' answers to 14 items as described in a previous publication (Kirkegaard & Bjerrekær, 2016). The items cover a variety of domains (including verbal, spatial, mathematical ability and general knowledge) and were taken as an estimate of general cognitive ability/general intelligence/g (Jensen, 1998). The exact items (question text, response options), sample sizes and pass rates can be found in the supplementary materials. While brief, scores from this ad hoc test were previously shown to be related to known correlates, e.g. religious belief (Dutton, 2014; Zuckerman et al., 2013), with typical effect sizes (Kirkegaard & Bjerrekær, 2016). There were data for ~56k users, however, to avoid using unreliable CA estimates, only users who answered at least 5 items were retained, yielding a sample size of 25,815. Figure 1 shows the distribution of CA in the reduced sample.

Table 3: Distribution of self-identified race/ethnicity (SIRE) using the combinations coding.

Group	Count	Percent
White	18261	70.74
(missing)	1741	6.74
Other combos	1197	4.64
Asian	958	3.71
Hispanic / Latin	779	3.02
Black	775	3.00
Other	606	2.35
Hispanic / Latin, White	454	1.76
White, Other	292	1.13
Native American, White	244	0.95
Indian	226	0.88
Asian, White	175	0.68
Black, White	107	0.41

As can be seen, despite the nature of the test, the distribution of scores was approximately normal (skew = -0.54, kurtosis = -0.22). In terms of the original standardization on the complete dataset, this subsample represented a selected group as the mean CA was 0.56 z (sd = 0.61). The CA scores were then restandardized for this subsample.

3 Analyses

All analyses were done in R. An R notebook is available in the supplementary materials.

3.1 Group differences per item

The simplest approach to analyzing the data is to calculate the mean CA by CAS item. Table 4 shows the results.

Of the 12 CAS items, 11 were negatively related to CA, and 10 beyond chance levels. Clearly, self- reporting CAS behavior (or intentions) is quite consistently related to lower CA, even when done on a dating site for other users to see.

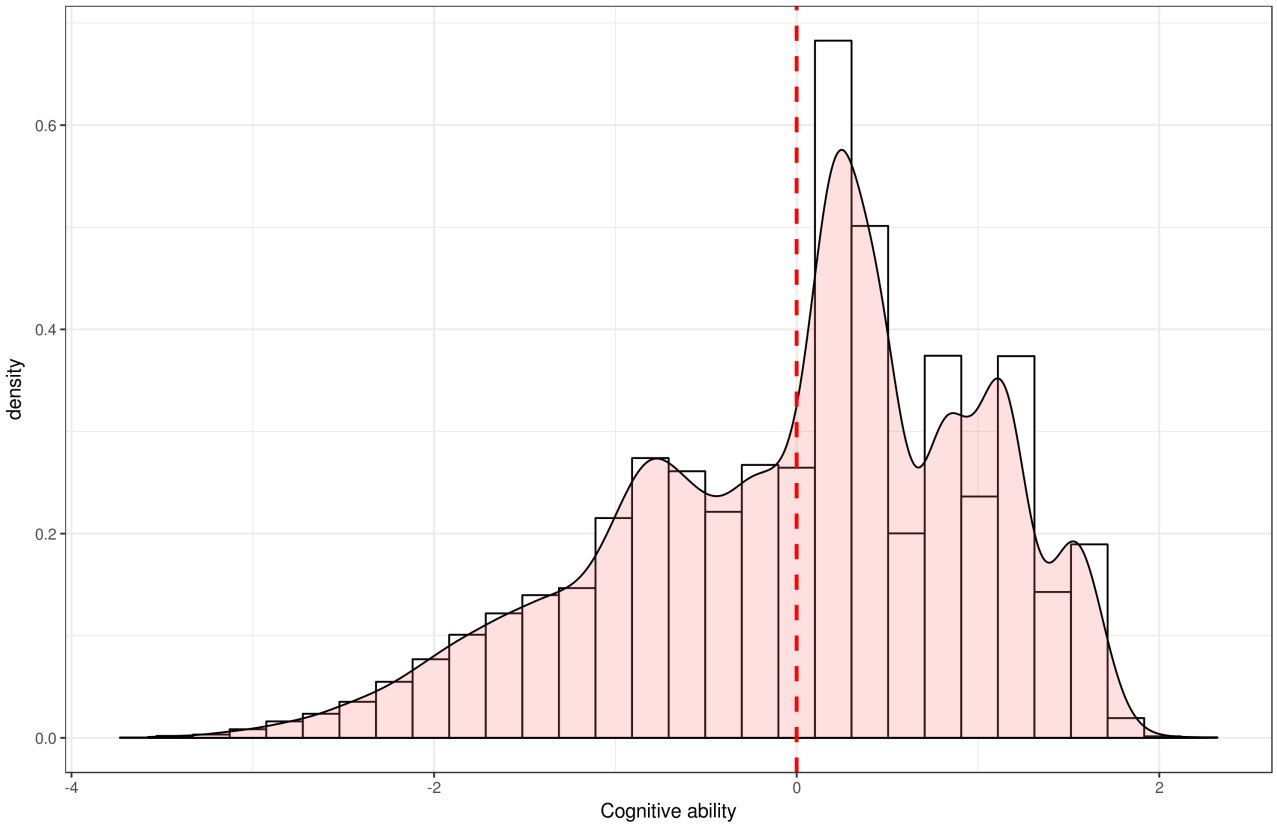

Figure 1: Distribution of cognitive ability.

Table 4: Descriptive statistics for criminal or antisocial outcomes.

CAS	d	d lower	d upper	n
arrested	-0.24	-0.19	-0.28	9653
prison	-0.34	-0.19	-0.48	12336
punched in face	-0.26	-0.23	-0.30	13784
cheated exam	-0.13	-0.07	-0.20	4079
would tax cheat	-0.15	-0.11	-0.18	11728
stole glass from bar	-0.03	0.01	-0.06	12626
used fake id	0.02	0.06	-0.02	10811
torture animal for fun	-0.35	-0.23	-0.48	8989
steal newspapers	-0.26	-0.16	-0.35	1727
litter	-0.38	-0.35	-0.41	23256
cigarette littering	-0.49	-0.44	-0.55	14905
hit SO in anger	-0.47	-0.24	-0.70	2876

3.2 *An overall CAS score*

A general CAS (reflective) factor was hypothesized based on analogies with other general factors such as those of cognitive ability (Jensen, 1998) and psychopathology (Caspi et al., 2014). To determine whether it was sensible to calculate an overall CAS score, the correlations between the items were calculated. Because the items were coded as dichotomous, latent correlations were used to prevent artificially low correlations (tetrachoric, see Uebersax (2015). Of the 66 inter-item correlations, 100 % were positive, ranging from .02 to .72, with a mean of .22. The results were nearly identical for the full sample (mean = .24, range .02 to .73), thus was not an artifact of subsetting by CA item coverage.

Despite the observed positive manifold among items, it is not straightforward to calculate an overall score by person: there is massive, non-random missing data across items. This missingness both reflects the fact that not all users take the time to answer thousands of questions on the site, and due to systematic skipping of items (investigated in Section 3.4). The amount of missing data was judged too large for reliable analysis and the sample must thus be further subsetted before. To decide on an optimal amount of data to retain, subsets of the sample were created that had at least 13, ..., 1 CAS datapoints, not necessarily the same items (e.g. one case might have items 1-5, while another

might have 6-10, but both have 5 items). Figure 2 shows the sample sizes by the item count.

A steep drop is seen at item 7, and this was chosen at the minimum number of items needed for analysis, yielding a sample of n = 7,882.

Two approaches were then used to score the CAS factor. In the first approach, the missing data were noiselessly imputed using the IRMI algorithm (Templ et al., 2011). After this, the data were scored using both unweighted summation and item-response theory (IRT) analysis. The IRT approach used the 2-parameter normal model, as implemented in the **psych** package (Revelle, 2017). In the second approach, the data were analyzed with IRT without any initial imputation. This is possible because IRT analysis allows missing data (for details about how psych deals with missing data, see the documentation for the *scoreIrt* function). Thus, in total, there were 3 sets of scores for each case. Table 5 shows the correlations between the CAS scores as well as CA.

There are several things of note. First, the correlations between the estimates of general CAS behavior were quite strong, from .82 to .94. Thus, the exact method choice is unlikely to seriously distort results. Second, all three estimates were negatively related to CA with quite typical effect sizes (r's -.13 to -.18). The strongest correlations were seen for methods that imputed the missing data beforehand. Third, the number of answered CAS items was not strongly related to any other variable, suggesting that bias from selective reporting was not strong. The scores from the simple summation were used for further analysis because these had the highest correlations with the other general CAS behavior estimates, the strongest relationship to CA, and the weakest relationship to the number of items answered. Figure 3 shows the mean CA by each general CAS score.

A fairly linear trend was observed, in line with previous research (Frisell et al., 2012).

3.3 Multivariate analyses

The relationship seen between CAS score and CA might be inflated or deflated by the presence of variation in other predictors. To examine whether this was the case, OLS regression was used to predict CAS score from CA as well as the control variables. The primary model results are shown in Table 6.

The primary model produced a slightly smaller beta for CA (.153) than the bivariate correlation (.177). The addition of the control variables did not do much to improve predictive validity, as CA was almost equally good to the combined set of predictors (r = .177 vs. R adj. = .207). A weak trend was observed between gender-sexual orientation involving non-heterosexuals and CAS such that crime level were highest for heterosexual men, lowest for heterosexual women and intermediate in roughly monotonically falling fashion between (except for bisexual men, who were slightly above heterosexual men). Thus, the findings are roughly in line with previous research (Beaver et al., 2016). However, the sample size of the present study was too small to allow for precise results.

To examine robustness, a number of model variations were tried. First, the alternative coding of SIRE, common combinations, was used instead. This produced a slight decrease in model fit and essentially no change in the beta for CA. Second, a model was fit only on the White (only SIRE) sub-sample. This produced a slight decrease in model fit (R adj. = .197) and a slight decrease in the beta for CA (-.163). Third, a model was fit with the inclusion of an interaction between CA and gender-sexual orientation. This fit slightly better (R adj. = .209), owning to an interaction between heterosexual female and CA (0.07, p = .011), indicating that CA was a less useful predictor for female heterosexuals (or females in general). This was confirmed in a simple subgroup analysis: the CA x CAS correlations were -.20 and -.13, for men and women respectively. The model also found a slightly stronger main effect of CA (-.171). Fourth, a model was fit by excluding persons with a CA score below -2. This group of persons likely constitute people who refuse to answer IQ-like questions on a dating site rather than people with a particularly low level of ability, and they are thus likely to disrupt the pattern in the data. This model fit slightly better (R adj. = .211) and further strengthened the effect of CA (-.200). Fifth, finally, a model with a nonlinear effect of CA was fit, using a restricted cubic spline (same as for age). This fit slightly better still (R adj. = .218), though at the price of being less interpretable. Figure 4 shows a comparison between the two model predictions for the effect of CA based on simulated data (the other variables were set to their mean or modal value: White-only, male, heterosexual, sample mean age [33.7]).

As can be seen, the nonlinear model fit suggested that the influence of CA on CAS was greater at higher levels of CA.

3.4 Systematically skipping of CAS items

The results in Table 4 indicated that non-random skipping of CAS items was not a big issue, though it may be a small issue. To further investigate this, a logistic model was fit for each CAS item, with the dependent outcome being whether the item was skipped or not. The predictors in the model were the total number of questions answered by the user, their CA level, their crime score as estimated by IRT based on the non-imputed data, as well as their age and gender-sexual

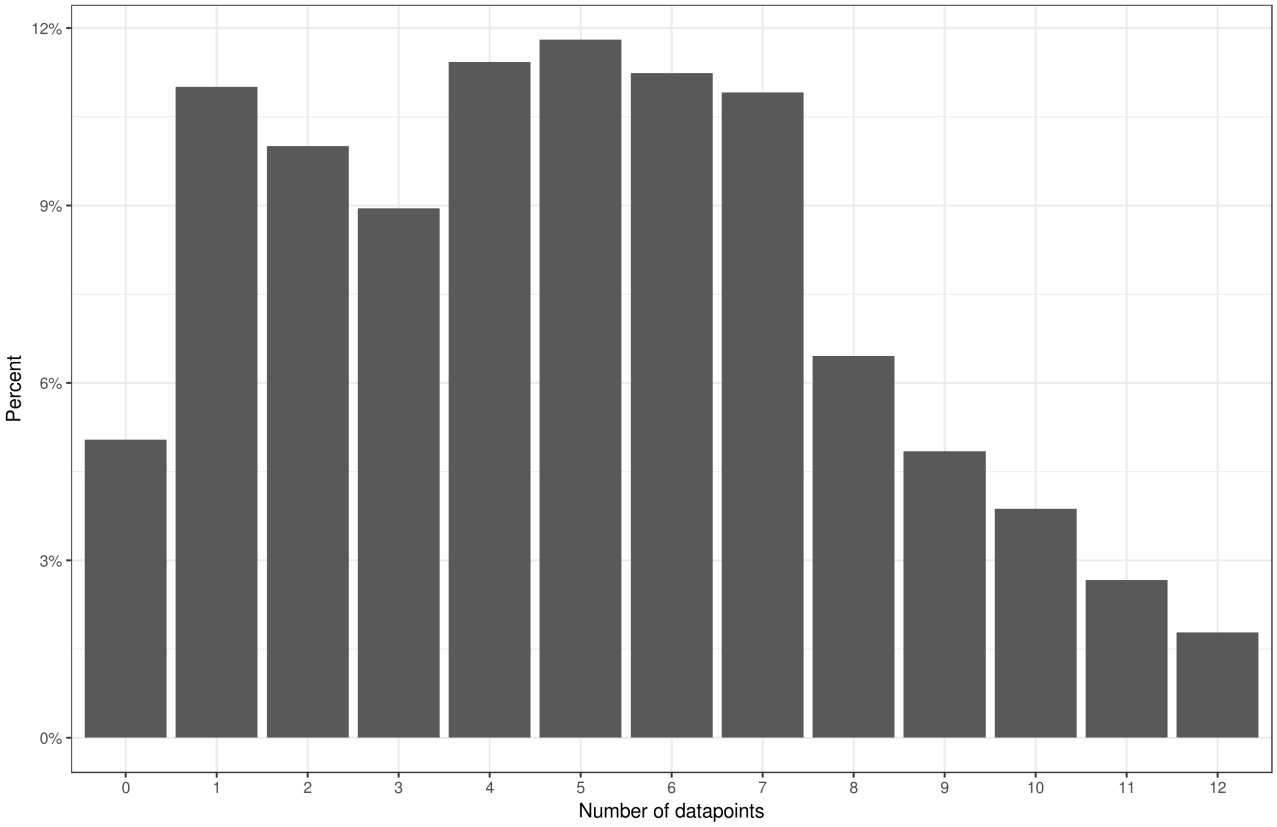

Figure 2: Percent of cases by number of criminal and antisocial item datapoints available.

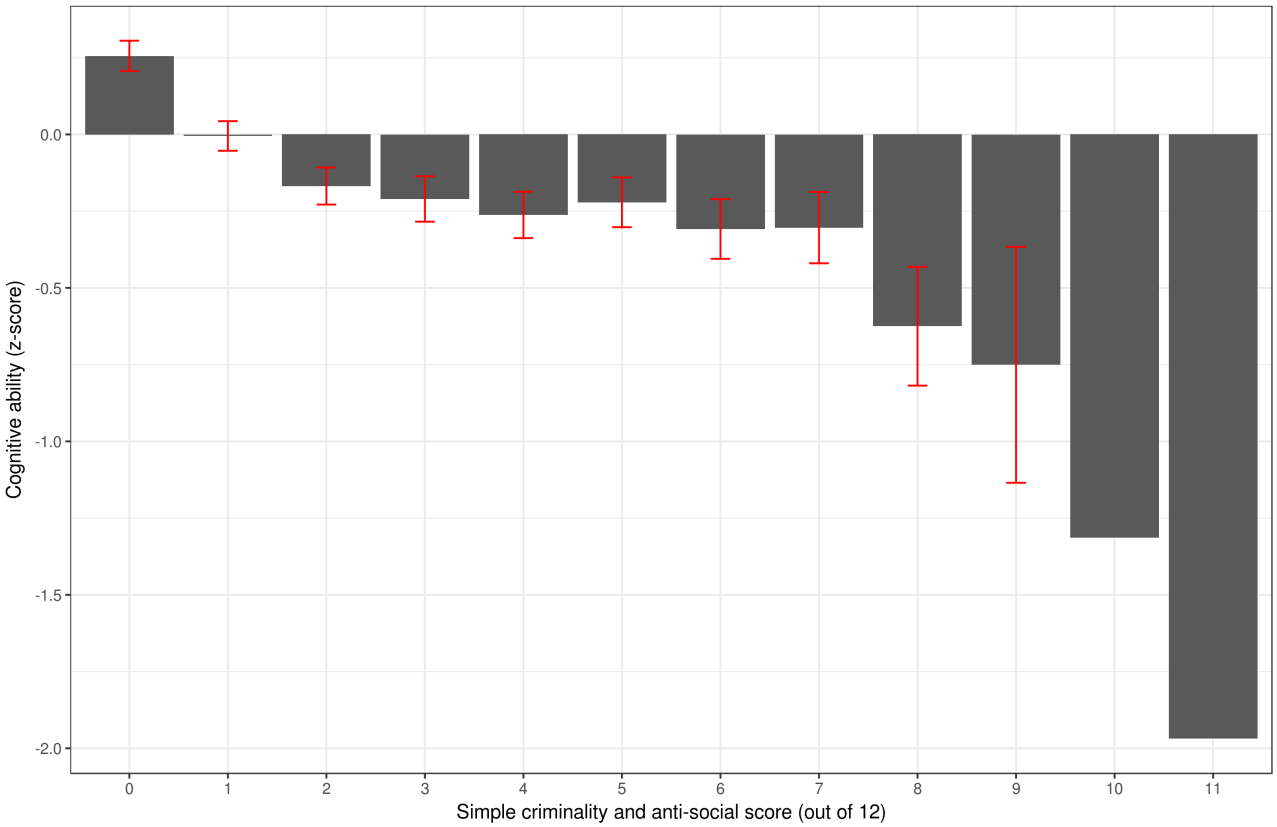

Figure 3: Mean cognitive ability by simple criminal and anti-social behavior score. n = 7,882. Correlation = -.18. Error bars indicate 95 % confidence intervals. The last two bars each contain only a single individual and hence error bars are not shown.

Table 5: Correlations between estimates of general criminal and anti-social (CAS) behavior scores, cognitive ability and number of CAS items answered. imp = based on imputed data.

	Crime sum imp	Crime score	Crime score imp	CA	CAS complete
Crime sum imp	1.00	0.90	0.94	-0.18	0.04
Crime score	0.90	1.00	0.82	-0.13	0.05
Crime score imp	0.94	0.82	1.00	-0.16	0.09
CA	-0.18	-0.13	-0.16	1.00	-0.03
CAS complete	0.04	0.05	0.09	-0.03	1.00

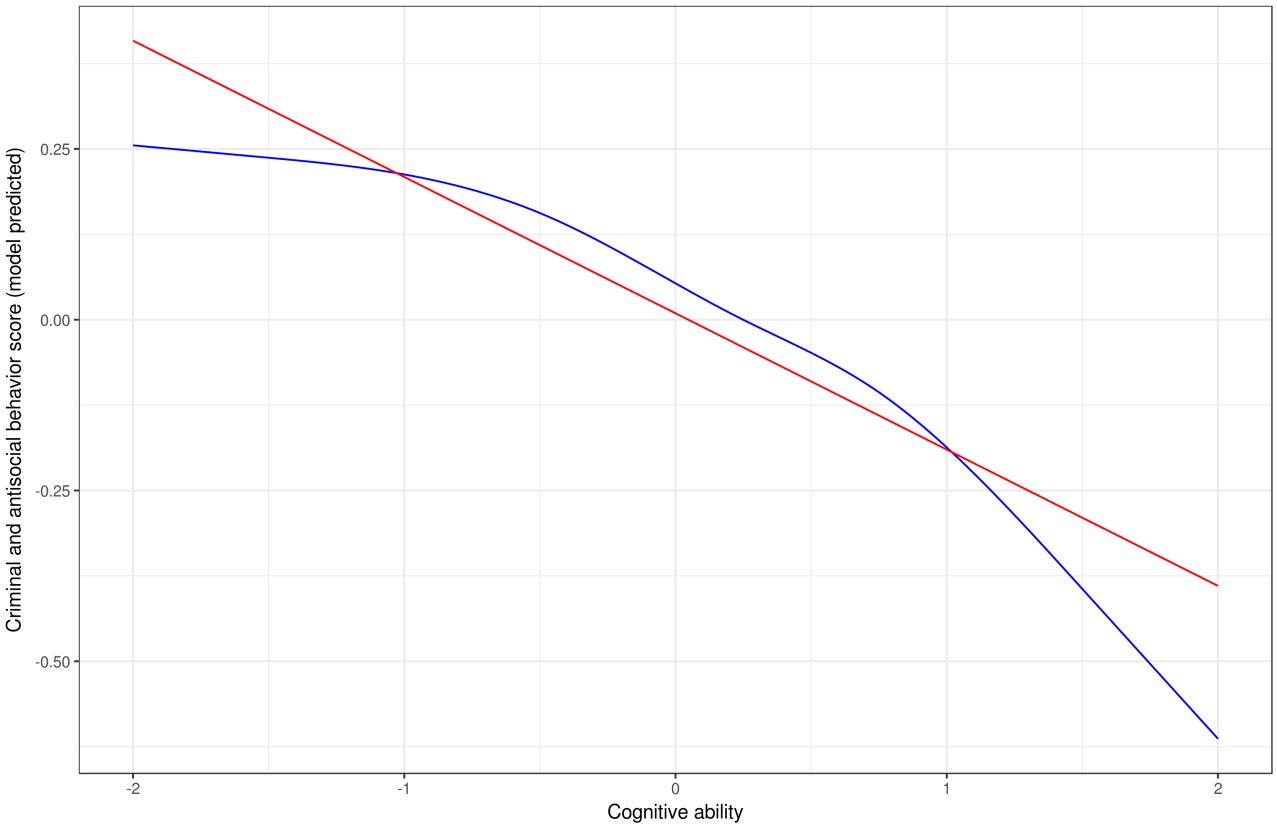

Figure 4: Model predictions for linear (red) and nonlinear (blue) models.

orientation. Theoretically, this should allow one to spot whether subjects' CA or crime scores are related to skipping particularly items, holding their overall number of items answered constant. Table 7 shows the results.

There was no consistent pattern in the data. For some items, higher CA/crime score predicted that persons would avoid disclosure, while for others, lower CA/crime score predicted avoiding disclosure. The predictability of the non-random skipping varied strongly by CAS item with the most predictable being whether one would cheat on exams or steal newspapers from a stand. The strongest results for the two predictors of interest were for having been imprisoned, where it was found that persons with lower CA and *lower* crime scores were more likely to not disclose their status; and the second strongest were seen for tax evasion, where both persons with higher CA and higher crime scores were more likely to not disclose their intentions.

4 Discussion and conclusion

The present study observed small to medium negative relationships (betas around -.15 to -.20) between most criminal and antisocial (CAS) behaviors and cognitive ability (CA). These relationships were robust to the addition of age (nonlinear), gender-sexual orientation, and self-identified race/ethnicity (SIRE) predictors. An interaction between sex was found such that CA tended to be a stronger predictor for males. A number of alternative model specifications were tried and produced essentially identical results.

Table 6: Primary model. Outcome: general criminal and anti-social behavior score. n = 7,410. R adj. = .207. Apostrophes denote restricted cubic spline terms.

Predictor	Beta	SE	p
Cognitive ability	-0.153	0.011	<0.0001
Heterosexual male		(ref)	
Bisexual male	0.057	0.079	0.476
Homosexual male	-0.085	0.056	0.126
Homosexual female	-0.096	0.108	0.375
Bisexual female	-0.157	0.058	0.006
Heterosexual female	-0.265	0.029	<0.0001
age	-0.019	0.012	0.097
age'	0.010	0.081	0.904
age"	0.158	0.330	0.632
age"'	-0.410	0.423	0.332
White	-0.027	0.049	0.586
Black	-0.030	0.063	0.635
Asian	-0.053	0.064	0.406
Hispanic	0.074	0.059	0.212
Native American	-0.036	0.077	0.644
Indian	-0.017	0.097	0.857
Middle Eastern	0.148	0.099	0.137
Pacific Islander	0.049	0.129	0.705
Other	0.206	0.063	0.001
Multi-SIRE	0.038	0.062	0.542

As such, the findings are highly congruent with the literature which reports a robust relation between lower CA and various measures of CAS behaviors (Frisell et al., 2012; Herrnstein & Murray, 1994; Høgh & Wolf, 1983; Levine, 2011; McGloin & Pratt, 2003).

A trend towards a gender continuum finding was found, as previously reported by Beaver et al (2016), such that e.g. homo- and bisexual females tended to have higher CAS scores than heterosexual females. However, the model estimates were too imprecise for one to be able to draw any strong conclusions from this study.

It is perhaps somewhat surprising that many people are willing to admit to serious crimes or poor behaviors on a dating site for potential partners to see. It's possible that a tendency to admit this is related to CA, which would bias the estimate of the relationship. If smarter people are more likely to admit having been arrested given that they have been arrested, this would bias the correlation towards 1. If the admit tendency x CA relationship was the other way, the bias would be towards -1. It has been found that smarter people are more honest (not just self-report more honesty), so this suggests the bias is towards 1, not -1 (Paulhus & Dubois, 2015; Ruffle & Tobol, 2016), which would thus tend to deflate any CA x CAS relation. However, when non-random skipping behavior was examined, no consistent pattern was found. Rather, it seems that smarter people deliberately avoided answering some CAS items, while the tendency was reversed for other items. In general, the study of biases in self-reported CAS data deserve further study.

The study has a number of limitations.

First, the final dataset used consisted of a subset of a self- selected online sample. Persons wanting to date are not a random subset of the population, but are younger and much more likely to be single. In general, people who use the internet tend to be brighter, so the sample is probably also somewhat selected for CA. This would tend to lower the observed correlations due to reduced variance (Hunter & Schmidt, 2004). Prisoners usually do not have access to dating sites[2], so they would tend to be missing from the sample. This would reduce the variance for some of the criminal outcomes and thus also reduce the observed correlations. This problem was further exacerbated by the subsetting of the sample for higher quality CA estimates. One particular interesting finding was that self-identified race/ethnicity did not seem to be much related to CAS, despite the known relationships based on other data sources (Beaver et al., 2014; Herrnstein & Murray, 1994; New Century Foundation, 2005). This may be related to differential lying/non-disclosure by SIRE (Hindelang, 1981; Piquero et al., 2014), the self-selection of the sample, or reflect biases in the justice system (Alexander, 2014; Beaver et al., 2013).

Second, some of the CAS items were unclear in their interpretation. Punching someone in the face (item 3) might be in self-defense, part of a consensual fight (e.g. boxing), or as part of the job (e.g. police officer). Wanting to cheat on taxes if it could never be found out is a hypothetical, not an actual action, and thus may never be instantiated given that the chance of discovery is never 0 % in real life. Despite these problems of interpretation, all the outcomes were positively related to each other. Thus, there seems to be a general CAS factor. Such a pattern has also been found at the aggregate-level in a study of London boroughs (Kirkegaard, 2016), where the rates of different violations were all positively related.

Third, the quality of the cognitive data was low to medium. While the cognitive test scores seem to function well based on correlations with known correlates (i.e. calibration), the test is very brief based on a max of 14 items (Kirkegaard & Bjerrekær, 2016). The test has not been validated on another sample, so it's test-retest reliability is not known, and it is not known

[2] It should be said that there are many active dating sites for dating inmates, but they involve sending letters since prison inmates usually do not have internet access (Wilson, 2013).

Table 7: Results of non-random item skipping models. Numbers in columns 2-4 are betas from a logistic regression. Betas for age and gender-sexual orientation not shown.

CAS	Questions answered	CA	Crime score	R2 adj.
arrested	-0.90	0.14	0.26	0.09
prison	-1.13	-0.42	-0.54	0.22
punched in face	-1.10	0.19	0.10	0.09
cheated exam	-2.17	0.02	0.07	0.40
would tax cheat	-1.19	0.35	0.31	0.16
stole glass from bar	-1.10	0.19	-0.07	0.10
used fake id	-1.10	0.20	0.18	0.11
torture animal for fun	-1.54	-0.37	-0.06	0.25
steal newspapers	-2.48	-0.06	-0.07	0.44
litter	-0.29	-0.03	0.08	0.03
cigarette littering	-0.99	0.08	0.34	0.09
hit SO in anger	-0.83	-0.30	0.01	0.12

whether it suffers from measurement bias. The probable low reliability of the test would tend to decrease the observed correlations. It's not clear which direction, if any, measurement bias would distort the relationship to CAS scores in. The lower reliability, however, would certainly cause the relation to appear weaker than it is.

Overall, though the study has a number of problems, these would mainly tend to decrease the observed relationships. The fact that despite these problems negative relationships can still be seen testifies to the robustness of the relationship between CAS behaviors and CA.

Supplementary material and acknowledgments

Peer review thread: https://openpsych.net/forum/showthread.php?tid=294

Study files: https://osf.io/7htpz/

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